

Sustainability Analysis of Coffee Agribusiness in Indonesia: Environmental, Economic, and Social Perspectives

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ABSTRACT

Sustainable coffee agribusiness is an approach to coffee cultivation, processing, and marketing that considers environmental, economic, and social aspects. This research aims to assess the sustainability of coffee agribusiness by focusing on these three aspects to ensure the coffee industry continues to grow without damaging the ecosystem, improving farmers' welfare, and strengthening economic stability. The research method used is literature review by collecting data from relevant journals, scientific articles, and previous research in the last five years. The results showed that the environmental aspects of coffee agribusiness can be maintained through the implementation of agroforestry systems, reduced use of hazardous chemicals, and better waste management. From an economic perspective, the main challenges faced by farmers are fluctuating coffee prices and high production costs. Solutions include strengthening cooperatives, diversifying processed coffee products, and accessing fair trade certification schemes. Meanwhile, the social aspects of coffee agribusiness sustainability include farmer welfare, women's empowerment, and increased involvement of the younger generation in the sector. Support from the government, private sector, and non-governmental organizations is needed to create policies that support the sustainability of coffee agribusiness. By applying the principles of sustainable agriculture, the coffee agribusiness

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INTRODUCTION

Coffee is an agricultural commodity with high economic value and is the most popular beverage in the world. The high demand for coffee comes not only from domestic consumption, but also exports to various countries. Research by Widjayanti and Saputra (2022) also shows that coffee has a higher economic value than other plantation crops, which makes it an important source of foreign exchange. The popularity of coffee continues to increase along with changes in people's lifestyles that make coffee part of the daily consumption culture. According to research by Afri et al. (2024), coffee consumption in Indonesia is expected to increase by an average of 3.07% per year from 2020 to 2024. This makes coffee agribusiness a promising sector for farmers, entrepreneurs and investors. Coffee agribusiness covers the entire value chain, from production, processing, distribution, to marketing, all of which play a role in determining the competitiveness of the coffee industry in the global market.

Indonesia is one of the largest coffee producing countries in the world with various advantages in coffee production. Indonesia is one of the largest coffee producers in the world, ranking fourth after Brazil, Colombia and Vietnam in terms of coffee production (Wibowo et al., 2023). Indonesian coffee is known to have a distinctive and diverse flavor, depending on the region of origin. The two main types of coffee

cultivated in Indonesia are Robusta coffee and Arabica coffee. Robusta coffee production in Indonesia accounts for about 55% of total coffee production, making it very important to the local and national economy (Hidayat et al., 2018). On the other hand, Arabica coffee is known for its smoother taste, strong aroma, and more balanced acidity, making it a favorite choice among coffee lovers (Priantari & Firmanto, 2022). With favorable geographical conditions, such as tropical climate and fertile soil, Indonesia has great potential in coffee agribusiness development. Some of the leading coffee producing regions include Aceh, North Sumatra, West Java, East Java, Bali, South Sulawesi, and Flores. These advantages make Indonesia one of the important players in the global coffee industry.

Despite its great potential, coffee agribusiness in Indonesia faces various challenges that can affect its sustainability. The main challenge faced by coffee farmers is climate change, which impacts crop productivity and quality. Based on research by Mutolib and Rahmat (2023), around 79% of coffee farmers recognize that climate change has an impact on their weather patterns and planting times. Increasing temperatures, changes in rainfall patterns, and increasing attacks by coffee plant pests and diseases pose a serious threat to farmers. In addition, fluctuations in coffee prices on the global market often lead to income uncertainty for farmers, especially for those who still rely on traditional trading systems and have limited access to international markets. The liberal international trade system complicates the position of farmers, who must adapt to changing trade patterns in an era of globalization without adequate support (Izzati et al., 2022). In addition to environmental and economic factors, social aspects are also a challenge in coffee agribusiness. Most coffee farmers in Indonesia are smallholders with limited access to modern agricultural technology, capital, and education on more productive and sustainable agricultural practices. Lack of understanding of good cultivation techniques and business management leads to low yields and product quality. Therefore, assistance and education for farmers is needed so that they can increase the productivity and competitiveness of the coffee they produce. Research by Sudarko et al. (2020) noted that entrepreneurial capacity building among smallholder coffee farmers is essential to improve their access to broader markets and modern agricultural technologies.

One approach that can be applied to face these challenges is a sustainable agricultural system. Setyokuncoro et al. (2022), point out that by implementing sustainable agriculture, farmers can increase production and explore new markets, which in turn can contribute significantly to their income. In this system, the use of synthetic chemical inputs such as fertilizers and pesticides can be reduced by switching to more environmentally friendly methods, such as the use of organic fertilizers and integrated pest management. In addition, crop diversification can also be implemented to reduce dependence on one type of commodity and increase farmers' economic resilience to coffee price fluctuations. Sustainability in coffee agribusiness includes not only environmental, but also economic and social aspects. Economically, a sustainable coffee agribusiness must be able to provide stable profits for farmers and business actors in this sector. Efficient business management, from production to marketing, is needed so that farmers can obtain more profitable selling prices. One strategy that can be implemented is the strengthening of farmer cooperatives and sustainable coffee certifications such as Fair Trade and Rainforest Alliance, which can help farmers get higher selling prices and wider market access.

From a social perspective, sustainable coffee agribusiness must be able to improve the welfare of farmers and surrounding communities. Agroforestry-based coffee farming management can help create a better microclimate, increase productivity, and offer better ecosystem benefits (Nugroho et al., 2023). Empowering farmers through training, access to finance, and infrastructure development in coffee-producing areas are important steps in improving their productivity and quality of life. In addition, strengthening the role of women in coffee agribusiness also needs attention, given that many women are involved in various stages of coffee production, from cultivation to post-harvest. By improving social welfare, coffee agribusiness can become an inclusive sector and contribute to rural development.

The government and other stakeholders play an important role in supporting the sustainability of coffee agribusiness in Indonesia. Policies that support sustainable agriculture, increase market access, and facilitate research and development in the coffee sector must continue to be strengthened. According to Wahab and Mahdiya (2023), appropriate regulations and policy reforms can improve the business environment, encourage investment, and provide convenience for business actors. In addition, cooperation with research institutions and the private sector in developing more efficient and environmentally friendly agricultural technologies can help improve the competitiveness of Indonesian coffee in the global market. The role of consumers is equally important in supporting the sustainability of coffee agribusiness. Support for local agriculture contributes to community development and environmental sustainability (Handayani et al., 2024). Consumer awareness of the importance of sustainably produced coffee products can encourage producers to implement more environmentally friendly and ethical agricultural practices. Growing coffee consumption trends, such as third-wave coffee that emphasizes quality and transparency in the supply chain, open opportunities for Indonesian coffee farmers to increase the added value of their products and reach premium markets.

Based on the problems and potentials described, this study aims to assess the sustainability of coffee agribusiness from environmental, economic, and social aspects. With this study, it is expected that effective strategies can be obtained in developing a coffee agribusiness sector that is not only economically profitable, but also sustainable in the long term. Thus, coffee agribusiness can continue to contribute to national economic development, food security, and the welfare of society at large.

Literature review

Sustainability of Coffee Agribusiness in Environmental Perspective

Environmental sustainability in coffee agribusiness is closely related to environmentally friendly cultivation practices and ecosystem conservation (Siregar, 2023). According to research conducted by Ananda et al. (2023), environmentally unfriendly agricultural practices, such as excessive pesticide use and deforestation for coffee plantations, contribute to environmental degradation. To address this, several studies recommend the implementation of agroforestry systems, the use of organic fertilizers, and better management of coffee processing waste (Scientific Journal of Agriculture, 2020).

Economic Aspects of Coffee Agribusiness Sustainability

Studies conducted by various researchers show that the economic aspects of coffee agribusiness still face various challenges, including fluctuations in coffee prices in the global market and farmers' dependence on middlemen (Siregar, 2023). According to a report from the Central Bureau of Statistics (BPS), coffee price instability has a direct impact on the welfare of small-scale coffee farmers. Some studies suggest solutions such as cooperative strengthening, coffee-based product diversification, and Fair Trade certification to help increase farmers' coffee selling prices (Ananda et al., 2023).

Social Aspects of Coffee Agribusiness Sustainability

Social aspects in coffee agribusiness include farmer welfare, women's involvement in the coffee industry, and regeneration of young farmers. Based on research conducted by Rahmawati (2021), women have an important role in various stages of coffee production, but still face limited access to resources and training. In addition, the low interest of the younger generation in coffee farming poses a challenge to the sustainability of the industry. To address this, several studies recommend training programs, women's empowerment, and increased access to education for coffee farming communities (Indonesian Journal of Agribusiness, 2022).

Collaboration and Policy Support in Coffee Agribusiness Sustainability

Various studies emphasize the importance of policy support from the government and the private sector in ensuring the sustainability of coffee agribusiness (Siregar, 2023). Regulations that favor smallholders, access to capital, and strengthening infrastructure are determining factors in the sustainability of the coffee industry (Ananda et al., 2023). In addition, sustainable coffee certification programs and the promotion of Indonesian coffee in the global market are strategic steps to improve the competitiveness of national coffee.

METHODOLOGY

This research uses the literature review method to analyze the sustainability of coffee agribusiness from environmental, economic, and social aspects. Data were collected from various scientific sources, such as indexed journals, academic articles, reference books, and reports from research institutions and related institutions. To ensure relevance, the literature used was published in the last five years (2019-2024).

Data collection was conducted through searches in scientific databases such as Google Scholar, Scopus, ScienceDirect, and Sinta. The literature found was then selected based on its relevance to coffee agribusiness and sustainable agriculture. The data obtained were categorized into three main aspects: environmental, economic, and social, to facilitate further analysis.

Data analysis was conducted using the content analysis method, with steps including data reduction, classification based on main themes, and synthesis of information to gain a deeper understanding. The collected data were compared and related to relevant concepts and theories to identify trends, patterns, and challenges in coffee agribusiness sustainability.

To ensure data validity, this study used source triangulation techniques, comparing information from various references to avoid bias and improve the accuracy of findings. The results are expected to provide insights into strategies that can be implemented by stakeholders in developing a sustainable coffee agribusiness.

RESULTS**Table 1.** Research Results

Aspects	Description
Environmental Aspects of Coffee Agribusiness Sustainability	Unsustainable coffee cultivation can cause deforestation, soil erosion, and water pollution from fertilizers and pesticides. Solutions include the use of organic fertilizers, agroforestry systems, and better management of coffee waste to maintain ecosystem balance.
Economic Aspects of Coffee Agribusiness Sustainability	Farmers face economic challenges such as fluctuating coffee prices, high production costs, and limited market access. Strategies to improve farmers' economic welfare include high-quality post-harvest coffee processing, cooperative business models, and partnerships with the coffee industry to strengthen the supply chain.
Social Aspects in the Sustainability of Coffee Agribusiness	Social aspects include farmer welfare and access to training and facilities that support coffee farming. Educational programs, counseling, and increased involvement of local communities are needed so that the economic benefits of coffee can be felt equally by rural communities.
Role of Technology in Sustainable Coffee Agribusiness	Technology can improve the sustainability of coffee agribusiness through agricultural digitalization, data-based weather monitoring, innovations in coffee processing, and digital marketing through e-commerce. The use of these technologies helps improve production efficiency and expand market access for farmers.
Strategies to Realize Sustainable Coffee Agribusiness	Collaboration between the government, research institutions, farmer organizations, and the private sector is needed. Regulations that support sustainable agriculture, incentives for farmers who implement environmentally friendly practices, and investments in the sustainable coffee industry can strengthen the sector.

Sustainable coffee agribusiness is a concept that emphasizes the balance between coffee production, environmental sustainability, and the social and economic welfare of farmers. Sustainability in coffee agribusiness focuses not only on high yields, but also on how the production process can be carried out responsibly towards nature and society. By implementing a sustainable agribusiness system, the coffee industry can continue to grow without damaging the surrounding ecosystem, so that the benefits can be felt in the long term by all parties involved in the coffee supply chain.

However, in practice, there are still many coffee farmers who do not have sufficient understanding of the importance of sustainability. Some farmers prioritize short-term crop yields without considering the long-term environmental and economic impacts. Environmentally unfriendly agricultural practices, such as excessive use of chemical fertilizers and pesticides, land clearing, and waste of natural resources, are still common in many coffee-producing regions. This can lead to soil degradation, water pollution, and biodiversity loss, which will ultimately affect future coffee productivity.

Therefore, it is necessary to raise awareness and educate farmers about the importance of sustainability in coffee agribusiness. The government, research institutions, and non-governmental organizations need to play an active role in providing training, extension, and assistance to farmers so that they can implement more environmentally friendly agricultural practices. In addition, scientific publications and articles such as this can also help in disseminating information about the concept of sustainable coffee agribusiness so that more parties understand and apply it in the coffee industry.

DISCUSSION**Environmental Aspects of Coffee Agribusiness Sustainability**

The sustainability of coffee agribusiness largely depends on how coffee cultivation practices are carried out with due regard to environmental balance. Unsustainable coffee cultivation can cause various negative impacts, such as deforestation, soil degradation, and water pollution. Excessive land use without

considering environmental conservation can result in biodiversity loss and ecosystem changes. In addition, uncontrolled clearing of new land for coffee plantations can lead to deforestation, which contributes to global warming and climate change. Therefore, coffee cultivation practices must be carried out with environmental conservation in mind so that productivity remains high without damaging the ecosystem. Environmentally friendly coffee cultivation practices can improve environmental quality and support the social and economic sustainability of farmers (Pyk & Hatab, 2018).

One of the main problems in the environmental aspect of coffee agribusiness is the excessive use of chemicals, such as inorganic fertilizers, pesticides, and herbicides. These chemicals can pollute soil and water, ultimately impacting the balance of the ecosystem. In addition, poorly managed coffee waste can also cause pollution of rivers and clean water sources around the plantation. To reduce these negative impacts, it is necessary to implement environmentally friendly farming systems such as the use of organic fertilizers, cultivation techniques without harmful chemicals, and better waste management. Thus, coffee farming can run sustainably without damaging the surrounding ecosystem.

Agroforestry is one method that can be applied to maintain environmental balance in coffee agribusiness. Integrating coffee plants with other plants in an agroforestry system can increase productivity and maintain ecosystem stability (Kaparang et al., 2024). This system combines coffee plants with shade trees and other plants that support natural ecosystems. By implementing agroforestry, farmers not only maintain soil fertility but also help increase moisture, prevent erosion, and reduce carbon emissions. In addition, this system can also increase biodiversity as various types of plants and wildlife can still coexist within the coffee plantation environment. Thus, agroforestry can be an effective solution in reducing the negative impacts of coffee agribusiness on the environment.

The government and various related institutions have an important role in supporting the sustainability of coffee agribusiness through regulations and conservation programs. Policies that encourage the use of environmentally friendly agricultural practices, such as incentives for farmers who implement sustainable agricultural systems and restrictions on the use of hazardous chemicals, need to be developed. In addition, education and counseling to farmers on the importance of protecting the environment should also be promoted so that they better understand the impact of every action taken in the coffee cultivation process. With the support of various parties, it is hoped that coffee agribusiness can develop sustainably, provide economic benefits for farmers, and maintain environmental sustainability.

Economic Aspects of Coffee Agribusiness Sustainability

The sustainability of coffee agribusiness depends not only on environmental aspects, but also on economic aspects that determine the welfare of farmers and the stability of the coffee industry as a whole. The adoption of sustainable farming practices can provide added value to coffee farmers and reduce the risk of price volatility (Handayani et al., 2024). One of the main challenges in coffee agribusiness is price fluctuations in the global market that can impact farmers' income. Unstable coffee prices often make it difficult for farmers to plan production and long-term investments. Factors such as extreme weather, market demand, and international trade policies also influence the stability of coffee prices. Therefore, strategies are needed that can help farmers deal with price uncertainty and improve the competitiveness of their coffee products.

High production costs are also an obstacle to the sustainability of coffee agribusiness. Farmers often have to spend a lot of money to buy fertilizers, pesticides, and agricultural tools. In addition, inefficient post-harvest processes can degrade coffee quality and reduce its market value. To overcome these problems, farmers need to be given access to modern agricultural technologies that are more efficient and environmentally friendly. The use of organic fertilizers and more cost-effective cultivation techniques can be an alternative to reduce production costs without sacrificing the quality of the harvest. In addition, diversification of processed coffee products such as ground coffee, instant coffee, and other derivative products can also increase added value for farmers and business actors in this sector.

Partnerships with cooperatives and coffee processing industries can also be a solution to improve farmers' welfare. By joining a cooperative, farmers can gain better access to business capital, training, and a wider market. Cooperatives also play a role in improving farmers' bargaining position against middlemen and exporters, so that the selling price of coffee can be more profitable for them. In addition, cooperation with coffee processing industries can open up opportunities for farmers to sell premium quality coffee that has a higher price in the international market. This business model not only benefits farmers, but also supports the growth of the coffee industry as a whole.

To improve economic sustainability in coffee agribusiness, the government and related institutions need to play a role in providing support, both in the form of regulation and financial assistance. A deeper understanding of the barriers and opportunities in implementing sustainability standards is essential to improve farmers' capacity to participate (Nugroho et al., 2023). Training programs for farmers on efficient cultivation techniques, access to low-interest business credit, and development of agricultural infrastructure such as roads and post-harvest facilities are some of the measures that can be taken to strengthen the sector.

In addition, the promotion of local coffee to the international market through organic and fair trade certification can also help increase the selling value of Indonesian coffee. With the right strategies in place, coffee agribusiness can provide greater economic benefits for farmers and contribute to national economic growth.

Social Aspects in Coffee Agribusiness Sustainability

The sustainability of coffee agribusiness depends not only on environmental and economic factors, but also on social aspects that include the welfare of farmers and surrounding communities. Coffee farmers, especially in rural areas, often face various social challenges such as low levels of education, limited access to technology and information, and inequality in the coffee supply chain. These inequalities often put farmers in a weak position in price negotiations and marketing of their coffee products. Therefore, efforts are needed to improve farmers' capacity through education and training so that they have better skills in managing their agricultural businesses sustainably.

One of the social problems that often arise in coffee agribusiness is the low welfare of farmers. Although coffee is a high-value commodity in the international market, many smallholder farmers still live below the poverty line due to low selling prices and high production costs. According to one study, farmer empowerment programs through agribusiness training have been shown to increase farmers' productivity and income, with social factors such as experience, education, and number of coffee trees owned having a significant impact on income (Ayesha et al., 2024; Nguyen & Sarker, 2018). Certification programs such as Fair Trade and Rainforest Alliance can be a solution in improving farmers' welfare by providing fairer prices and access to global markets. In addition, a strong cooperative system can also help farmers earn greater profits by selling their products collectively and reducing dependence on middlemen.

Social sustainability in coffee agribusiness also relates to the role of women and the younger generation in the industry. Community-based initiatives and institutional support programs serve to provide necessary information, proper cultivation techniques, and effective marketing strategies for coffee farmers to boost their businesses (Slamet et al., 2024). In many coffee-growing regions, women play an important role in cultivation and post-harvest processes, yet they often receive limited recognition and access to agricultural resources. Therefore, women's empowerment through training, access to finance, and expanded business opportunities needs to be enhanced to enable them to contribute more to the coffee industry. In addition, attracting the younger generation to engage in the coffee sector is also crucial to ensure the sustainability of the industry in the future. Digital technology and innovation in the coffee industry can be an attraction for the younger generation to be more interested in contributing to the agricultural sector.

Support from the government and non-governmental organizations is also indispensable in improving the social aspects of coffee agribusiness. Extension programs on sustainable agriculture, business capital assistance for smallholders, and the development of social infrastructure such as education and health facilities in coffee-producing areas will help improve the quality of life of local communities. In addition, collaboration between various stakeholders, including the private sector, academia, and local communities, can create a more inclusive and sustainable coffee agribusiness ecosystem. By paying attention to these social aspects, the coffee industry not only provides economic benefits, but is also able to create equitable welfare for all communities involved in it.

CONCLUSION

Sustainable coffee agribusiness is an approach that not only focuses on economic returns, but also considers environmental balance and social welfare. Sustainability in the coffee industry relies heavily on environmentally friendly cultivation practices, efficient resource use, and marketing strategies that are adaptive to global market dynamics. By applying cultivation techniques that pay attention to environmental sustainability, such as agroforestry systems and reducing the use of hazardous chemicals, coffee agribusiness can continue to grow without damaging the surrounding ecosystem. In addition, awareness of the importance of sustainable agriculture needs to be continuously increased through education and counseling to farmers.

From an economic perspective, sustainable coffee agribusiness can provide long-term benefits for farmers and business actors in this sector. However, challenges such as fluctuating coffee prices in the global market, high production costs, and inequality in the supply chain are still obstacles in improving farmers' welfare. Therefore, solutions such as cooperative strengthening, fair trade certification, and diversification of coffee-based products can be strategic steps to improve the competitiveness and economic stability of coffee farmers. Support from the government and private sector also plays an important role in providing access to capital, technology training, and regulations that favor smallholders so that they can compete in an increasingly competitive industry.

In addition, the social aspects of coffee agribusiness sustainability must also be considered to ensure the welfare of farming communities and the sustainability of the workforce in this sector. Women's empowerment, youth involvement, and improving the quality of life of communities in coffee-producing areas are key factors in maintaining an inclusive coffee industry ecosystem. Collaboration between the

government, academia, non-governmental organizations, and the private sector is needed to create policies and programs that support the sustainability of coffee agribusiness. With a holistic approach, coffee agribusiness can not only provide significant economic benefits, but also contribute to preserving the environment and improving social welfare for farmers and society at large.

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