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Utilizing a Circular Economy in Household Waste Management MSMEs: A Case Study of Innovation in a Small Town

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Abstract: Circular economy has become an alternative model in addressing household waste problems through the development of SMEs in small cities. This research analyzes the implementation of circular economy concepts in household waste processing SMEs with case studies in three small cities in Central Java. Qualitative methods with a case study approach were used to collect data through interviews and observations of 15 waste banks and waste processing SMEs. The results showed that the implementation of a circular economy in SMEs resulted in an average income increase of 45% in the 2022-2024 period and waste volume reduction of up to 60%. The business models developed include collection, sorting, processing, and marketing of recycled products. However, constraints were found in terms of access to capital, technology, and marketing. This research provides theoretical contributions in developing small-scale circular economy models and policy recommendations to support waste management SMEs.

Keyword: circular economy, SMEs, household waste, waste bank, small cities

INTRODUCTION

The broiler chicken industry stands as a cornerstone of Indonesia's agricultural economy and a critical pillar of national food security. Its strategic importance is recognized within national development frameworks, including the Ministry of Research's National Research Priorities for 2020-2024 and the Asta Cita vision, which links robust food production to the enhancement of human capital through improved nutrition. This study focuses on the epicenter of Indonesia's broiler industry: five key provinces on the island of Java (West Java, Central Java, East Java, Banten, and Yogyakarta). These provinces collectively account for approximately 68.21% of the national output, making them a highly representative sample for a deep analysis of the sector's dynamics and challenges.

Despite its potential for high profitability, the industry is beset by persistent structural problems. It is characterized by high capital intensity, which creates significant barriers to entry and expansion, particularly for smallholder farmers. Furthermore, the sector is subject to extreme price volatility, exposing producers to substantial financial risk. At the heart of these challenges lies a fundamental structural inefficiency: the core-plasma partnership model.

In this system, the core company often acts as both the sole supplier of critical inputs (such as day-old chicks and feed) and the primary buyer of the finished broilers. This creates a power imbalance that can lead to an "unequal partnership system", constraining the profitability and viability of plasma farmers. This dynamic has fueled a significant academic debate regarding the primary factors influencing broiler production. Some scholars prioritize investment in technology and management efficiency as the key drivers of productivity. Others argue that price stability is the most critical factor for small farmers who are highly vulnerable to market fluctuations, while a third perspective emphasizes that access to capital through bank credit and domestic investment is the fundamental prerequisite for growth in a capital-intensive sector.

This research addresses a notable gap in the existing literature. Previous studies on Indonesia's broiler sector have typically been limited by shorter analytical periods (often a maximum of 10 years) and a narrower set of explanatory variables (a maximum of five). This study distinguishes itself by utilizing a comprehensive 24-year panel dataset spanning from 2000 to 2023 and integrating a broader set of variables to provide a more robust and nuanced analysis. The core problem investigated is not merely a matter of optimizing production inputs, but rather of understanding how the sector's potential as a powerful economic engine is constrained by its internal structural conflicts. This duality frames the entire analysis. Accordingly, this paper pursues two primary objectives:

1. To analyze the simultaneous and partial influence of the number of core farmers, price, bank credit, and domestic investment on broiler chicken production in Java's five main producing provinces.
2. To quantify the impact of broiler chicken production on the Gross Regional Domestic Product (GRDP) of these provinces. Indonesia produces approximately 21.1 million tons of waste per year, with a low collection rate of less than 40 percent (Indonesia.go.id, 2023). Of the total national waste production, 65.71% (13.9 million tons) is managed, while the remaining 34.29% (7.2 million tons) is improperly managed. This situation creates various significant environmental problems, especially in small towns with limited waste management infrastructure and technology. Small towns with populations of 50,000-200,000 people face the dilemma of managing household waste, which continues to increase along with population growth and economic activity. The circular economy has emerged as an innovative solution that shifts the waste management paradigm from a linear (take-make-dispose) to a closed cycle that optimizes resource use. This concept emphasizes the 3R principle (Reduce, Reuse, Recycle), which was further developed into the 6R by adding Rethink, Refuse, and Repair. Waste management in Indonesia is regulated by Law Number 18 of 2008 concerning Waste Management, but its implementation still faces various structural and technical barriers.
3. MSMEs in the household waste processing sector have significant potential to implement the circular economy concept. MSME WASTE refers to small and medium-sized enterprises focused on managing and collecting plastic waste to create valuable products. This business model not only provides waste management solutions but also creates new economic value for the community. Data shows that the total turnover from all established waste banks reached IDR 3,996,178,438, with the largest distribution on the island of Java, accounting for 68.35% of the national total. Small towns have unique characteristics for implementing a circular economy through MSMEs. Social proximity, relatively small operational scale, and flexibility in decision-making are factors that support the implementation of this model. Furthermore, small towns generally have lower levels of waste heterogeneity than large cities, facilitating the sorting and processing process. However, limited access to technology, capital, and markets is a key barriers that need to be addressed.

4. Research on the circular economy within MSMEs in Indonesia is still limited, particularly focusing on small cities. Previous studies have primarily explored implementation in large cities or on an industrial scale. However, small cities have significant potential to become effective models for implementing a circular economy due to their supportive socio-economic characteristics. The examination aims to fill this gap by analyzing in detail the implementation of a circular economy within MSMEs processing household waste in three small cities in Central Java. The urgency of this research lies in the need to develop an effective and economical waste management model in small cities. With increasing urbanization and consumer consumption, the volume of household waste in small cities is predicted to continue to increase. A circular economy model through MSMEs could be an appropriate solution because it does not require large infrastructure investments and can be implemented gradually according to local capacity.

Literature Review

Circular Economy Concept

A circular economy is an economic model that aims to eliminate waste and sustainably use resources through the redesign of materials, products, and systems (MacArthur, 2013). This concept evolved from ecological economic thinking, which integrates natural principles into human economic systems. Unlike the linear economic model that follows a "take-make-dispose" pattern, a circular economy adopts a closed-loop approach that minimizes resource input and waste. The Ellen MacArthur Foundation (2015) identified three key principles of a circular economy: first, designing to eliminate waste and pollution; second, keeping products and materials in use; and third, regenerating natural systems. These principles are translated into a hierarchy of R's starting from Refuse, Reduce, Reuse, Recycle, Recover, and Redesign. At the micro scale, a circular economy can be implemented through changes in consumer behavior, product innovation, and new business models. A study by Geissdoerfer et al. (2017) showed that implementing a circular economy at the company level can increase resource efficiency by up to 80% and reduce carbon emissions by up to 70%. Circular business models include the sharing economy, product-as-a-service, and closed-loop manufacturing.

MSMEs and Waste Management

MSMEs play a strategic role in implementing a circular economy due to their high flexibility and adaptability. Rizos et al. (2016) identified that MSMEs have an advantage in implementing circular practices due to their simple organizational structures, rapid decision-making, and close ties to local communities. However, MSMEs also face limitations in terms of access to technology, capital, and knowledge about circular economy practices. In the waste management sector, MSMEs act as aggregators, processors, and distributors in the recycling value chain. A study by Velis (2017) showed that the informal waste management sector, which is largely comprised of MSMEs, contributes up to 60% of the collection of recycled materials in developing countries.

In Indonesia, waste banks, as a form of MSME waste management, have grown rapidly, with over 5,000 units spread across the archipelago. Damanhuri & Padmi (2019) identified three main business models for MSME waste management in Indonesia: the waste bank model, the organic waste processing model, and the inorganic waste upcycling model. Each model has distinct characteristics and dynamics in implementing circular economy principles. The waste bank model focuses on collecting and selling recycled materials, the organic processing model converts organic waste into compost or biogas, and the upcycling model transforms inorganic waste into value-added products.

Circular Economy in Small Cities

The implementation of a circular economy in small cities has distinct characteristics compared to large cities. Williams (2019) identified that small cities have advantages in terms of social cohesion, manageable scale, and the proximity effect, which facilitate the implementation of circular systems. However, small cities also face limitations in terms of economic diversity, access to technology, and connections to global markets. A study by Petit-Boix & Leipold (2018) showed that small cities in Europe that implemented circular economy strategies experienced increased economic resilience and a reduced ecological footprint. Key success factors include strong local leadership, high community participation, and partnerships with the private sector. In terms of waste management, small cities have advantages in terms of homogeneity of waste types and ease of implementation of collection and sorting systems. In Indonesia, research on the circular economy in small cities is still limited. Suharto & Raharjo (2021) conducted a study in Magelang City and found that the implementation of community-based waste banks can reduce waste volume by up to 40% and increase community income by an average of IDR 150,000 per month. However, these studies have not yet explored in detail the business models of MSMEs and the value chains they form.

Research Gaps

Based on the literature review, several research gaps remain to be addressed. First, there is a lack of studies exploring the implementation of a circular economy in waste-managing MSMEs in small cities in Indonesia. Second, there is a lack of detailed business model analysis of how MSMEs integrate circular economy principles into their operations. Third, there has been no comprehensive evaluation of the economic, social, and environmental impacts of the implementation of a circular economy by MSMEs in small cities. This study attempts to fill this gap by conducting a detailed analysis of the business model of waste management MSMEs in implementing a circular economy in small towns. This research will also evaluate the supporting and inhibiting factors for implementation, as well as the resulting economic, social, and environmental impacts.

METHOD

Research Approach

This research uses a qualitative approach with a multiple case study design to analyze the implementation of a circular economy in MSMEs engaged in household waste management. The qualitative approach was chosen because it aligns with the research objectives, which sought to understand the phenomenon in depth and explore the perspectives of the actors involved in the implementation of a circular economy. Multiple case studies allow researchers to conduct cross-case comparisons and identify patterns and variations in implementation. The research paradigm used is interpretive constructivism, which recognizes that reality is socially constructed by the actors involved. In this case, the implementation of a circular economy is understood as the result of social interactions between MSMEs, the community, the government, and other stakeholders. The researcher served as the primary instrument in data collection and analysis, maintaining reflexivity to minimize subjective bias.

Research Locations and Subjects

The research was conducted in three small cities in Central Java Province: Magelang City, Surakarta City, and Tegal City. The locations were selected based on the following criteria: a population of 50,000-200,000 people, the presence of MSMEs active in household waste management, and accessibility to the research. These three cities were selected because they have distinct geographic and socio-economic characteristics, allowing for a rich variety

of case studies. The research subjects consisted of 15 MSMEs engaged in household waste management, including eight waste banks, four composting businesses, and three upcycling businesses using plastic waste. The MSME selection criteria were: operating for at least two years, having a minimum monthly turnover of IDR 5 million, and implementing at least the 3R principles in their operations. In addition to MSMEs, the study also involved 12 key informants from local governments, academics, and community leaders to gain a broader perspective.

Data Collection Methods

Primary data was collected through three main methods. First, in-depth interviews with MSME owners and managers were conducted using semi-structured interview guidelines. Interviews focused on aspects of their business models, implementation of circular economy principles, and supporting and inhibiting factors. Each interview lasted 60-90 minutes and was recorded with the informants' consent. Second, participant observation was conducted to observe the MSMEs' operational processes, from collection, sorting, processing, and product marketing. Observations were conducted for 2-3 days in each MSME using a structured observation protocol. Third, focus group discussions (FGDs) were conducted in each city involving 6-8 MSMEs to discuss strategic issues in implementing a circular economy. Secondary data was collected from government documents, MSME financial reports, regional statistical data, and previous studies. Secondary data served as triangulation and enriched the analysis. Furthermore, visual documentation of the operational processes and products produced by the MSMEs was conducted.

Data Analysis

Data analysis was conducted using a thematic analysis method, which followed six stages: familiarization with the data, initial coding, theme discovery, theme review, theme naming, and report writing. The coding process was conducted inductively using NVivo 12 software to facilitate data organization and analysis. Triangulation was achieved by comparing data from various sources and methods to increase the validity of the findings. The analysis was conducted at three levels: within-case analysis, cross-case analysis, and meta-analysis. The within-case analysis explored in detail the implementation of a circular economy in each MSME. A cross-case analysis identified patterns and variations in implementation across MSMEs and cities. A meta-analysis developed theoretical propositions about the implementation of a circular economy in MSMEs in small cities.

Validity and Reliability

The validity of the research was maintained through several strategies. First, source triangulation using multiple informants and multiple sites. Second, method triangulation by combining interviews, observations, and focus group discussions (FGDs). Third, member checking by verifying findings with key informants. Fourth, peer debriefing involves other researchers to review findings and interpretations. Reliability was maintained through a standardized research protocol, systematic documentation, and a detailed audit trail. The entire research process was documented in a research journal to facilitate verification and replication. Reflexivity statements are created to identify potential researcher bias and strategies to address it.

RESULT AND DISCUSSION

Profile of Household Waste Management MSMEs

The results show that the 15 MSMEs studied have diverse characteristics in terms of operational scale, type of waste processed, and business model implemented. Waste banks

dominate with 8 units (53.3%), followed by compost processing businesses with 4 units (26.7%), and plastic waste upcycling businesses with 3 units (20%). The average operational age of MSMEs is 4.2 years, with a range of 2-8 years, indicating that this sector is relatively new but has demonstrated operational stability. In terms of operational scale, waste bank MSMEs manage an average of 2.3 tons of waste per month with a turnover of IDR 12-35 million per month. Compost processing MSMEs process 3.8 tons of organic waste per month with a turnover of IDR 8-18 million per month. Meanwhile, upcycling MSMEs handle 1.2 tons of plastic waste per month with a turnover of IDR 15-45 million per month. This data shows that upcycling businesses have the highest added value per unit of material processed. The employment structure of MSMEs is dominated by women, with an average of 68% of the total workforce. This is consistent with the finding that the household waste processing sector is generally more accessible to women because it can be integrated with domestic activities. The average number of workers per MSME is six, with 40% being permanent workers and 60% being part-time or seasonal workers.

Implementation of Circular Economy Principles

Analysis of the implementation of circular economy principles shows significant variation across MSME types. The Reduce principle is implemented by 100% of MSMEs through waste reduction campaigns and public education. Waste banks are the most active in this aspect, holding regular educational programs for members and the general public. The "Zero Waste Challenge" program conducted by Bank Sampah Mutiara in Magelang successfully reduced the volume of household waste among members by an average of 35% within a six-month period. The Reuse principle is applied by 87% of MSMEs with a variety of approaches. Waste banks organize used goods exchange programs among members, while upcycling businesses focus on modifying products for new functions. The "Green Creation" MSME in Tegal develops furniture products from used cardboard with a durability of up to two years and attractive designs, creating a niche market with a 150% profit margin.

The Recycle principle is the most common principle implemented by 100% of MSMEs, but with varying levels of sophistication. Waste banks carry out basic recycling by selling materials to collectors, while upcycling businesses carry out advanced recycling by transforming materials into products with different functions and value. Data shows that MSMEs using advanced recycling have an average profit margin 180% higher than those using basic recycling. The Recover principle is implemented by 60% of MSMEs, particularly those engaged in organic waste processing. Compost businesses use fermentation technology to convert organic waste into high-quality fertilizer. "Kompos Sejahtera" in Surakarta uses the bokashi technique, producing premium-quality compost with a nitrogen content of 2.8% and phosphorus of 1.4%, exceeding the Indonesian National Standard (SNI) for organic fertilizer.

Business Models and Value Chains

Business model analysis reveals three main patterns developed by MSMEs. The first model is the "Aggregator Model," implemented by waste banks, focusing on the collection and sale of recycled materials. This model relies on volume and operational efficiency to generate profits. The primary revenue stream from the sale of materials is with a margin of 15-25% of the selling price to the industry. The second model is the "Processor Model," implemented by composting businesses, focusing on transforming organic waste into value-added products. This model requires higher investment in technology and expertise but yields higher margins. The revenue stream from the sale of processed products has a margin of 80-120% of production costs.

The third model is the "Creator Model," implemented by upcycling businesses, focusing on the creation of new products with unique designs and functions. This model is the most intensive in terms of creativity and innovation, yet generates the highest added value. The revenue stream comes from the sale of creative products with a margin of 200-400% of the cost of materials. The resulting value chain involves multiple stakeholders with complementary roles. The community acts as waste suppliers, MSMEs as processors, and local and regional markets as end consumers. Intermediaries such as collectors and distributors still play a significant role, especially for small-scale MSMEs that do not yet have direct access to the end market.

Value chain analysis shows that the activities that create the greatest value are design and marketing, while the activities with the highest costs are logistics and raw material procurement. MSMEs that successfully integrate design and marketing activities into their internal operations demonstrate higher profitability than those that rely on external parties for these activities.

Economic, Social, and Environmental Impact

The economic impact of implementing a circular economy by MSMEs shows positive and significant results. Financial data indicate that the average increase in MSME revenue in the 2022-2024 period was 45%, with variations of 25-78% depending on the type of business and the level of implementation of circular principles. Upcycling MSMEs showed the highest increase with an average of 65%, followed by composting at 48%, and waste banks at 32%. Job creation was also significant, with an average of 2.3 people per MSME during the study period. The total employment created by the 15 MSMEs was 90 people, 67% of whom were women. The multiplier effect on the local economy is demonstrated through increased purchasing power and the development of supporting businesses such as transportation and packaging services.

The social impact is primarily seen in increased community environmental awareness and strengthened social capital. A survey of 450 MSME members and the surrounding community showed an average increase in environmental awareness of 73% and participation in waste management programs of 68%. Educational programs conducted by MSMEs also contributed to increased public knowledge of circular economy principles. Social cohesion within the community was strengthened with the formation of waste management groups at the neighborhood (RT/RW) level. Data shows that 85% of MSMEs successfully formed at least three partner groups at the community level, with an average of 15 members per group. Collective activities such as communal waste banks and recycled product markets became a means of social interaction that strengthened bonds and bridged social capital.

The environmental impact showed positive results in reducing waste volume and conserving natural resources. Operational data reveal that 15 MSMEs successfully processed a total of 456 tons of waste per year, equivalent to a 38% reduction in household waste volume in their operational areas. This conversion contributed to reducing the burden on landfills (TPA) and extending the operational life of the landfills. Carbon footprint reduction is also significant through the substitution of virgin products with recycled ones and the reduction of waste transportation to landfills. Life cycle assessment calculations indicate that the operations of 15 MSMEs generate an average carbon savings of 234 tons of CO2 equivalent per year. Water and energy conservation also occur through the use of recycled materials, which require lower inputs than virgin materials.

Supporting and Inhibiting Factors

The analysis of supporting factors reveals five main categories contributing to the successful implementation of a circular economy. First, the leadership and entrepreneurial

spirit of MSME founders, who have a clear vision for the circular economy and the ability to organize resources. Second, strong social capital within the community facilitates the mobilization of community participation and the formation of collaborative networks. Third, support from local government policies through MSME development programs and incentives for environmentally friendly businesses. Fourth, access to knowledge and technology through partnerships with universities and NGOs. Fifth, high market acceptance of environmentally friendly products, especially among the educated middle-class consumer segment.

The main inhibiting factor includes limited access to capital for technology investment and business expansion. Interview results showed that 80% of MSMEs identified access to capital as a major obstacle, primarily because their assets do not meet conventional banking collateral requirements. Limited processing technology also poses a barrier, particularly for improving product quality and diversification. Limited market linkages are a third barrier, hindering MSMEs from accessing broader and more profitable markets. The majority of MSMEs still rely on local markets with relatively small margins. Limited skills and knowledge of modern business management also hamper business development, particularly in digital marketing, financial management, and quality control.

Suboptimal regulations pose a structural barrier, with the lack of specific standards for recycled products and complex licensing procedures. Fluctuating prices for recycled materials also create uncertainty in business planning. Competition with the unregistered informal sector also creates unfair competition in terms of pricing and material access.

Development and Innovation Strategies

MSMEs develop various innovation strategies to overcome obstacles and increase competitiveness. Product innovation strategies are implemented through product diversification and quality improvement. "Eco Craft" in Magelang developed 15 product variants from plastic waste, with designs that adhere to market trends and international quality standards. This innovation resulted in an 85% increase in revenue in the past two years. Process innovation is implemented through the adoption of simple technology and operational system improvements. The Digital Waste Bank in Surakarta uses a mobile application for transaction recording and communication with members, resulting in a 40% increase in operational efficiency and 78% increase in member satisfaction. Adopting technology that aligns with MSME capacity is key to successful process innovation.

Market innovation is implemented through new market penetration and the development of alternative distribution channels. MSMEs are beginning to utilize e-commerce and social media platforms to expand their market reach. "Green House" in Tegal successfully penetrated the Jakarta market through its online platform, with a 120% increase in sales within a year. Partnerships with hotels and restaurants are also an effective market expansion strategy. Organizational innovation is implemented through the development of strategic partnerships and collaboration between MSMEs. The formation of the "Green MSME Alliance," connecting 25 MSMEs from three cities, created synergy in raw material procurement, technology sharing, and joint marketing. This collaborative approach resulted in an average cost reduction of 23% and significant market expansion.

Circular Economy Integration Models

Based on a cross-case analysis, this study identified three circular economy integration models developed by MSMEs. The first model is "Linear-to-Circular Transition," where MSMEs gradually integrate circular principles into their initially linear operations. This model is implemented by 60% of MSMEs, focusing on implementing the 3R principles as a starting point. The second model is "Circular-by-Design," where MSMEs are established

from the outset with circular economy principles as their core business model. This model is implemented by 27% of MSMEs, generally founded by entrepreneurs with higher education backgrounds and exposure to sustainability concepts. This model demonstrates better performance in terms of environmental impact and innovation capability.

The third model is the "Hybrid Circular Model," which combines linear and circular activities within a diversified business portfolio. This model is implemented by 13% of MSMEs, which have a larger operational scale and adequate access to capital. The hybrid model is flexible in encountering market fluctuations and offers better risk mitigation. The effectiveness of each model varies depending on external and internal factors of the MSME. The Circular-by-Design model demonstrates the best environmental performance but requires a high initial investment. The Linear-to-Circular model offers a low entry barrier but requires a longer time to achieve optimization. The Hybrid model provides balanced performance but requires high managerial capability.

CONCLUSION

This study successfully identified that the implementation of a circular economy in MSMEs processing household waste in a small town has demonstrated positive results across multiple dimensions. From an economic perspective, it is evident that MSMEs adopting circular economy principles experienced an average 45% increase in revenue and significant job creation. The business models developed varied from aggregators and processors to creators, with varying levels of value creation. The implementation of circular economy principles showed significant variation, with the principles of Reduce and Recycle universally adopted, while the principles of Reuse and Recover remain limited to MSMEs with specific capabilities. Key success factors include strong leadership, adequate social capital, and a supportive ecosystem. Conversely, limited access to capital, technology, and markets is a key barriers that need to be addressed.

The environmental impact showed encouraging results, with a reduction in waste volume of up to 60% and carbon savings of 234 tons of CO2 equivalent per year among the 15 MSMEs studied. The social impact is reflected in increased community environmental awareness and strengthened social cohesion through collective waste management programs. The innovations developed by MSMEs include product, process, market, and organizational innovations, which contribute to increased competitiveness. The three identified circular economy integration models provide MSMEs with strategic options according to their respective capacities and objectives. The Circular-by-Design model demonstrates the best performance but requires a high initial investment, while the Linear-to-Circular model provides easier transition flexibility. The Hybrid model is suitable for larger-scale MSMEs that require risk diversification.

This research's contribution to the development of circular economy theory lies in the identification of micro-level implementation mechanisms and the specific characteristics of implementation in small cities. Practically, this research provides a blueprint for the development of similar MSMEs and policy recommendations to support circular economy implementation in small municipalities. Limitations of the study include its focus on three cities in one province and the relatively short observation period, so generalization of the results should be done with caution. Recommendations for future research include longitudinal studies to observe the long-term evolution of circular economy implementation, comparative research across regions with different characteristics, and the development of an assessment framework for evaluating circular economy performance at the MSME level. The development of tools and methodologies to support the implementation of a circular economy in MSMEs is also a prospective research area.

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