



Sustainability Entrepreneurship Strategy in Increasing the Sustainability and Competitiveness of the Cocoa Industry

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Abstract

The cocoa industry is undergoing complex market dynamics driven by increasing global awareness of sustainability issues. Sustainable entrepreneurship has emerged as a strategic approach to balancing economic performance, environmental protection, and social equity. This study aims to examine the key factors influencing the sustainability of the cocoa industry from a sustainable entrepreneurship perspective and to analyze its impact on economic, social, and environmental outcomes. A quantitative descriptive approach was employed, with data analyzed using Structural Equation Modeling (SEM). The results indicate that all measurement indicators exhibit outer loading values exceeding 0.70, confirming acceptable convergent validity. Sustainable entrepreneurship demonstrates a strong and statistically significant effect on the overall sustainability of the cocoa sector. Specifically, its application leads to enhanced business efficiency, improved social welfare, and greater adoption of environmentally responsible practices. Moreover, the high R^2 values for the sustainability constructs suggest that sustainable entrepreneurship serves as a major explanatory variable for performance across all three dimensions. These findings highlight the strategic role of sustainable entrepreneurship in fostering a resilient and sustainable cocoa industry. The implications provide valuable insights for policymakers, industry actors, and stakeholders in developing sustainability oriented cocoa agribusiness models.

Introduction

The cocoa industry is the backbone of the economy in many countries in the world and encompasses all businesses related to chocolate production, from the supply chain and processing of raw materials to the marketing of chocolate to consumers (Gallo et al., 2018). More than 6 million producers are involved in the cocoa industry and about 50 million people depend on the cocoa trade (Nur et al., 2023; Beg et al., 2017; Franzen & Borgerhoff Mulder, 2007; Hütz-Adams et al., 2016). The cocoa industry has a strategic role in the global economy, especially for major producing countries such as Indonesia. As one of the exporters, cocoa beans, Indonesia contributes significantly to the global supply chain (Budihardjo, 2022). The Ministry of Agriculture has designated cocoa as one of the leading commodities in agricultural development since 2015 along with rubber, coconut sawit, coffee and other commodities. The target growth rate of cocoa production is set at 3.9% per year. This shows the government's desire to continue to encourage efforts to increase cocoa production. Efforts to achieve this target are implemented through programs to increase sustainable commodity production through rehabilitation, intensification, extensification and diversification activities (Ariningsih et al., 2021; Pretty & Bharucha, 2014; Marinus et al., 2023; Muoghalu & Akanwa, 2021). In some areas, intensification of cocoa production has led to deforestation, loss of biodiversity, increased carbon emissions, decreased energy efficiency, soil degradation, and contamination by pesticides. In addition, this system also contributes to socio-economic problems such as low

food security and increased vulnerability to cocoa price fluctuations (Jacobi et al., 2017; Buor, 2022; Amuda & Alabdulrahman, 2024; Okojie et al., 2015). Unsustainable exploitation of resources can trigger environmental and social conflicts (Jumiyati et al., 2018). The sustainable commitments of some of the largest chocolate industries demonstrate the need and readiness of the processing industry to invest in cocoa sustainability (Niether et al., 2020; Thorlakson et al., 2018; Martins et al., 2023). On the other hand, cocoa production also faces challenges in international trade and market preferences related to environmental sustainability aspects, such as ecolabel certification, carbon footprint, potential global warming, and the impact on human health of agricultural products (Rahmah et al., 2024). Therefore, these two challenges, namely socio-economic impact and environmental sustainability requirements, encourage the need to explore more sustainable cocoa processing systems in both aspects in order to improve more competitive cocoa cultivation practices (Rahmah et al., 2024; García-Herrero et al., 2019; Bandanaa et al., 2025). Sustainability entrepreneurship as a strategic approach in facing various challenges of the cocoa industry. This approach refers to the application of business innovations that are not only oriented towards economic benefits but also contribute to environmental sustainability and social welfare. Thus, sustainability entrepreneurship plays a role in creating a balance between economic, social, and environmental aspects to realize a more sustainable cocoa industry. Therefore, a more inclusive approach, based on the active participation of all actors in the cocoa supply chain, is key in creating a fairer and more sustainable industry (Schweikert et al., 2018). The formulation of the problem in this study is what factors affect the sustainability of the cocoa industry from the perspective of sustainability entrepreneurship and how the impact of sustainable entrepreneurship on economic, social and environmental aspects in the cocoa industry.

Methods

Research Design

This research applied a quantitative research design with a descriptive and explanatory orientation. The descriptive aspect was intended to portray the current practices of sustainability entrepreneurship within the cocoa industry, while the explanatory dimension aimed to test the causal relationships between sustainability entrepreneurship and the three pillars of sustainability, namely economic, social, and environmental aspects. The choice of a quantitative design was based on its ability to systematically measure stakeholder perceptions and provide statistically verifiable conclusions. The analytical framework relied on Structural Equation Modeling using Partial Least Squares (SEM-PLS), implemented through the SmartPLS 4.0 application. SEM-PLS was selected because it is particularly well-suited for exploratory studies with complex models and does not require strict normality assumptions. Moreover, it allows simultaneous testing of both the measurement model, which evaluates the validity and reliability of constructs, and the structural model, which examines hypothesized causal relationships. This approach was considered appropriate given the multidimensional nature of sustainability entrepreneurship, which integrates economic, social, and environmental constructs into a single analytical framework.

Data Sources

This study utilized both primary and secondary data to provide comprehensive insights. Primary data were collected through the dissemination of structured questionnaires and semi-structured interviews with stakeholders in the cocoa industry, including smallholder farmers, farmer group leaders, and company managers from PT. Indonesia Hijau, which has actively implemented sustainability-based practices. Secondary data were obtained from company annual reports, government agricultural statistics, academic literature, and policy documents

relevant to sustainability and entrepreneurship in the cocoa sector. The combination of these two sources ensured that the analysis captured both the perceptions of key actors in the field and the broader institutional and policy context.

Population and Sampling

The study population consisted of actors directly involved in the cocoa industry value chain in Sulawesi, Indonesia, a region recognized as one of the largest cocoa-producing areas in the country. This population included cocoa farmers and farmer groups engaged in cultivation, farmer leaders and cooperatives who coordinate production and marketing activities, and managers from PT. Indonesia Hijau who represent downstream and processing perspectives. A purposive sampling technique was employed to ensure that respondents had relevant knowledge and experience with sustainability-oriented cocoa production and entrepreneurship. The final sample size was determined based on the requirements of SEM-PLS, which generally recommends at least five to ten times the number of indicators included in the model. This ensured that the data collected were sufficient to meet statistical power requirements and to support the complexity of the analysis.

Data Collection Instruments

Two instruments were employed in the data collection process, namely questionnaires and interviews. The questionnaire was structured with a five-point Likert scale ranging from “strongly disagree” to “strongly agree.” Items were designed to capture perceptions of sustainability entrepreneurship across the economic, social, and environmental dimensions. The instrument was developed by adapting relevant literature on sustainability and entrepreneurship to the context of the cocoa industry. To establish content validity, the questionnaire was reviewed by academic experts in agribusiness and sustainability, while a pilot test was conducted with a small group of respondents to ensure clarity of wording and relevance. Semi-structured interviews were also carried out with key informants, particularly farmer group leaders and managers of PT. Indonesia Hijau. These interviews provided qualitative insights into the practical implementation of sustainability strategies, enriching the quantitative results and ensuring triangulation of the data.

Operationalization of Variables

The operationalization of variables in this study was guided by sustainability entrepreneurship theory and adapted to the specific conditions of the cocoa industry. The economic sustainability construct was represented through indicators such as efficiency in production costs, product diversification, innovation in processing, and stability of revenue. Social sustainability was measured by considering aspects such as farmer empowerment, training and capacity-building activities, equitable benefit-sharing, and the application of fair trade principles. Environmental sustainability was assessed through the use of organic fertilizers, the practice of agroforestry systems, the adoption of sustainable irrigation methods, and the recycling of agricultural waste. Finally, the dependent variable, sustainability entrepreneurship, was defined as the integration of economic, social, and environmental dimensions into entrepreneurial strategies within the cocoa industry. Each of these constructs was represented by multiple items in the questionnaire, which were subsequently tested for convergent validity, discriminant validity, and internal consistency reliability through SEM-PLS analysis.

Data Collection Procedure

The data collection process was conducted over a three-month period and combined both field-based and online strategies. Questionnaires were distributed directly to cocoa farmers and

farmer groups during community and cooperative meetings, while in areas that were less accessible, the questionnaires were disseminated through online forms. The use of agricultural extension officers and local coordinators helped facilitate access to respondents and increased the rate of return for the surveys. Semi-structured interviews were scheduled with representatives of PT. Indonesia Hijau and farmer organizations, either face-to-face or via online communication platforms, depending on logistical conditions. In addition to primary data collection, secondary data such as company reports, government statistics, and prior academic studies were systematically compiled and reviewed to support and triangulate the primary findings.

Data Analysis

Data analysis followed a structured procedure in two main stages. First, descriptive statistics were produced using Microsoft Excel to summarize the demographic profile of respondents and provide an overview of general trends. Second, inferential analysis was carried out using SmartPLS 4.0 software. The measurement model or outer model was assessed to evaluate convergent validity, discriminant validity, and reliability of constructs through outer loading values, Average Variance Extracted (AVE), Cronbach's Alpha, and Composite Reliability. After ensuring that the constructs met validity and reliability criteria, the structural model or inner model was tested to evaluate the hypothesized relationships among constructs. This included examining path coefficients, the coefficient of determination (R^2), and predictive relevance (Q^2). Hypotheses were tested using bootstrapping with 5,000 resamples, applying a significance level of five percent to determine whether the relationships between sustainability entrepreneurship and each sustainability dimension were statistically significant.

Ethical Considerations

The research process was carried out in compliance with ethical principles for studies involving human participants. Respondents were fully informed about the objectives of the study, the voluntary nature of their participation, and the confidentiality of their responses. Informed consent was obtained prior to participation, either in written or verbal form depending on the context. Anonymity was maintained by ensuring that individual names and identifiers were not recorded in the dataset, and sensitive information regarding farmer incomes or company operations was treated with strict confidentiality. The study was conducted exclusively for academic purposes, and all procedures adhered to the ethical standards set by the researchers' institution.

Results and Discussion

Aspects of Sustainability Entrepreneurship

Entrepreneurship plays a role in driving economic growth, but as the urgency of sustainable development increases globally, the orientation is no longer solely on financial gain. Previous research shows that entrepreneurs are now required to develop business models that are in line with sustainability principles, covering economic, social, and environmental aspects. Sustainable entrepreneurship can be understood as a process that is consciously directed to support the achievement of sustainable development goals. This process includes identifying, assessing, and utilizing business opportunities that are able to create economic value, strengthen social, and preserve the environment (Gopal, 2023; Zong & Guan, 2025; Rozak et al., 2021; Allam et al., 2022; Ahmad et al., 2024).

Economic Aspects

Results PT. Indonesia Hijau To enter the cocoa industry is driven by a combination of economic, social, environmental, and commitment to sustainable development. According to the Owner PT. Indonesia Hijau Erwin Hertawan, “*Sulawesi has great potential as a superior cocoa producer that can be processed into high-value-added products, in line with the direction of downstream and the growth of the domestic market that increasingly cares about local products*”. PT. Indonesia Hijau not only to pursue profits, but also to empower farmers, preserve the environment, and encourage the transition to a *value-added economy*. To strengthen global competitiveness, the company is developing product innovations such as premium chocolate, low-sugar chocolate, as well as product diversification (powder, paste, stick) (Sainab & Kautsar, 2025) that are oriented towards health and sustainability. In terms of processes, innovation is carried out through controlled fermentation, drying with solar energy, and digitization of blockchain-based *traceability* systems to ensure transparency of product origin. This practice not only improves production efficiency, but also strengthens consumer confidence in the quality and ethics of Indonesian cocoa products, this is in line with research (Fahmid et al., 2022) Some of the efforts that can be made to increase the competitiveness of Indonesian cocoa include replanting (replanting cocoa plantations) and improving the quality of fermentation to improve the quality of cocoa beans. In addition, to improve the export performance of cocoa products in general, it is also necessary to strengthen the downstream sector and the cocoa processing industry in the country (Annan, 2022; Fahmid et al., 2022; Satrio & Kurniawan, 2022).

Social Aspects

PT. Indonesia Hijau Running a sustainability-based cocoa industry with a focus on improving the welfare of farmers through *fair trade* schemes, price transparency, and direct purchases without intermediaries. Incentives are given based on quality and sustainability practices, such as fermentation according to SNI and the use of renewable energy (solar power) for drying cocoa beans. The company also routinely conducts technical training to partner farmer groups, covering Good Agricultural Practices (GAP), appropriate technology, financial management, and access to institutions microfinance, in order to increase the independence and professionalism of farmers. Together with PT.Callebaut/PT. Papandayan Cocoa Industry (PCI), PT. Indonesia Hijau Supporting cocoa cultivation through the provision of superior seeds and agroforestry system education. PCI plays a role in environmental conservation, increased productivity, and strengthening a stable and competitive supply chain. Apart from being a downstream actor, PCI is also a strategic actor in the upstream development of the cocoa industry through technical assistance and the development of long-term partnerships with farmers, which collectively encourage the sustainability and competitiveness of the national cocoa industry, this is in line with research Qonita et al. (2025) policy interventions that encourage social collaboration, commodity strengthening, and technology utilization have the potential to create an entrepreneurial model that is not it only survives economically, but it is also rooted and grows in a just and sustainable social structure. The use of this collaboration is also useful as a source of information for farmers including superior variety of cocoa seeds, cocoa maintenance techniques, handling cocoa pests and diseases, as well as the development of cocoa cultivation, including techniques for planting two types of cocoa in one tree (Kautsar, 2025; Ndubuaku & Asogwa, 2006).

Environmental Aspects

PT. Indonesia Hijau together with the assisted farmer groups to implement an environmentally friendly sustainable agroforestry system. Suherman's farmer group develops local innovations

in the form of organic fertilization from livestock waste (goat feces and urine), independent nurseries, and genetic engineering. Livestock waste is processed into compost and biogas, increasing efficiency and productivity ecologically. The Rustam group also uses organic fertilizer from goat dung, while the Sakir and Yunus groups combine organic and inorganic fertilizers (NPK and PETRO ZA PLUS), according to the principle of soil sustainability.

Partners such as PT. Barry Callebaut/PT. Papandayan Cocoa encouraging cocoa intercropping systems with shade plants (coconut, banana, mango) to maintain optimal light intensity (75–80%) and improve plant health, this is in line with research Becker et al. (2025) shows that low shade tree cover has enormous environmental benefits if agroforestry is applied on a large scale. On the other hand, post-harvest cocoa husk waste is used by farmer mothers to be processed into solid organic fertilizer through mixing with goat manure using special machines, reducing dependence on chemical fertilizers. Another sustainable practice is the use of drip irrigation, which efficiently delivers water directly to the plant's roots and saves water during dry seasons. PT. Indonesia Hijau also building multi-stakeholder partnerships, one of which is with EcoSer (Ecological and Social Research Institute), an independent institution that assists the sustainability certification process such as *the Rainforest Alliance*. EcoSer conducts field audits, technical training, and ongoing evaluations to ensure agricultural practices meet agroecological and social standards, including the prohibition of harmful pesticides, soil management, and agroforestry management.

The Influence of Sustainability Entrepreneurship on (Economic, Social and Environmental)

In this study, there are 3 independent variables, namely economic, social and environmental and one dependent variable, namely the sustainability of the cocoa industry (Sustainability Entrepreneurship). The main focus of this study is to test the relationship between independent variables and dependent variables through the Structural Equation Modeling (SEM) approach which is processed using Smart PLS 4.0 software. This method was chosen to identify and analyze the direct influence of the Sustainability Entrepreneurship construct on various aspects of sustainability in the cocoa industry.

Measurement Model (Outer Model)

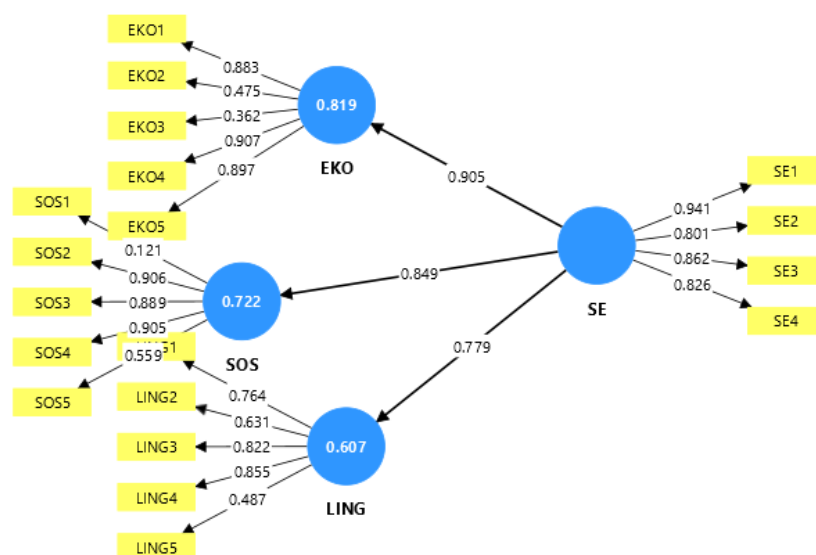


Figure 1. Structural Equation Modeling (SEM) with Partial Least Squares (PLS-SEM)

Source: SEM PLS Processed Data (2025)

Table 1. Results of Outer Loading Values

Variabel	Indicator Symbols	Outer Loading	Rule of Tumb	Conclusion
Sustainability Entrepreneurship	SE1	0.941	0.700	Valid
	SE2	0.801	0.700	Valid
	SE3	0.862	0.700	Valid
	SE4	0.826	0.700	Valid
Economics	EKO1	0.883	0.700	Valid
	EKO2	0.475	0.700	Tidak Valid
	EKO3	0.362	0.700	Tidak Valid
	EKO4	0.907	0.700	Valid
	EKO5	0.897	0.700	Valid
Social	SOS1	0.121	0.700	Tidak Valid
	SOS2	0.906	0.700	Valid
	SOS3	0.889	0.700	Valid
	SOS4	0.905	0.700	Valid
	SOS5	0.559	0.700	Tidak Valid
Environmental	LING1	0.764	0.700	Valid
	LING2	0.631	0.700	Tidak Valid
	LING3	0.822	0.700	Valid
	LING4	0.855	0.700	Valid
	LING5	0.487	0.700	Tidak Valid

Source: Data processed with SEM, 2025

The results of data processing showed that there were a number of indicators with loading factor values below 0.70, which indicated the invalidity of these indicators in terms of convergent validity. To ensure the quality of the measurement model, retesting was carried out by excluding indicators that did not meet the predetermined outer loading threshold, which was below 0.70.

Table 2. Outer Loading Value Results After Testing

Variabel	Indicator Symbols	Outer Loading	Rule of Tumb	Conclusion
Sustainability Entrepreneurship	SE1	0.941	0.700	Valid
	SE2	0.801	0.700	Valid
	SE3	0.862	0.700	Valid
	SE4	0.826	0.700	Valid
Economics	EKO1	0.883	0.700	Valid
	EKO4	0.907	0.700	Valid
	EKO5	0.897	0.700	Valid
Social	SOS2	0.906	0.700	Valid
	SOS3	0.889	0.700	Valid
	SOS4	0.905	0.700	Valid
Environmental	LING1	0.764	0.700	Valid
	LING3	0.822	0.700	Valid

	LING4	0.855	0.700	Valid
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Source: Primary data processed with SEM (2025)

Based on the results of the convergent validity analysis carried out through the Structural Equation Modeling (SEM) approach, it was found that all indicators in each construct had an outer loading value that exceeded the recommended minimum threshold, which was above 0.7. This shows that all indicators used in this study have met the criteria for convergent validity statistically. In table 1.2, you can see the outer loading which is not less than 0.7. According to (Ghozali, 2014), individual reflection is said to be high or valid if it correlates with a margin of more than 0.7. Loading factor ≥ 0.7 . The outer loading value in table 1.2 shows that these indicators have high convergent validity in measuring the latent construct of Sustainability Entrepreneurship (SE) This means that each indicator truly reflects the concept of sustainable entrepreneurship in accordance with the theoretical dimensions that have been formulated. The four Sustainability Entrepreneurship (SE) indicators used in this study conceptually reflect the three main dimensions of sustainability entrepreneurship, namely: Economic (EKO), Social (SOS) and Environment (LING)

Table 3. Cronbach's Alpha Results

	Cronbach's alpha
Sustainability Entrepreneurship	0.881
Economics	0.794
Environmental	0.778
Social	0.763

Source: Primary data processed with SEM (2025)

Construct reliability testing was performed to determine Cronbach's Alpha value, which can be accessed through the *Construct Reliability and Validity display* on the SmartPLS application. Based on the results of the analysis using Smart PLS, Cronbach's Alpha value is interpreted to refer to five categories of reliability levels (Rafinda, 2021)

Table 4. Skala Cronbach's Alpha

Skala cronbach alpha	Information
0.81 - 1.00	Highly reliable
0.61 - 0.80	Reliable
0.42 - 0.60	Quite reliable
0.21 - 0.41	Unreliable
0.00 - 0.20	Very unreliable

Source: Primary data processed with SEM (2025)

Based on the results of the convergence and reliability analysis, it can be concluded that the four main constructs in the research model are: 1) The sustainability entrepreneurship variable has a Cronbach's Alpha value of 0.881, which means that the sustainability entrepreneurship variable is very reliable, which indicates that the construct has good internal reliability; 2) The economic variable has a Cronbach's Alpha value of 0.794 which means that the economic variable is reliable which indicates that the construct has good internal reliability; 3) The social variable has a Cronbach's Alpha value of 0.778 which means that the economic variable is reliable which indicates that the construct has good internal reliability; 4) The environmental variable has a Cronbach's Alpha value of 0.763 which means that the economic variable is reliable which indicates that the construct has good internal reliability

Structural Model Analysis (Inner Model)

Broni et al. (2018) at the bootstrapping test stage, T-static test parameters were obtained to predict the existence of a causal relationship. The significance of the relationship between latent variables can be seen from the value of the path coefficient obtained. The value of the path coefficient can give an idea of the strength of the relationship between latent variables. To determine the hypothesis using the SEM method, it can be seen from Bootstrapping on the Smart PLS 4.0 used. Criterion: If t-statistics > t-table, then there is a significant influence. To determine the significance of the influence between latent variables, two statistical indicators were used, namely: T-Statistics (T-value) and P-Value. With a significance level of 5% ($\alpha = 0.05$), the decision-making criterion is that if the T-statistic ≥ 1.960 and the P-value < 0.05 , then the hypothesis is accepted (there is a significant influence). If the T-statistic < 1.960 or the P-value ≥ 0.05 , then the hypothesis is rejected (insignificant). If the t-statistics < t-table, then there is no significant effect with $\alpha = 0.05$. The analysis of the structural inner model can be seen in the following table.

Table 4. The Value of the Significance of Latent Change in Sustainability Entrepreneurship

	T Statistik	P Value
SE (Sustainability Entrepreneurship) - Economics	38.660	0.000
SE (Sustainability Entrepreneurship) – Social	19.664	0.000
SE (Sustainability Entrepreneurship)- Environment	21.218	0.000

Source: Primary data processed with SEM (2025)

Sustainability Entrepreneurship (SE) – Economics

The T-value of 38,660 and the P-value of 0.000 show that Sustainability Entrepreneurship has a very significant influence on the economic aspect of the sustainability of the cocoa industry. This means that the application of Sustainability Entrepreneurship (SE) principles, such as cost efficiency, business innovation, and strengthening the economic value of farmers, is able to encourage the economic sustainability of cocoa industry players.

Sustainability Entrepreneurship (SE)- Social

The T-statistical value of 19,664 and the P-value of 0.000 indicate that SE has a significant effect on social aspects. These results show that sustainable initiatives in entrepreneurship also include community empowerment, quality of life improvement, and community participation, which are important in maintaining the social sustainability of cocoa farmers.

Sustainability Entrepreneurship (SE)- Environment

With a T-statistic of 21,218 and a P-value of 0,000, it can be concluded that there is a significant influence between Sustainability Entrepreneurship (SE) and environmental sustainability. This implies that practices such as the use of environmentally friendly technology, waste management, and resource conservation support environmental sustainability in the industry

Path Coefficient

The path coefficient describes the strength and direction of the relationship between latent constructs in a structural model. Based on the results of bootstrapping using SmartPLS, the following path coefficient values were obtained

Table 5. Result Path Coefficient

	Path coefficient
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Sustainability – Economics	0.916
Sustainability – Social	0.811
Sustainability – Environment	0.854

Source: Primary data processed with SEM (2025)

The value of the positive coefficient is close to 1, indicating that Sustainability Entrepreneurship (SE) has a positive and significant effect on all three aspects of sustainability. The strongest influence occurred on the economic aspect ($\beta = 0.916$), meaning that SE is very effective in encouraging business efficiency, increasing revenue, and the sustainability of the cocoa business. The influence on social ($\beta = 0.854$) shows that SE plays a major role in fostering farmers, empowering communities, and improving social welfare. Meanwhile, the influence on the environment ($\beta = 0.811$) remained strong, reflecting that Sustainability Entrepreneurship (SE) activities also include environmentally friendly practices although the intensity is slightly lower than other aspects.

Coefficient of Determination (R^2)

The R^2 value indicates how much variation in endogenous constructs (economic, social, environmental) can be explained by exogenous constructs (SE). The R^2 values in this study are:

Table 6. Determination Coefficient Results

	R^2	Interpretation
Economics	0.839	83%
Social	0.73	73%
Environmental	0.658	65%

Source: Data processed with SEM (2025)

The table above shows that this study is in the "moderate to substantial" category, which means that the Sustainability Entrepreneurship (SE) variable has a very strong clear power on the sustainability of the cocoa industry, especially in the economic ($R^2 = 0.839$) and social ($R^2 = 0.730$) dimensions. This shows that SE effectively explains most of the variation that occurs in both dimensions. In the environmental dimension, although the value is lower than the economic and social one, the R^2 of 0.658 still shows the strong contribution of SE to environmentally friendly practices in the cocoa industry.

Table 7. Result F-square

	F-Square
Economic	5.195
Social	1.924
Environmental	2.697

Source: Data processed with SEM (2025)

The results of the study by looking at the F square table with the criteria according to (Marshall, 2017) If the F square nilai 0.02 is considered small, the value of F square 0.02 – 0.15 is considered moderate and the value of F square 0.15 – 0.35 is considered large. If it is less than 0.02, it can be ignored or considered to have no effect. It can therefore be concluded that

Economics

The F-square value of 5,195 shows that the contribution of sustainability entrepreneurship (SE) to economic sustainability is very dominant. This means that when SE is eliminated from the

model, the predictions of economic sustainability will decline drastically. This value far exceeds the large threshold (0.35) so it can be concluded that the influence of sustainability entrepreneurship (SE) on the efficiency, income, and business continuity of cocoa farmers is very significant.

Social

The F-square value of 1.924 indicates that the social F-square value falls into the category of very large effects. This means that SE plays a very important role in supporting the social aspects of the cocoa industry, such as community welfare, farmer development, and community participation. When SE is not included in the model, then the prediction of the social aspect loses almost all of its explanatory variance

Environmental

The F-square value of 2,697 shows that Sustainability Entrepreneurship (SE) has a very strong influence on environmental sustainability, for example in waste management, natural resource conservation or so-called agroforestry and environmentally friendly agricultural practices. This value proves that environmental sustainability in the cocoa industry is highly dependent on the principles of Sustainability Entrepreneurship (SE) applied.

Based on the results of the PLS-SEM analysis, Sustainability Entrepreneurship is proven to be the main factor that affects the sustainability of the cocoa industry, especially in economic, social, and environmental aspects. This study shows that the application of sustainable entrepreneurship principles significantly improves economic efficiency, social welfare, and concern for the environment. Therefore, the SE strategy can be used as the basis for sustainable cocoa industry competitiveness development in the future.

The findings of this study provide strong evidence that sustainability entrepreneurship plays a significant role in advancing the sustainability of the cocoa industry across economic, social, and environmental dimensions. The use of SEM-PLS demonstrated that the construct of sustainability entrepreneurship exerts a positive and statistically significant influence on each of these dimensions, with the strongest effect observed in the economic aspect, followed by social and environmental outcomes. These results confirm that entrepreneurship, when integrated with sustainability principles, is not only a driver of business efficiency but also a catalyst for social empowerment and ecological stewardship.

From the economic perspective, the results show that sustainability entrepreneurship contributes substantially to cost efficiency, product innovation, and revenue stability among cocoa industry actors. The path coefficient for the economic dimension was the highest among all constructs, suggesting that entrepreneurs in the cocoa sector primarily experience the benefits of sustainability practices through economic improvements. This finding is consistent with prior studies which argue that integrating sustainability into agribusiness models enhances competitiveness and profitability by encouraging innovation and value-added product development (Fahmid et al., 2022; Rahmah et al., 2024). However, while economic gains are evident, there is a need to critically reflect on whether these improvements equally benefit all stakeholders, particularly smallholder farmers, or whether they are more concentrated within larger firms and downstream industry players.

The influence of sustainability entrepreneurship on the social dimension was also found to be strong and significant, though slightly lower than its effect on economic outcomes. This result highlights the importance of initiatives such as farmer empowerment programs, capacity-building activities, and equitable trade practices in promoting social sustainability within the

cocoa industry. The finding aligns with the work of Qonita et al. (2025), who emphasize the role of collaboration and social inclusion in strengthening entrepreneurial resilience. Nevertheless, while improvements in social welfare were evident, the results also suggest that these practices remain dependent on institutional support and company-led programs, raising concerns about long-term sustainability if external support is reduced. Therefore, future strategies should aim at building stronger institutional frameworks that enable farmer groups to independently maintain social sustainability initiatives.

Environmental sustainability, while positively influenced by sustainability entrepreneurship, showed the weakest effect among the three dimensions. Practices such as organic fertilization, agroforestry, and waste recycling were indeed supported by sustainability-driven entrepreneurship, yet their adoption remains more limited compared to economic and social practices. This result resonates with previous findings that environmental interventions often require higher upfront investment, longer time horizons, and stronger regulatory incentives compared to economic or social initiatives (Becker et al., 2025; Niether et al., 2020). The relatively lower influence observed in this study suggests that while environmental awareness is increasing, there are structural and financial barriers that prevent wider implementation of eco-friendly practices in the cocoa sector. This highlights the need for policies and financial mechanisms that can support farmers in adopting long-term environmentally sustainable practices, such as subsidies for organic inputs, training in agroforestry systems, and incentives for waste management innovations.

Beyond confirming the positive role of sustainability entrepreneurship, the findings of this study also contribute to the broader theoretical discussion on the triple bottom line framework (Schweikert et al., 2018). The evidence shows that economic, social, and environmental sustainability are not independent, but rather interconnected outcomes of entrepreneurial strategies that balance profitability with responsibility. Importantly, the stronger influence on economic and social aspects suggests that sustainability entrepreneurship is currently more effective in addressing immediate livelihood concerns and market competitiveness than in tackling long-term ecological challenges. This imbalance reflects a broader global trend where economic and social sustainability often progress more rapidly than environmental sustainability, particularly in resource-dependent industries such as agriculture.

The implications of this study are multi-layered. For farmers, the findings emphasize the importance of adopting entrepreneurial approaches that go beyond production efficiency, by incorporating sustainable practices that enhance income security, strengthen collective capacity, and improve environmental resilience. For companies such as PT. Indonesia Hijau, the results underscore the strategic value of sustainability entrepreneurship in building consumer trust, meeting certification standards, and differentiating products in increasingly competitive global markets. For policymakers, the study highlights the urgency of designing supportive frameworks, including access to finance, capacity-building programs, and incentives for eco-friendly practices, to ensure that sustainability entrepreneurship is not only economically viable but also socially inclusive and environmentally impactful.

Despite these contributions, the study also reveals some limitations that must be acknowledged. The moderate influence on environmental sustainability indicates that further interventions are required to integrate ecological dimensions more fully into entrepreneurship models. Additionally, while the SEM-PLS results provide strong statistical evidence, the study relies on self-reported perceptions, which may not fully capture the complexities of actual practices. Future research could incorporate longitudinal studies, comparative analysis across regions, or

mixed-method approaches that combine quantitative modeling with ethnographic insights to deepen the understanding of sustainability entrepreneurship in agriculture.

The discussion demonstrates that sustainability entrepreneurship is a critical driver of the cocoa industry's resilience and competitiveness. It strengthens economic performance, promotes social welfare, and gradually encourages environmentally responsible practices. However, the uneven progress across sustainability dimensions suggests that more targeted interventions are necessary, especially to overcome barriers to environmental sustainability. By addressing these challenges, sustainability entrepreneurship has the potential to transform the cocoa industry into a more inclusive, competitive, and environmentally sustainable sector.

Conclusion

Based on the results of the analysis using the Structural Equation Modeling (SEM) method with the Smart PLS 4.0 approach, it can be concluded that Sustainability Entrepreneurship (SE) has a strong and significant influence on the sustainability of the cocoa industry, especially in three main dimensions: economic, social, and environmental. The application of the principles of Sustainability Entrepreneurship (SE) is substantially proven, namely: increasing the efficiency and income of farmers and industry players (economic dimension), strengthening social empowerment, community collaboration, and the welfare of farmers' households (social dimension), encouraging the adoption of environmentally friendly agricultural practices, resource efficiency, and concern for nature conservation (environmental dimension). The outer loading value shows that these indicators have high convergent validity in measuring the latent construct of Sustainability Entrepreneurship (SE). This means that each indicator truly reflects the concept of sustainable entrepreneurship in accordance with the theoretical dimensions that have been formulated. The four Sustainability Entrepreneurship (SE) indicators used in this study conceptually reflect the three main dimensions in sustainability entrepreneurship. The high R^2 value in all three dimensions indicates that the variation in the sustainability aspect of the cocoa industry can be explained significantly by economic variables, therefore, Sustainability Entrepreneurship is the main strategy in creating a highly competitive and sustainable cocoa industry in the long term.

References

- Ahmad, H., Yaqub, M., & Lee, S. H. (2024). Environmental-, social-, and governance-related factors for business investment and sustainability: A scientometric review of global trends. *Environment, development and Sustainability*, 26(2), 2965-2987. <http://dx.doi.org/10.1007/s10668-023-02921-x>
- Allam, Z., Sharifi, A., Bibri, S. E., Jones, D. S., & Krogstie, J. (2022). The metaverse as a virtual form of smart cities: Opportunities and challenges for environmental, economic, and social sustainability in urban futures. *Smart Cities*, 5(3), 771-801. <https://doi.org/10.3390/smartcities5030040>
- Amuda, Y. J., & Alabdulrahman, S. (2024). Cocoa, Palm Tree, and Cassava Plantations among Smallholder Farmers: Toward Policy and Technological Efficiencies for Sustainable Socio-Economic Development in Southern Nigeria. *Sustainability*, 16(2), 477. <https://doi.org/10.3390/su16020477>
- Annan, A. T. (2022). *Quality Enhancement in Cocoa Production* (Doctoral dissertation, Universitäts-und Landesbibliothek Bonn).
- Ariningsih, E., Purba, H. J., Sinuraya, J. F., Septanti, K. S., & Suharyono, S. (2021). Permasalahan dan strategi peningkatan produksi dan mutu kakao Indonesia. *Analisis*

- Kebijakan Pertanian*, 19(1), 89-108. <https://doi.org/10.21082/akp.v19n1.2021.89-108>
- Bandanaa, J., Asante, I. K., Annang, T. Y., Blockeel, J., Heidenreich, A., Kadzere, I., ... & Egyir, I. S. (2025). Social and Environmental Trade-Offs and Synergies in Cocoa Production: Does the Farming System Matter?. *Sustainability*, 17(4), 1674. <https://doi.org/10.3390/su17041674>
- Becker, A., Wegner, J. D., Dawoe, E., Schindler, K., Thompson, W. J., Bunn, C., ... & Blaser-Hart, W. J. (2025). The unrealized potential of agroforestry for an emissions-intensive agricultural commodity. *Nature Sustainability*, 1-10. <http://arxiv.org/abs/2410.20882>
- Beg, M. S., Ahmad, S., Jan, K., & Bashir, K. (2017). Status, supply chain and processing of cocoa-A review. *Trends in food science & technology*, 66, 108-116. <https://doi.org/10.1016/j.tifs.2017.06.007>
- Broni, M. Y., Hosen, M., & Saiti, B. (2018). The causality between stock market and banking sector: evidence from dual banking system. *International Journal of Business and Society*.
- Budihardjo, K. (2022). Agribusiness efforts to increase cocoa production (*Theobroma cacao* L.) in order to support the processed products in order to improve the economy of residents in Gunung Kidul Regency. *Journal of Agribusiness*, 24(1), 159–172. <http://dx.doi.org/10.31849/agr.v24i1.7477>
- Buor, J. K. (2022). Understanding the socio-economic and environmental impacts of Ghana's change in economic status on the upstream cocoa supply chain. *Management of Environmental Quality: An International Journal*, 33(6), 1379-1403. <http://dx.doi.org/10.1108/MEQ-11-2021-0261>
- Fahmid, I. M., Wahyudi, Salman, D., Kariyasa, I. K., Fahmid, M. M., Agustian, A., ... & Mardianto, S. (2022). “Downstreaming” Policy Supporting the Competitiveness of Indonesian Cocoa in the Global Market. *Frontiers in Sustainable Food Systems*, 6, 821330. <http://dx.doi.org/10.3389/fsufs.2022.821330>
- Fahmid, I. M., Wahyudi, Salman, D., Kariyasa, I. K., Fahmid, M. M., Agustian, A., ... & Mardianto, S. (2022). “Downstreaming” Policy Supporting the Competitiveness of Indonesian Cocoa in the Global Market. *Frontiers in Sustainable Food Systems*, 6, 821330. <https://doi.org/10.3389/fsufs.2022.821330>
- Franzen, M., & Borgerhoff Mulder, M. (2007). Ecological, economic and social perspectives on cocoa production worldwide. *Biodiversity and conservation*, 16(13), 3835-3849. <http://dx.doi.org/10.1007/s10531-007-9183-5>
- Gallo, P. J., & Antolin-Lopez, R. (2018). Associative sustainable business models: Cases in the bean-to-bar chocolate industry. *Journal of Cleaner Production*, 10(4), 401. <http://dx.doi.org/10.1016/j.jclepro.2017.11.021>
- García-Herrero, L., De Menna, F., & Vittuari, M. (2019). Sustainability concerns and practices in the chocolate life cycle: Integrating consumers’ perceptions and experts’ knowledge. *Sustainable Production and Consumption*, 20, 117-127. <https://doi.org/10.1016/j.spc.2019.06.003>
- Gopal, P. N. (2023). Sustainable entrepreneurship in SMEs: A systematic literature review. *Aleph*, 87(1–2), 149–200.

<https://repositorio.ufsc.br/xmlui/bitstream/handle/123456789/167638/341506.pdf?sequence=1&isAllowed=y>

- Hütz-Adams, F., Huber, C., Knoke, I., Morazán, P., & Mürlebach, M. (2016). Strengthening the competitiveness of cocoa production and improving the income of cocoa producers in West and Central Africa. *SÜDWIND eV Kaiserstr., Bonn, Germany, 1*, 1-15.
- Jacobi, J., Rist, S., & Altieri, M. A. (2017). Incentives and disincentives for diversified agroforestry systems from different actors' perspectives in Bolivia. *International Journal of Agricultural Sustainability*, 15(4), 365–379. <http://dx.doi.org/10.1080/14735903.2017.1332140>
- Jumiyati, S., Arsyad, M., Pulubuhu, D. A. T., & Hadid, A. (2018, May). Cocoa based agroforestry: An economic perspective in resource scarcity conflict era. In *IOP conference series: earth and environmental science* (Vol. 157, No. 1, p. 012009). IOP Publishing. <https://doi.org/10.1088/1755-1315/157/1/012043>
- Kautsar, M. N. (2025). Participatory Social Mapping For Cocoa Farming Development Interventions in Polewali Mandar, Indonesia. *Tarjih: Agribusiness Development Journal*, 5(01), 137-147. <https://doi.org/10.47030/tadj.v5i01.953>
- Marinus, W., Van de Ven, G. W., Descheemaeker, K., Vanlauwe, B., & Giller, K. E. (2023). Farmer responses to an input subsidy and co-learning program: intensification, extensification, specialization, and diversification?. *Agronomy for Sustainable Development*, 43(3), 40. <http://dx.doi.org/10.1007/s13593-023-00893-w>
- Marshall, R., Sullivan-Mort, G., Polonsky, M., Kilbourne, W., D'souza, C., & Hartmann, P. (2017). Introduction to the special issue on sustainability. *Australasian Marketing Journal*, 25(2), 83–84. <https://doi.org/10.1016/j.ausmj.2017.05.003>
- Martins, F. P., Batalhão, A. C., Ahokas, M., Liboni Amui, L. B., & Cezarino, L. O. (2023). Rethinking sustainability in cocoa supply chain in light of SDG disclosure. *Sustainability Accounting, Management and Policy Journal*, 14(7), 258-286. <https://doi.org/10.1016/j.spc.2019.06.003>
- Muoghalu, L. N., & Akanwa, A. O. (2021). Ecological intensification for sustainable agriculture: the Nigerian perspective. In *Ecological intensification of natural resources for sustainable agriculture* (pp. 521-564). Singapore: Springer Singapore. http://dx.doi.org/10.1007/978-981-33-4203-3_15
- Ndubuaku, T. C. N., & Asogwa, E. U. (2006). Strategies for the control of pests and diseases for sustainable cocoa production in Nigeria. *African Scientist*, 7(4), 209-216.
- Niether, W., Blaser, W. J., Andres, C., & Armengot, L. (2020). Cocoa agroforestry systems versus monocultures: A multi-dimensional meta-analysis. *Environmental Research Letters*, 15(10). <https://doi.org/10.1088/1748-9326/ab1f4>
- Nur, T., et al. (2023). Environmental impact analysis to achieve sustainability for artisan chocolate products supply chain. *Sustainability*, 15(18). <https://doi.org/10.3390/su151810000>
- Okojie, L. O., Olowoyo, S. O., Sanusi, R. A., & Popoola, A. R. (2015). Cocoa farming households' vulnerability to climate variability in Ekiti State, Nigeria. *International Journal of Applied Agriculture and Apiculture Research*, 11(1-2), 37-50. <https://doi.org/10.1002/bse.2230>

- Pretty, J., & Bharucha, Z. P. (2014). Sustainable intensification in agricultural systems. *Annals of botany*, 114(8), 1571-1596. <http://dx.doi.org/10.1093/aob/mcu205>
- Qonita, R. R. A., Masyhuri, Jamhari, & Perwitasari, H. (2025). Social environmental support in encouraging entrepreneurial behavior of millennial farmers in the Special Region of Yogyakarta, Indonesia: An effort to realize sustainable agriculture. *Caraka Tani: Journal of Sustainable Agriculture*, 40(1), 64–83. <https://doi.org/10.20961/carakatani.v40i1.92724>
- Rafinda, S. (2021). Analysis of the sustainability of oil palm farming. *Journal of Artificial Intelligence and Digital Business (RIGGS)*, 4(2), 14–17. <http://dx.doi.org/10.31004/riggs.v4i2.1450>
- Rahmah, D. M., et al. (2024). Integrating life cycle assessment and multi criteria decision making analysis towards sustainable cocoa production system in Indonesia: An environmental, economic, and social impact perspective. *Heliyon*, 10(19), e38630. <https://doi.org/10.1016/j.heliyon.2024.e38630>
- Rhamadani, N., Darma, R., & Arsal, A. (2023). Cocoa agribusiness restoration in Lilirilau District, Soppeng Regency from social, economic and institutional aspects of farmers. *Journal of Tropical Galung*, 12(3), 348–364. <https://doi.org/10.31850/jgt.v12i3.1126>
- Rozak, H. A., Adhiatma, A., Fachrunnisa, O., & Rahayu, T. (2021). Social media engagement, organizational agility and digitalization strategic plan to improve SMEs' performance. *IEEE Transactions on Engineering Management*, 70(11), 3766-3775. <http://dx.doi.org/10.1109/TEM.2021.3085977>
- Sainab., & Kautsar, M. N. (2025). Tarjih: Agribusiness development market demand and economic performance analysis of PT. Indonesia. *Journal of Agribusiness Studies*, 5(1), 148–155. <https://doi.org/10.47030/tadj.v5i01.952>
- Satrio, R., & Kurniawan, A. (2022). External efforts to increase cocoa exports to the European market: A comparison between Ghana and Indonesia. *JISPO Jurnal Ilmu Sosial dan Ilmu Politik*, 12(1). <https://doi.org/10.15575/jispo.v12i1.14324>
- Schweikert, A., Espinet, X., & Chinowsky, P. (2018). The triple bottom line: Bringing a sustainability framework to prioritize climate change investments for infrastructure planning. *Sustainability Science*, 13(2), 377–391. <https://doi.org/10.1007/s11625-017-0431-7>
- Thorlakson, T. (2018). A move beyond sustainability certification: The evolution of the chocolate industry's sustainable sourcing practices. *Business Strategy and the Environment*, 27(8), 1653-1665.
- Zong, Z., & Guan, Y. (2025). AI-driven intelligent data analytics and predictive analysis in Industry 4.0: Transforming knowledge, innovation, and efficiency. *Journal of the Knowledge Economy*, 16(1), 864-903. <http://dx.doi.org/10.1007/s13132-024-02001-z>