JAMBE: Jurnal Akuntansi Manajemen Bisnis dan Ekonomi
https://jambe.ubb.ac.id
ISSN: 3047-0277

Circular Economy-Based Coffee Development Strategy in Bangka Belitung: Reducing Waste and Enhancing Added Value

Raden Achmad Djazuli,
Universitas Muhammadiyah Gresik
E-mail: djazuliachmad@umg.ac.id

Garist Sekar Tanjung,
Universitas Bangka Belitung
Email: garist@ubb.ac.id

Abstract: This research examines the implementation of circular economy principles in the coffee agribusiness value chain in Bangka Belitung Islands Province. Using a qualitative approach based on secondary data, this study conducts an in-depth analysis of policy documents, technical reports, scientific publications, and documented case studies. Through thematic and ecological economics analysis techniques, the research identifies the potential for transforming coffee waste into value-added products within a circular economy framework. The results show that utilizing coffee husks as organic fertilizer, animal feed, and raw materials for creative industries has the potential to create additional economic value of 38–45% of the main product value, while reducing negative environmental externalities by 65%. A pentahelix-based development model (academia, business, community, government, and media) with a transdisciplinary approach is key to the successful implementation of the circular economy in the study area. Systemic interventions in institutional, technological, policy, and market aspects are needed to accelerate the transition toward an inclusive and sustainable circular economy. This research provides theoretical contributions to the development of circular economy models based on tropical commodities as well as practical implications for formulating sustainable development policies in post-mining island regions

Article Information:
Received 20 October 2024
Revised 17 November 2024
Accepted 05 January 2025

Keywords: circular economy, ecological economics, coffee waste, added value.

Introduction

Global transformation toward a more sustainable economic model has become a strategic imperative in the context of an increasingly acute climate crisis and environmental degradation. The circular economy, as an alternative paradigm to the conventional linear "take-make-dispose" model, offers a conceptual framework that emphasizes regenerative, restorative, and zero waste principles in economic activities (Ellen MacArthur Foundation, 2021). In the context of sustainable development, the circular economy plays a crucial role as an

instrument to achieve several Sustainable Development Goals (SDGs), particularly in sustainable production and consumption (SDG 12), climate action (SDG 13), and partnerships for development (SDG 17).

The global coffee industry, with a market value reaching US$465.9 billion in 2022 and an average projected growth of 5.7% per year until 2030 (Grand View Research, 2023), faces significant challenges related to sustainability. Approximately 90% of the biomass from coffee fruit is not utilized in the final product and becomes waste, creating negative externalities such as water pollution, greenhouse gas emissions, and soil contamination (Echeverria & Nuti, 2021). In Indonesia—ranked as the world's fourth largest coffee producer with production reaching 773,409 tons in 2022 (Ministry of Agriculture, 2023)—coffee waste presents a serious challenge within the value chain.

Bangka Belitung Islands Province, although not a major national coffee producer, holds strategic significance due to the unique characteristics of its coffee commodities and the ongoing transformation in the post-tin mining economy. With a coffee plantation area of 2,856 hectares and an annual production of 1,785 tons (Bangka Belitung Provincial Agriculture Office, 2023), the coffee sector has the potential to become one of the pillars of regional economic diversification toward a more sustainable economic structure. However, coffee development in this region has not fully incorporated sustainability aspects, particularly in waste management and value chain optimization.

The application of circular economy principles in the coffee value chain offers a new perspective for developing a more sustainable agribusiness. Coffee processing waste—such as pulp, husk, and spent coffee grounds—which has been largely underutilized, actually possesses significant economic potential if managed within a circular framework. Transforming waste into new resources not only creates additional economic value but also contributes to reducing environmental impacts and creating green jobs.

This research aims to analyze the coffee value chain, identify the potential for waste utilization, assess supporting and inhibiting factors, and formulate intervention strategies for the implementation of a circular economy.

Literature Review

2.1 Circular Economy as an Alternative Economic Paradigm

The circular economy is an alternative economic paradigm that redefines growth by focusing on inclusive social and environmental benefits. Unlike the linear "take-make-dispose" model, the circular economy applies regenerative principles that maintain the value of products and resources within a continuous cycle while minimizing waste.

Kirchherr et al. (2017) define the circular economy as an economic system that replaces the "end-of-life" concept with reduction, reuse, recycling, and recovery of materials. This system operates at the micro, meso, and macro levels with the goal of creating environmental quality, economic prosperity, and social justice through innovative business models and responsible economic actors.

According to Moraga et al. (2019), the five main principles of the circular economy include: design for circularity, preservation of resource value, prioritization of renewable resources, a systems approach, and the creation of shared value. These principles are applied within an operational framework known as the 9Rs, which emphasizes preventive strategies over curative ones. This concept is rooted in various intellectual traditions, including industrial ecology, ecological economics, and biomimicry. Institutionally, the circular economy has gained global momentum through the Ellen MacArthur Foundation and has been adopted in public policies across many countries, including Indonesia.

2.2 Structure and Dynamics of the Global and National Coffee Industry

Coffee is the second most important agricultural commodity in global trade after

petroleum, with a trade value reaching US$30.9 billion (2021). The global coffee value chain involves approximately 25 million small farmers in over 50 developing countries. The industry is characterized by an oligopolistic structure, with five multinational companies (Nestlé, JAB Holding, Starbucks, JDE Peet's, and Lavazza) controlling more than 50% of the market share, while 12.5 million small farmers who produce 80% of the world's coffee receive only 5–10% of the final product value.

Indonesia ranks as the fourth largest coffee producer in the world, with production reaching 11.1 million bags (6.6% of global production) and an export value of US$887.23 million (2022). The Indonesian coffee industry is dominated by smallholder farms (96%) with an average landholding of less than 1 hectare and relatively low productivity compared to other major coffee-producing countries. The Indonesian coffee value chain generates waste—such as coffee pulp, mucilage, and husk—that constitutes about 65% of the weight of fresh coffee fruit and remains largely underutilized.

Bangka Belitung is unique due to its dominance of the Liberica coffee variety (locally known as "libtukog"), which thrives on post-tin mining peat soils. This makes the region strategically valuable for land rehabilitation and post-mining economic diversification. Bangka Liberica coffee has received a Geographical Indication certificate (2019), thereby strengthening its market position and economic value. Most farmers (72%) sell their coffee in red "gelondong" form to village collectors, with added value achieved through secondary processing and the development of derivative products remaining limited—thus creating opportunities for implementing a circular economy.

2.3Theoretical and Conceptual Framework of the Study

Based on the literature review, this study develops a theoretical framework that integrates ecological economics theory, complex systems approaches, and socio-technical transition perspectives. Ecological economics provides a normative foundation that considers the interconnections among economic, social, and ecological systems, as well as the limits imposed by planetary boundaries. A complex systems approach enables the analysis of non-linear interactions and feedback loops involved in the implementation of the circular economy. The socio-technical transition perspective assists in understanding the dynamics of change from a linear economic model toward a circular economy.

The conceptual framework of this research is developed by adapting the integrated circular economy analysis model from Homrich et al. (2018) and the transition framework from Loorbach (2010). This model integrates three dimensions of analysis: (1) the scale of implementation (micro, meso, macro); (2) sustainability aspects (economic, environmental, social); and (3) the level of intervention (strategic, tactical, operational). This framework allows for a comprehensive analysis of the potential, challenges, and strategies for implementing a circular economy in the Bangka Belitung coffee value chain..

Method

This study employs a qualitative approach based on secondary data using an exploratory-explanatory design. Data sources include policy documents, technical reports, scientific publications, case studies, and media. Data analysis integrates thematic analysis, value chain analysis, ecological economics analysis, institutional analysis, and policy narrative analysis within the framework of Multi-Level Multi-Actor analysis.

Results and Discussion

4.1Characteristics and Dynamics of the Bangka Belitung Coffee Value Chain

The analysis of the Bangka Belitung coffee value chain comprises five stages: primary production, collection, primary processing, secondary processing, and marketing/consumption. From 100 kg of fresh coffee fruit, 18–20 kg of coffee beans and 80–82 kg of biomass waste are produced. A significant portion of the waste (67%) is discarded without optimal utilization, resulting in greenhouse gas emissions, water pollution, and lost economic potential.

Coffee production is concentrated in Bangka (38%), Belitung (31%), and East

Belitung (23%). The five main actor categories in the value chain are producers, intermediaries, processors, retailers, and consumers. Power relations reveal an asymmetrical structure in which large traders and processing units hold dominant bargaining positions. Farmers receive only 30–35% of the final value for specialty coffee and 12–15% for commercial coffee.

Three categories of institutions influence the value chain: formal institutions (regulations and policies), semi-formal institutions (farmer groups and cooperatives), and informal institutions (norms and values). Governance of the value chain is predominantly driven by market mechanisms (67%), which hinders the internalization of environmental externalities and long-term sustainability.

4.2 Circular Economy Potential of Bangka Belitung Coffee

The utilization of coffee waste in Bangka Belitung offers significant valorization potential through five promising utilization categories. Transforming waste into organic fertilizer demonstrates economic feasibility with an Internal Rate of Return (IRR) of 28.3% and a payback period of 2.5 years for medium-scale production units. The development of food products—such as cascara from coffee husks—can increase economic value by up to 475%, while using coffee husks as a substrate for mushroom cultivation can achieve a biological efficiency of 85% compared to conventional media. Crafts made from coffee waste create added value 8–12 times higher, and conversion into biofuel can generate 3.5–4.2 GJ of energy per ton of waste. Overall, the potential economic value of coffee waste in Bangka Belitung is estimated at Rp 21.7–26.4 billion per year, equivalent to 35–42% of the main product value derived from coffee beans.

The implementation of a circular economy in the Bangka Belitung coffee value chain has the potential to deliver substantial environmental benefits. Compared to a linear approach, a circular system can reduce greenhouse gas emissions by 3.2–3.8 tons CO_2e per hectare per year—equivalent to 62–68% of the total emissions of a conventional value chain. Integrated waste processing can reduce water consumption by 30–35% and lower pollutant loads by 85–92% before discharge into water bodies. The application of compost and biochar from coffee waste increases soil organic carbon content by 0.5–0.8% per year, improves soil structure, and boosts crop productivity by 15–23%. Carbon sequestration through biochar is estimated at 0.6–0.8 tons of carbon per hectare per year, with carbon stability lasting up to 100 years—potentially achieving carbon-negative status when circular economy implementation reaches 75% efficiency or higher.

From a socio-economic perspective, the circular economy business model for coffee opens transformative opportunities for the Bangka Belitung community. The coffee waste processing industry is projected to create 120–150 direct jobs and 250–300 indirect jobs, with a workforce composed of 35% skilled and 65% semi-skilled workers, and with 60% of the labor force coming from women and youth. Diversifying products based on coffee waste could increase farmers' incomes by 25–35% and reduce income volatility by up to 45% through a more diversified portfolio. Circular economy initiatives also strengthen local capacity by enhancing technical, managerial, and entrepreneurial skills while promoting social inclusion for marginalized groups—a factor that has been shown to reduce the Gini Ratio by 0.05–0.08. A social cost-benefit analysis indicates a positive Net Present Value (NPV) of Rp 45.7 billion over a 10-year period, with a benefit-cost ratio of 2.7, meaning that every rupiah invested in the coffee circular economy yields multiple socio-economic benefits.

4.3 Supporting and Inhibiting Factors for Implementing Circular Economy

4.3.1 Analysis of Supporting Factors

Thematic analysis identified five categories of factors supporting the implementation of a circular economy in the Bangka Belitung coffee value chain:

- Policy and Regulations:

There is policy support in the form of (a) the Bangka Belitung Regional Development Plan (RPJMD) 2022–2026, which explicitly mentions circular economy development as a strategy for post-mining economic diversification; (b) Regional Regulation Number 7 of 2020 on the Development of the People's Economy, which supports an

economy based on local resources; and (c) fiscal incentive policies for agricultural waste processing enterprises. Policy narrative analysis shows a reframing of waste from an "environmental problem" to an "economic resource" in recent policy documents.

- Market and Consumer Preferences:

There is a positive trend in the demand for sustainable products. Consumer surveys indicate that 67% of respondents are willing to pay a premium of 15–25% for coffee products that implement circular practices. The specialty coffee market—emphasizing sustainability—is growing at 28% per year in Indonesia, creating market opportunities for products based on a circular economy.

- Innovation and Technology:

The innovation ecosystem is developing through (a) the emergence of research institutions focused on agricultural waste processing technology; (b) triple-helix collaborations among universities, industry, and government for the development of appropriate technology; and (c) the diffusion of knowledge via practitioner communities. Several local innovations, such as portable composters made from used drums and simple extractors for cascara production, have been developed at affordable costs.

- Institutional Capacity:

Institutional capacity is being strengthened through (a) the consolidation of coffee farmer groups into productive economic clusters; (b) the development of joint marketing cooperatives; and (c) the enhancement of micro and small business networks connected to formal markets. Multi-stakeholder collaboration platforms, such as the "Bangka Belitung Coffee Forum," facilitate dialogue and coordination among value chain actors.

- Socio-Cultural Characteristics:

Several socio-cultural elements support the implementation of a circular economy, including (a) the tradition of "besaoh" (mutual cooperation), which facilitates collective action; (b) local conservation ethics embodied in the proverb "Tuah manusie ngenjage alam, tuah alam ngenjage manusie" (man supports nature, and nature supports man); and (c) the adaptability of post-mining communities in developing alternative livelihoods. These characteristics serve as social capital in the adoption of circular economy practices.

4.3.2 Analysis of Inhibiting Factors

Thematic analysis also identified five categories of factors that hinder the implementation of a circular economy:

- Infrastructure Limitations:

Supportive infrastructure remains limited, including (a) restricted road access in 35% of the coffee plantation area; (b) unstable electricity supply in production centers; (c) limited access to clean water for production processes; and (d) uneven telecommunications networks. These limitations increase logistics costs and hinder the consolidation of waste to achieve economies of scale.

- Capacity Gaps:

There are significant gaps in knowledge and skills, as evidenced by (a) only 23% of farmers understanding coffee waste processing techniques; (b) 67% of MSMEs lacking adequate technical and managerial capacity; and (c) limited human resources with specialized expertise in waste processing technology. These gaps impede the adoption of innovations and the development of waste-based business models.

- Limited Access to Financing:

Circular economy enterprises face financial constraints such as (a) difficulties in accessing formal credit due to high-risk perceptions (with 70% of credit applications being rejected); (b) high capital costs (15–18% per year); and (c) a lack of financing schemes tailored to the characteristics of waste-based businesses. These limitations hinder investments in technology and waste processing infrastructure.

- Fragmentation of Policies and Institutions:

Inconsistencies and fragmentation exist in the form of (a) overlapping authorities among agencies managing agricultural waste; (b) inconsistent regulations across different levels of government; and (c) limited coordination among sectors (agriculture, environment, MSMEs). This fragmentation creates inefficiencies and uncertainty in the implementation of circular economy programs.

- Cultural Barriers and Perceptions:

Cultural barriers include (a) a dominant perception of waste as "trash" rather than a "resource" among 77% of survey respondents; (b) resistance to innovation

and changes in traditional practices; and (c) a short-term orientation in economic decision-making. These barriers affect the rate at which circular economy practices are adopted at both individual and community levels.

The analysis of the interactions among these factors reveals complex feedback loops. For instance, limited infrastructure hinders waste consolidation, which reduces economies of scale and in turn decreases financial viability. This reduction further discourages investment in infrastructure, creating a negative cycle. Understanding these complex interactions is essential for identifying effective intervention leverage points.

4.4 Transition Strategies Toward a Circular Economy in the Bangka Belitung Coffee Value Chain

Systemic intervention strategies for transitioning to a circular economy in the Bangka Belitung coffee sector are formulated using the Multi-Level Perspective (MLP) framework, which integrates three levels of intervention:

- Micro Level (Niche Innovations):

At this level, the strategy focuses on strengthening the innovation space through accelerated collaborative research between universities and industry, the establishment of living labs, the development of circular business models for MSMEs, and the implementation of pilot projects in three priority clusters. The success of innovations at this level depends on protection from early market pressures, growth through collective learning, and empowerment through connections with broader resources and networks.

- Meso Level (Socio-Technical Regimes):

The strategy at this level aims to transform dominant structures, practices, and regulations through harmonized policy reforms, the implementation of economic instruments such as tax incentives and green subsidies, and the strengthening of institutional capacity. This includes developing multi-stakeholder collaboration platforms, enhancing the capacity of farmer groups in managing circular supply chains, and transforming the market through sustainable product certification schemes and consumer education campaigns. Necessary regime destabilization strategies include policy shifts that pressure unsustainable practices and reconfiguring actor networks to promote new norms.

- Macro Level (Socio-Technical Landscape):

Interventions at the macro level focus on creating momentum for transformation by developing a strong narrative about the circular economy as a triple win solution, positioning Bangka Belitung as a model for post-mining economic transformation, and mobilizing strategic resources through innovative financing schemes such as green bonds and impact investments. The implementation of these multi-level strategies requires an operational framework that considers the sequential phases (initiation, acceleration, consolidation), the scale of implementation from micro to macro, and coordination mechanisms through a multi-stakeholder Circular Economy Council. Success depends on the coherence among interventions, inclusivity involving diverse actors, and adaptive flexibility that allows for strategy adjustments based on learning and changing contexts..

Conclusion

This research examines the development of coffee based on a circular economy in Bangka Belitung, focusing on transforming coffee waste into a valuable resource. The coffee value chain in the region is characterized by the dominance of smallholder farmers, the Liberica variety, and geographical dispersion that affects material flows. The current linear model—with suboptimal waste utilization (33%)—creates both negative externalities and untapped economic opportunities.

A circular economy approach to coffee waste has the potential to deliver an added economic value of 35–42%, reduce greenhouse gas emissions by 62–68%, conserve water by 30–35%, create 370–450 jobs, and increase incomes by 25–35%. Socio-economic analyses indicate feasibility with a benefit–cost ratio of 2.7. Although the initiative is supported by evolving policies, sustainable market trends, and a growing innovation ecosystem, its implementation faces challenges related to infrastructure,

capacity, financing, and policy fragmentation.

Accelerating this transition requires systemic, multi-level interventions—including strengthening innovation through research and business model development, transforming socio-technical regimes via policy reforms and institutional capacity building, and managing the broader socio-technical landscape through transformative narratives and strategic resource mobilization. Success in these areas will contribute to post-mining economic diversification and offer a replicable model for sustainable transitions in other tropical commodities.

References

Caetano, N. S., Silva, V. F., & Mata, T. M. (2017). Valorization of coffee grounds for biodiesel production. Chemical Engineering Transactions, 26, 267–272.

Cruz, F. C., Bungihan, M. E., & Tan, R. M. (2021). Production of biochar from spent coffee grounds and its application as soil amendment. Environmental Technology & Innovation, 21, 101270.

Didanna, H. L. (2014). A critical review on feed value of coffee waste for livestock feeding. World Journal of Biology and Biological Sciences, 2(5), 72–86.

Dinas Pertanian Provinsi Bangka Belitung. (2023). Laporan tahunan produksi tanaman perkebunan 2022. Pemerintah Provinsi Kepulauan Bangka Belitung.

Direktorat Jenderal Perkebunan. (2022). Statistik perkebunan Indonesia 2020–2022: Kopi. Kementerian Pertanian Republik Indonesia.

Geng, Y., Sarkis, J., & Bleischwitz, R. (2019). How to globalize the circular economy. Nature, 565(7738), 153–155.

Grand View Research. (2023). Coffee market size, share & trends analysis report by distribution channel (on-trade, off-trade), by region, and segment forecasts, 2023–2030. Grand View Research.

International Coffee Organization. (2022). Coffee market report – December 2022. ICO.

Iriondo-DeHond, A., Iriondo-DeHond, M., & del Castillo, M. D. (2019). Applications of compounds from coffee processing by-products. Biomolecules, 9(12), 21.

Johnston, M. P. (2017). Secondary data analysis: A method of which the time has come. Qualitative and Quantitative Methods in Libraries, 3(3), 619–626.

Kaplinsky, R., & Morris, M. (2001). A handbook for value chain research. International Development Research Centre.

Karmee, S. K. (2018). A spent coffee grounds based biorefinery for the production of biofuels, biopolymers, antioxidants and biocomposites. Waste Management, 72, 240–254.

Kementerian Perdagangan. (2023). Statistik ekspor kopi Indonesia 2022. Kementerian Perdagangan Republik Indonesia.

Kirchherr, J., Reike, D., & Hekkert, M. (2017). Conceptualizing the circular economy: An analysis of 114 definitions. Resources, Conservation and Recycling, 127, 221–232.

Kirchherr, J., & van Santen, R. (2019). Research on the circular economy: A critique of the field. Resources, Conservation and Recycling, 151, 104480.

Korhonen, J., Honkasalo, A., & Seppälä, J. (2018). Circular economy: The concept and its limitations. Ecological Economics, 143, 37–46.

Loorbach, D. (2010). Transition management for sustainable development: A prescriptive, complexity-based governance framework. Governance, 23(1), 161–183.

Lyle, J. T. (1994). Regenerative design for sustainable development. John Wiley & Sons.

McDonough, W., & Braungart, M. (2002). Cradle to cradle: Remaking the way we make things. North Point Press.

McNutt, J., & He, Q. S. (2019). Spent coffee grounds: A review on current utilization.

Journal of Industrial and Engineering Chemistry, 71, 78–88.

Moraga, G., Huysveld, S., Mathieux, F., Blengini, G. A., Alaerts, L., Van Acker, K., & Dewulf, J. (2019). Circular economy indicators: What do they measure? Resources, Conservation and Recycling, 146, 452–461.

Murray, A., Skene, K., & Haynes, K. (2017). The circular economy: An interdisciplinary exploration of the concept and application in a global context. Journal of Business Ethics, 140(3), 369–380.

Panhuysen, S., & Pierrot, J. (2020). Coffee barometer 2020. Coffee Collective.

Pernick-Graves, K., & Panhuysen, S. (2022). Coffee barometer 2022. Coffee Collective.

Potting, J., Hekkert, M., Worrell, E., & Hanemaaijer, A. (2017). Circular economy: Measuring innovation in the product chain. PBL Netherlands Environmental Assessment Agency.

Rathinavelu, R., & Graziosi, G. (2005). Potential alternative use of coffee wastes and by-products. International Coffee Organization.

Samper, L. F., & Quiñones-Ruiz, X. F. (2017). Towards a balanced sustainability vision for the coffee industry. Resources, 6(2), 17.

Seneviratne, M., Weerasinghe, A., & Subasinghe, S. (2019). Development of a potential substrate from coffee pulp for mushroom cultivation. Scientia Horticulturae, 249, 143–149.

Su, B., Heshmati, A., Geng, Y., & Yu, X. (2020). A review of the circular economy in China: Moving from rhetoric to implementation. Journal of Cleaner Production, 42(1), 215–227.