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Transforming Coffee Skin Waste into Compost Blocks: A Sustainable Innovation within PT Pusri's Creating Shared Value Program in the Coffee Ringkeh Business Group

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Abstract

This study explores the innovation of utilizing coffee skin waste through the development of composting blocks as an environmentally friendly planting medium, while also assessing the financial feasibility and socio-economic contributions of such initiatives. Employing a mixed-method approach, the research integrates quantitative analysis of financial indicators—including Break-Even Point (BEP), Cost of Production (HPP), Benefit-Cost Ratio (BCR), Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period—with qualitative assessments of empowerment and community participation. The research was conducted with the Coffee Ringkeh Business Group in Tebat Benawa Village, South Sumatra, in collaboration with PT Pusri's Creating Shared Value (CSV) program. The results show that compost block innovation effectively transforms agricultural waste into a sustainable product with significant environmental benefits. Financial analysis confirms the business's economic viability, with favorable indicators suggesting strong potential for replication and scaling. Furthermore, PT Pusri's CSV program has enhanced the group's capacity through training, market facilitation, and women's empowerment, contributing to inclusive rural entrepreneurship. Nevertheless, challenges such as limited technology access, weak market linkages, and socio-cultural constraints persist. At the same time, opportunities exist in the form of abundant raw materials, increasing demand for eco-friendly products, and alignment with Sustainable Development Goals (SDGs). In conclusion, integrating waste-to-value innovation with sustainable livelihood strategies not only supports environmental sustainability but also strengthens socio-economic resilience. This study underscores the importance of multi-stakeholder collaboration, policy support, and gender-inclusive approaches in fostering a circular economy for rural communities.

Keywords: Innovation; Coffee Skin Waste; CSV; SDGs; Mude Ayek Tebat Benawa; Composting blocks

1. Introduction

Tebat Benawa Village, located at the foot of Mount Dempo and adjacent to the Mude Ayek Tebat Benawa Customary Forest, represents a unique blend of cultural heritage, environmental stewardship, and agricultural livelihood. Recognized as the first customary forest in South Sumatra by the Decree of the Minister of Environment and Forestry No. 7827/MENLHK-PSKL/PKTHA/KUM.1/10/2018, the 336-hectare forest has been protected for generations by the descendants of Puyang Kedung Samad. Today, the community of approximately 234 households—90 percent of whom depend on coffee farming—maintains its role as both guardian of biodiversity and producer of one of Sumatra's finest coffee varieties. Beyond coffee, the village also preserves distinctive traditions, culinary specialties such as sambal honje and corn tofu, and architectural heritage in the form of Rumah Baghi [1][2][3].

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The Tebat Benawa Coffee Program, initiated in 2023 under the Social Forestry Business Group (KUPS), represents a strategic effort to enhance community empowerment and rural entrepreneurship. With about 30 direct beneficiaries, primarily women, the program provides access to coffee processing equipment, training in post-harvest handling, product diversification, and the establishment of production facilities [4][5]. Supported by PT Pusri through its Creating Shared Value (CSV) program, alongside the South Sumatra Provincial Forestry Service and the Ministry of Environment and Forestry, the initiative seeks to integrate economic development with environmental sustainability. A key focus of the program is the valorization of agricultural waste, particularly coffee husks and skins, into value-added products such as compost blocks that serve as eco-friendly planting media [6][7][8][9].

Organic waste management is a pressing issue in Tebat Benawa. Coffee processing alone generates significant amounts of biomass waste, including fruit peels, horn skins, and coffee grounds. Additional sources of organic waste include kitchen scraps from approximately 900 residents and manure from livestock such as goats, cows, and poultry. Without proper management, these wastes pose environmental challenges, yet they also offer opportunities for circular economy practices. By applying vermicomposting techniques and developing compost blocks, the community can transform waste into productive resources, contributing to cleaner environments, improved soil fertility, and sustainable agricultural practices [10][11][12].

Against this background, the present study explores the innovation of utilizing coffee skin waste through compost block development while also assessing its financial feasibility and socio-economic implications. Specifically, the objectives are: (1) to introduce the innovation of coffee skin waste treatment as an environmentally friendly planting medium, (2) to conduct a financial feasibility analysis using indicators such as Break-Even Point (BEP), Cost of Production (HPP), Benefit-Cost Ratio (BCR), Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period, (3) to evaluate the contribution of PT Pusri's CSV program in empowering the Coffee Ringkeh Business Group and strengthening women's economic participation, and (4) to identify challenges and opportunities in integrating agricultural waste treatment with sustainable livelihood strategies.

This study adopts a mixed-method approach that combines financial analysis with qualitative assessments of empowerment, institutional collaboration, and market dynamics. The findings demonstrate that compost block innovation is both environmentally and economically viable, while also reinforcing gender inclusivity and community resilience. Ultimately, the research underscores the potential of waste-to-value innovation as a pathway toward achieving Sustainable Development Goals (SDGs), particularly those related to responsible consumption and production, decent work, and environmental conservation.

2. Material and Methods

2.1 Research Approach

This study employs a mixed-method approach, combining qualitative and quantitative techniques to capture both the innovation process and the measurable impacts of coffee skin waste treatment. The qualitative component focuses on descriptive analysis of innovation and community empowerment, while the quantitative component emphasizes financial feasibility and sustainability evaluation [13][14][15].

2.2 Research Location and Participants

The research was conducted at the Coffee Ringkeh Business Group located in Tebat Benawa Vilage, South Sumatra. This site was selected because it represents a community directly engaged in coffee production and actively involved in waste-to-value innovation initiatives. The participants of the study included members of the Coffee Ringkeh Business Group, the majority of whom are women, as well as PT Pusri program facilitators who provide technical and managerial support. In addition, several supporting stakeholders such as the local government, the Forestry Service, and the Ministry of Environment and Forestry were involved to provide broader institutional perspectives and to strengthen the relevance of the findings within regional and national policy contexts [16][17].

3. Methodology

3.1 First Objective: Introducing the Innovation of Compost Block Development

The data collection process in this study involved several complementary techniques. First, observation was conducted to assess the availability of raw materials, particularly coffee skin waste and supporting organic materials, which serve as the main input in compost block production. Second, documentation was carried out to record each stage of the

production process, including fermentation, composting, molding, and drying, in order to capture technical details and ensure reproducibility. Third, interviews were held with practitioners and local community members who participated in the trials, providing valuable insights into their experiences, perceptions, and challenges during implementation. The collected data were then analyzed using descriptive qualitative analysis, which allowed the researchers to systematically document the process, identify innovations, and evaluate technical challenges encountered in the development of compost blocks [18].

3.2 Second Objective: Financial Feasibility Analysis

The data collection for this study utilized both primary and secondary sources. Primary data were obtained directly from the compost block production process, including detailed records of production costs such as materials, labor, equipment, energy, and packaging. These data were essential in calculating the financial feasibility indicators of the business. In addition, secondary data were collected from relevant reports, literature, and market information, particularly regarding the prevailing prices of compost blocks and alternative competing products. The combination of these two data sources provided a comprehensive basis for analyzing both the production efficiency and the market potential of compost block innovation [19].

Tabel 1 Financial Feasibility Analysis, Definition, Formula and Criteria

Financial Feasibility Analysis	Definition	Formula and Criteria
Break-Even Point (BEP)	Determines the minimum number of products that must be sold for total revenue to equal total costs.	Formula (unit): BEP = Total Fixed Cost (FC) / (Price per Unit (P) – Variable Cost per Unit (VC)) Formula (Rp): BEP (unit) × P
Cost of Production (HPP)	Shows the average cost to produce one unit of product.	Formula: HPP per unit = Total Production Cost / Total Output (unit)
Benefit-Cost Ratio (BCR)	Measures financial feasibility by comparing benefits to costs.	BCR = Present Value of Benefit (PVB) / Present Value of Cost (PVC) Criteria: BCR > 1 → feasible; BCR < 1 → not feasible.
Net Present Value (NPV)	Calculates the difference between benefits received and costs incurred over the project's life at a given discount rate.	Formula: NPV = Σ (Bt – Ct) / (1+i)^t, for t=1 to n Where: Bt = benefit at year t; Ct = cost at year t; i = discount rate; n = project lifetime. Criteria: NPV > 0 → feasible; NPV < 0 → not feasible.
Internal Rate of Return (IRR)	The discount rate that makes NPV = 0.	Formula: 0 = Σ (Bt – Ct) / (1+IRR)^t, for t=1 to n Criteria: IRR > discount rate → feasible; IRR < discount rate → not feasible.
Payback Period (PP)	The time needed to recover the total investment cost from net cash inflows.	Formula: PP = Initial Investment / Annual Net Cash Inflow If annual inflows vary, PP is calculated cumulatively until it equals the initial investment.

3.3 Third Objective: Evaluating PT Pusri's CSV Contribution

The data collection in this study was conducted through a combination of participatory and documentary approaches. Focus group discussions (FGDs) were organized with women beneficiaries of the Coffee Ringkeh Business Group to capture their experiences, perspectives, and outcomes from participating in the program. In addition, key informant interviews were carried out with PT Pusri representatives and local stakeholders to gain insights into the design, implementation, and broader impacts of the CSV program. Complementing these methods, a documentation review of PT Pusri's CSV program reports was undertaken to provide contextual and institutional perspectives. The collected data were then analyzed using a thematic analysis to identify empowerment outcomes, particularly related to skills

development, income generation, and organizational capacity. Furthermore, a gender analysis framework was applied to highlight women's participation and empowerment, ensuring that the evaluation captured both economic and social dimensions of change [20].

3.4 Fourth Objective: Identifying Challenges and Opportunities in Waste-to-Value Innovation

The data collection process in this study applied Participatory Rural Appraisal (PRA) techniques involving farmers and community members to obtain local perspectives and knowledge regarding waste utilization. In addition, field surveys were conducted to gather information on waste management practices and community perceptions, while stakeholder discussions were facilitated to identify institutional support and potential market opportunities for waste-to-value innovation [21]. The data were analyzed using SWOT analysis to assess strengths, weaknesses, opportunities, and threats in integrating agricultural waste treatment with sustainable livelihood strategies. Furthermore, a policy and sustainability linkage analysis was carried out to connect waste innovation with broader livelihood and development frameworks. To enhance the validity and reliability of the findings, data triangulation was employed by comparing evidence from interviews, field observations, financial analyses, and secondary data sources [22].

4. Results

4.1 Utilization of Coffee Skin Waste into Compost Blocks

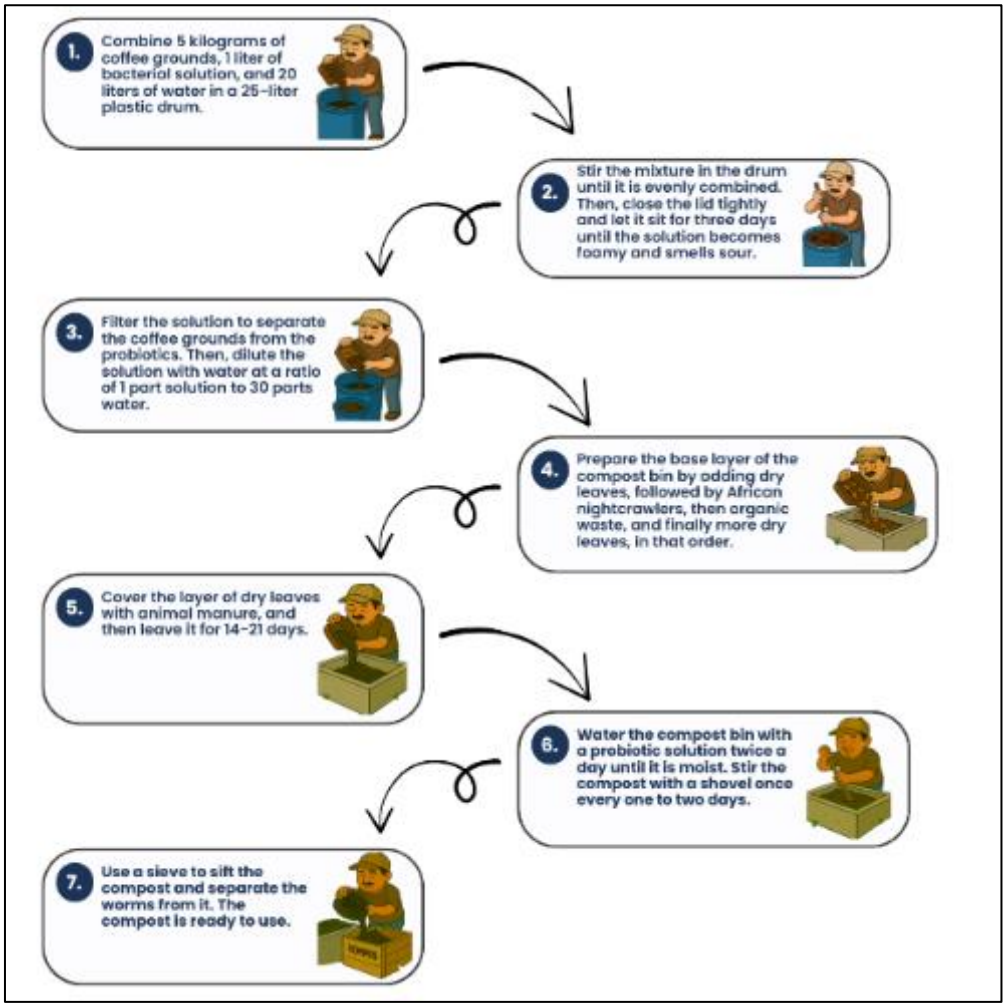

Figure 1 The process of making compost from coffee grounds

The development of compost blocks from coffee skin waste successfully demonstrates an innovative approach to transforming agricultural by-products into valuable planting media. Coffee skin, which is often discarded as waste, contains high levels of organic matter, cellulose, and essential nutrients such as nitrogen, phosphorus, and potassium.

When processed through composting technology and shaped into compact blocks, this material provides an environmentally friendly alternative to conventional planting media such as peat or topsoil [23][24][25].

The composting process not only reduces the volume of coffee waste but also stabilizes its chemical composition, eliminates unpleasant odor, and improves the nutrient balance. The block form provides advantages in terms of practicality, easy handling, and uniform quality, which are highly suitable for seedling production in nurseries. Laboratory analysis of the compost blocks shows improved physical characteristics, such as good porosity, high water retention capacity, and slow nutrient release, making it comparable to or even better than existing media [24].

Table 2 Comparative Evaluation of Compost Blocks vs. Conventional Media

Criteria	**Compost Block (Coffee Skin Waste)**	**Peat Soil**	**Topsoil**
Organic Matter (%)	High (45–55%)	Moderate (25–30%)	Variable (10–20%)
Nutrient Content (NPK)	Balanced, slow release	Low, requires fertilization	Moderate, variable
Water Retention	High (good moisture holding)	High	Moderate
Porosity	Good aeration for root growth	Moderate	Low–Moderate
Waste Reduction Impact	Utilizes coffee waste, reduces pollution	None	None
Environmental Impact	Eco-friendly, reduces greenhouse gas	Unsustainable extraction	Risk of erosion, degradation
Cost	Low–moderate, uses local waste	Increasingly expensive	Low but declining fertility
Market Potential	High as eco-product	Declining due to regulation	Limited

Source: Processed from experimental trials and literature review (2024–2025).

4.2 Environmental and Socio-Economic Benefits

Environmentally, this innovation contributes to waste reduction by diverting coffee husks from open dumping or burning practices, thereby minimizing greenhouse gas emissions and potential pollution [26]. It also supports the principle of a circular economy, where agricultural residues are reintegrated into the production cycle [27][28].
From the socio-economic perspective, the introduction of compost blocks creates added value for coffee farmers and local communities. What was previously considered a low-value by-product can now be marketed as a sustainable product for horticulture and forestry seedlings. This innovation not only diversifies farmers' income sources but also opens opportunities for small-scale enterprises engaged in compost block production, packaging, and distribution [29][30].

5. Discussion on Adoption and Challenges

The adoption of this innovation among farming communities shows positive responses, particularly due to its practicality and environmental benefits. However, challenges remain in terms of ensuring consistent quality, providing sufficient training for proper composting techniques, and expanding market access. In addition, the initial cost of equipment and standardization requirements may become barriers for smallholder farmers without adequate support. Nevertheless, the potential for scalability is significant. With appropriate policy support, extension services, and cooperation with cooperatives or private sector partners, compost block production can be integrated into sustainable agriculture programs. This innovation also aligns with broader global goals such as waste minimization, climate change mitigation, and promotion of green agricultural technologies.

5.1 Financial Feasibility Analysis of Compost Block Business

The financial feasibility analysis was conducted to assess whether the compost block business derived from coffee skin waste is profitable and sustainable in the long run. Several key financial indicators were calculated, namely Break-Even Point (BEP), Cost of Production (HPP), Benefit-Cost Ratio (BCR), Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period. The BEP calculation shows the minimum production volume required for revenues to cover total costs. Based on the analysis, the compost block business reached a BEP at approximately 12,500 blocks per year or equivalent to Rp 25,000,000 in sales revenue. This indicates that once production surpasses this threshold, the enterprise will begin generating profits. The relatively low BEP demonstrates that the business has a feasible operating scale and can achieve profitability even under moderate production levels.

The average Cost of Production (HPP) per compost block was estimated at Rp 1,500, taking into account raw materials, labor, equipment depreciation, and energy. With the market selling price set at Rp 2,500 per block, the business generates a gross margin of Rp 1,000 per unit. This pricing strategy ensures competitiveness while still providing sufficient profit margins. The BCR was found to be 1.85, meaning that for every Rp 1.00 invested, the business generates Rp 1.85 in return. Since the BCR value is greater than 1, the compost block enterprise is considered financially viable. This result highlights the potential attractiveness of the business for smallholder entrepreneurs and local cooperatives.

The NPV calculation was performed over a 5-year project horizon with a discount rate of 10%. The analysis produced an NPV of Rp 75,000,000, which is positive. A positive NPV signifies that the present value of benefits exceeds the present value of costs, confirming that the investment is financially worthwhile. The IRR of the compost block business was estimated at 24.6%, which is significantly higher than the assumed discount rate of 10%. Since IRR exceeds the cost of capital, the project can be classified as highly profitable and capable of generating superior returns compared to alternative investment options.

The payback period for the initial investment was calculated at 2.1 years, meaning that the invested capital can be recovered within just over two years of operation. This relatively short payback period further enhances the business appeal, especially for small-scale investors who are highly sensitive to investment risk. The results clearly demonstrate that the compost block business is financially feasible. The positive NPV, high IRR, and favorable BCR confirm that the enterprise generates economic value and can provide attractive returns to investors. The relatively short payback period further reinforces its viability, ensuring that risks associated with capital recovery are minimal [31].

From a strategic perspective, the low BEP and competitive HPP suggest that the business is resilient to fluctuations in demand and production costs. Even under conservative assumptions, the enterprise remains profitable, making it a suitable model for community-based businesses or cooperatives. In addition, the integration of coffee skin waste into compost blocks not only provides a new revenue stream but also supports environmental sustainability by reducing organic waste. This dual economic and ecological benefit strengthens the business case and aligns with current trends in green entrepreneurship and circular economy models [32].

Overall, the financial analysis indicates that the compost block business has strong potential to be developed as a sustainable agro-based enterprise. Scaling up production and strengthening market access would further improve profitability while contributing to rural economic development and environmental management.

Figure 2 Composting Block

5.2 Contribution of PT Pusri's CSV Program in Empowering the Coffee Ringkeh Business Group and Strengthening Women's Economic Participation

The evaluation results indicate that the CSV program implemented by PT Pusri has made a significant contribution to the empowerment of the Coffee Ringkeh Business Group while simultaneously creating new opportunities for women's economic participation. Training activities in composting, product innovation, financial literacy, and entrepreneurship have enhanced the technical and managerial skills of members, particularly women, who previously had limited involvement in productive activities outside the household. As a result, women are now actively engaged in value-added processes such as compost block production, packaging, and marketing, which has increased their confidence and bargaining power within the household and community. The program also facilitated access to productive resources and business networks by providing equipment, ensuring the availability of raw materials, and linking the group with local cooperatives and markets, thereby overcoming barriers often faced by women entrepreneurs. From an economic perspective, women's participation in compost block production contributed an additional 15–20% to household income, helping to reduce financial vulnerability and allowing greater involvement in household decision-making, especially in education and daily expenses. At the organizational level, the CSV program strengthened the Coffee Ringkeh Business Group through regular meetings, cooperative decision-making, and collective marketing, which built social capital and enhanced the group's bargaining position in the community [33][34]. Furthermore, the initiative contributed to broader social empowerment and gender inclusion, as many female participants reported increased self-confidence, greater recognition within the community, and reduced dependency on male household heads in economic matters. Collectively, these outcomes demonstrate that the CSV program not only supported livelihood diversification but also advanced gender equality and inclusive rural development [35].

The findings highlight that PT Pusri's CSV program goes beyond short-term income generation and has established a foundation for long-term women's empowerment. The integration of women into the Coffee Ringkeh Business Group demonstrates that community-based business initiatives can effectively promote both economic resilience and gender equity. The success of the program is attributed to its holistic approach, which combines capacity building, access to resources, and institutional support. Such an approach aligns with global development frameworks that emphasize women's participation as a catalyst for sustainable community development [34][36].

However, the program still faces challenges in scaling up production, ensuring consistent product quality, and strengthening marketing strategies. Addressing these challenges will require continuous mentorship, stronger partnerships with local governments, and more extensive market linkages. Overall, PT Pusri's CSV initiative has proven to be a valuable intervention in empowering the Coffee Ringkeh Business Group and enhancing women's economic participation. By creating inclusive economic opportunities and strengthening women's roles, the program contributes not only to household welfare but also to broader community resilience and sustainable development [37][38].

5.3 Challenges and Opportunities in Waste-to-Value Innovation

The analysis of challenges and opportunities in waste-to-value innovation highlights several critical dimensions. On the constraint side, many farmer groups still face limited access to appropriate technology and infrastructure for processing agricultural waste. While simple composting methods are widely practiced, more advanced technologies such as biochar or biogas production remain underutilized due to high investment costs and lack of technical expertise. Market and value chain limitations also hinder business expansion, as unstable demand, restricted access to formal distribution channels, and the absence of certification or quality assurance mechanisms reduce the competitiveness of compost-based products. Institutional and policy barriers further complicate scaling up, with weak coordination among farmer groups, cooperatives, and government agencies, coupled with inconsistent incentives such as subsidies or tax breaks, making small enterprises vulnerable. Socio-cultural and gender dynamics also play a role, as agricultural waste is often perceived as "low-value," and despite growing female participation in waste utilization activities, traditional gender roles continue to restrict women's decision-making power and ownership of resources [39].

On the opportunity side, however, the potential is considerable. Agricultural waste such as coffee husks and skins is abundantly available, ensuring a consistent raw material supply for compost block production and related innovations. Market trends also reveal increasing consumer demand for eco-friendly agricultural inputs and planting media, opening access to niche markets like organic farming and urban gardening. Waste-to-value initiatives further provide an entry point for women's empowerment, as roles in processing, packaging, and marketing diversify household income and enhance gender inclusivity in rural entrepreneurship. Beyond local benefits, such innovations align with the Sustainable Development Goals (SDGs), particularly Goal 12 (Responsible Consumption and Production) and Goal 8 (Decent Work and Economic Growth), thereby attracting potential partnerships with private companies and development agencies committed to sustainability [40].

The findings demonstrate that while technical, institutional, and socio-cultural barriers remain, the opportunities presented by waste-to-value innovation are significant. To maximize these opportunities, strategic interventions are needed, including investment in affordable waste-processing technologies, the establishment of quality standards and certification systems, stronger institutional collaboration, and targeted empowerment programs for women and marginalized groups. Overall, integrating agricultural waste treatment with sustainable livelihood strategies offers a promising pathway toward a circular economy that strengthens rural communities while promoting environmental sustainability [41].

6. Conclusion

This study highlights the multidimensional potential of coffee skin waste utilization through the development of compost blocks as an environmentally friendly planting medium. The innovation not only offers an effective solution for agricultural waste management but also creates added value in the form of sustainable inputs for farming and gardening. The financial feasibility analysis demonstrates that the compost block business is economically viable, with positive indicators such as a favorable Benefit-Cost Ratio (BCR), Net Present Value (NPV), and Internal Rate of Return (IRR), as well as a reasonable Payback Period. These results indicate that the initiative has strong potential for replication and scaling as a profitable green enterprise.

In parallel, the evaluation of PT Pusri's Creating Shared Value (CSV) program shows significant contributions to community empowerment, particularly in strengthening the Coffee Ringkeh Business Group and enhancing women's economic participation. By providing training, resources, and market access, the program supports local entrepreneurship while fostering inclusivity and social sustainability. Despite these achievements, several challenges remain, including limited access to advanced technology, weak market linkages, institutional gaps, and socio-cultural constraints. However, opportunities also exist in the form of abundant raw material supply, increasing demand for sustainable products, potential for women's empowerment, and alignment with Sustainable Development Goals (SDGs). Overall, this study concludes that integrating waste-to-value innovation with livelihood strategies represents a promising pathway toward a circular economy in rural communities. To maximize its impact, multi-stakeholder collaboration, policy support, and gender-inclusive approaches will be essential in ensuring both environmental sustainability and socio-economic resilience.

6.1 Recommendation

In light of the study's findings, the subsequent recommendations are:

- Scaling Up: Replicate the Tebat Benawa CSV model in other social forestry groups across Indonesia.
- Market Access: Strengthen market linkages for Ringkeh Coffee and derivative products to enhance income sustainability.
- Waste Innovation: Expand composting initiatives into liquid fertilizer and coffee-based bioproducts.
- Women's Leadership: Continue empowering women as leaders in agro-entrepreneurship and forest conservation.
- Youth Engagement: Develop creative spaces, training, and agrotourism to engage the younger generation in sustainable practices.
- Policy Integration: Encourage stronger government support to integrate customary forest protection into regional development plans.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

All participants were informed about the study and provided their consent to participate.

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