Efficient Vol 9 (1) (2025): 106-119 DOI: https://doi.org/10.15294/efficient.v9i1.38589

EFFICIENT

Indonesian Journal of Development Economics

https://journal.unnes.ac.id/sju/index.php/efficient

A Circular Economy Development Model to Enhance Circularity and Value Capture in Food MSMEs

[1]Erna Widijastuti, [2]Sandry Windiharto, [3]Silvia Margaret✉

[1]Central Java Provincial Development Planning Agency

[2]Central Java Provincial Development Planning Agency; Doctorate Program University of Western Australia

[3]Development Economic Study Program, Faculty of Economics and Business, Universitas Negeri Semarang

Permalink/DOI: https://doi.org/10.15294/efficient.v9i1.38589

Submitted: July 2025; Revised: October 2025; Accepted: January 2026

Abstract

This study aims to analyze the application of the circular economy in micro, small, and medium enterprises (MSMEs) in the food and beverage sector in Central Java Province and formulate an efficient and sustainable ecosystem development model. The research employed an exploratory descriptive method with a case study approach, examining 60 business units across four districts/cities: Semarang, Semarang Regency, Kendal, and Kudus. The analysis was conducted using a circular economy calculator to measure four key indicators: circularity, value capture, recycled content, and reuse index. The results showed that the circularity level in food MSMEs was still low, with 75.5% of respondents falling within the range of 1-5%. Most of the value capture, recycling content, and reuse index scores were also below 1%. This condition reflects the limitations of knowledge, access to technology, and the availability of adequate waste management infrastructure.

Keywords: Circular Economy, MSMEs Food and Beverages, Circularity, Value Capture, Central Java

How to Cite: A Circular Economy Development Model to Enhance Circularity and Value Capture in Food MSMEs. (2026). Efficient: Indonesian Journal of Development Economics, 9(1). 106-119. https://doi.org/10.15294/efficient.v9i1.38589

✉ Correspondence Address :
Address: Gedung L2 Lantai 2 FE Unnes
Kampus Sekaran, Gunungpati, Semarang, 50229
E-mail : silviamargaret@mail.unnes.ac.id

INTRODUCTION

In Indonesia, circular economy has been integrated into national development planning documents, where in the draft of the National Long-Term Development Plan (RPJPN) 2025–2045, circular economy will become one of the

strategies to achieve a Green Economy (Bappenas, 2024). The implementation of the green economy in Central Java aims to achieve climate-resilient Low Carbon Development (PRK), in line with the long-term development vision of sustainable and environmentally sound development.

The strategy for climate-resilient PRCs encompasses a series of work plans aimed at sustaining economic and social growth through activities that produce low Greenhouse Gas (GHG) emissions and reduce the intensity of these emissions. Additionally, this strategy focuses on reducing the use of non-renewable natural resources, thereby preserving the environment for future generations.

By integrating the principles of the green economy, Central Java strives to strike a balance between economic development and environmental protection, ensuring that the growth achieved is not only economically beneficial but also environmentally friendly. As a province with great potential in the agriculture, industry and renewable energy sectors, Central Java has the opportunity to become a model for green economy transformation in Indonesia (IESR, 2024).

The policy of implementing the green economy is divided into four groups. First, the implementation of the circular economy gradually by transforming from brown industry to green industry for both large, medium and medium-sized companies, MSMEs and SMEs, by adopting the principles of the circular economy (R0-R9), which are grouped into 3 parts:

Making and using products more intelligently (R0: refuses, R1: rethinks, R2: reduces); extend the life of the product (R3: reuse, R4: repair, R5: refurbish, R6: remanufacture, R7: repurpose); and benefiting from materials (R8: recycle, R9: recover). Second, implementing energy conservation to be more efficient and encouraging the energy transition to renewable energy sources which is achieved through the development of NRE infrastructure, energy saving movements, affordable, inclusive, and energy assistance-based energy independent villages.

Third, sustainable management of forests, agricultural land, fishery and marine cultivation land and their derivative products to increase productivity and support the downstream of the agricultural sector, as well as the development of green financing and the implementation of carbon pricing to support investment and green products (UNGA, 2012). The circular economy plays an important role because it can be a solution to increase economic growth by managing waste as a production material (Saputra, 2025).

The implementation of circular economy in Indonesia is prioritized in five key sectors: food, retail (focusing on plastic packaging), electronics, construction, and textiles. These five priority sectors represent nearly one-third of Indonesia's GDP and provided employment for over 43 million people in 2019 (Bappenas, 2021). The circular economy is a critical approach that can have a positive impact on Central Java's economy, particularly in creating a more sustainable and efficient economic system.

In the context of a region with a diverse industry, such as Central Java, implementing a circular economy can reduce dependence on limited natural resources and optimize the use of existing materials. By prioritizing circular economy principles, economic competitiveness is expected to increase through waste reduction, enhanced production efficiency, and cost savings. Additionally, the circular economy

supports sustainable development goals that focus on preserving the environment and improving people's quality of life.The implementation of the circular economy in Central Java appears to be poorly defined, as it has been carried out sporadically and has not yet established itself as a policy that serves as a reference for the government, the private sector, and the community.

A study conducted by Bappenas together with UNDP and the Danish Government shows that the implementation of the circular economy in 5 main sectors in Indonesia, namely food and beverages, construction, electronics, textiles, and retail (plastics) will increase GDP in the range of Rp 593 – Rp 638 trillion in 2030, 4.4 million green jobs will be created until 2030 (75% of the total jobs are female workers), and reduce waste generation by 18-52% compared to business as usual in 2030, and contribute to reducing GHG emissions by 126 million tons of CO_2.

On a micro scale, circular economy practices have been running in Indonesia and in Central Java. Currently, there are five circular business models designed to maximize the benefits of resources, production cycles, and materials. These five business models can be applied in various forms according to the regional context, business and industrial activities, and products produced throughout the supply chain.

When used together, these models have the potential to make a greater impact than when used alone. The five circular business models are: Circular inputs using renewable energy, bio-based materials, or recyclable materials; The sharing model seeks to increase the use of products through a collaborative use model; Service as a product (Product As A Service) is also known as a Product Service System which offers a complete product with its services for long-term maintenance; Product Use/Life Extension efforts to extend product life through repair, reprocessing, upgrading, and resale; Resource Recovery is the recovery of resources or energy from waste or by-products into secondary raw materials.

However, implementing a circular economy poses greater challenges in the food industry. The nature of this industry involves products that are perishable and have short life cycles, making the application of circular economy principles more complex. Despite efforts to reduce food waste through redistribution and composting, not all food waste can be reprocessed into valuable products.

In addition, food safety is a significant concern that limits the reuse of foodstuffs in the production process. Research indicates that challenges in implementing a circular economy in the food industry include difficulties in managing organic waste and the need for advanced technologies to recycle food waste.

The implementation of the circular economy poses challenges for micro, small, and medium enterprises (MSMEs), particularly due to several obstacles they face. First, basic knowledge about the concept and practice of the circular economy is still lacking among MSME actors. MSME actors have not fully understood the benefits and ways to integrate circular economy principles in their businesses.

Second, access to the waste treatment media and equipment necessary for recycling or reprocessing waste materials is often limited. Adequate technology and facilities usually require significant investments that are difficult for MSMEs to reach. Third, the paradigm that still relies on linear economic practices makes

the transition to a circular economy more difficult. Old habits of managing production and waste are difficult to change without adequate encouragement and education.

The implementation of the circular economy is one way to achieve green development in Central Java. Several approaches have been adopted in implementing the circular economy, either by improving existing voluntary community efforts or by requiring supportive policy directions from the government to accelerate its comprehensive implementation.

The study highlights the importance of implementing a circular economy in food MSMEs in Central Java, given the unique characteristics and specific challenges faced by this sector. The food industry involves products that are perishable and have a short life cycle, which makes the application of circular economy principles more complex compared to other sectors.

Although efforts to reduce food waste through redistribution and composting have been made, not all food waste can be reprocessed into valuable products. Food safety is also a significant concern that limits the reuse of foodstuffs in the production process, adding a layer of complexity to the implementation of the circular economy in this sector.

This focus on food MSMEs is driven by the need to understand and address the specific challenges they face. By identifying existing conditions, potentials, and existing problems and challenges, this study aims to provide relevant input to the Central Java Provincial Government. Through the R0-R9 approach, this study can identify the stages of implementing a realistic circular economy that aligns with the conditions of food MSMEs. In addition, by providing clear guidance on specific implementation stages and time targets, this study helps food MSMEs navigate changes toward more sustainable, efficient, and safe circular economy practices.

This research aims to identify the existing conditions in Central Java, including the identified loci, their potential, and the problems and challenges they face. Additionally, institutions and regulations that support or hinder the implementation of the circular economy will be analyzed. The economic opportunities of implementing the R0-R9 approach in MSMEs, particularly those focused on food and beverages, will also be evaluated to assess their impact on the welfare of business actors in Central Java, including their quantitative implications.

In this process, some of the research questions that are the focus are: What are the existing conditions, potentials, problems, and challenges in Central Java food and beverage MSMEs related to the implementation of the circular economy?; What is the model for developing a circular economy ecosystem for food and beverage MSMEs in Central Java? This research aims to analyze the current circularity level of F&B MSMEs in Central Java using standardized indicators and to determine the priority strategies for developing a sustainable ecosystem.

RESEARCH METHODS

The sample in this study comprises 60 food and beverage processing businesses spread across Central Java, selected from four cities/regencies: Semarang City, Semarang Regency, Kendal Regency, and Kudus Regency. This study employs a purposive sampling method. The reason for selecting this sample is based on the concept of degree of homogeneity,

which states that populations with similar characteristics can provide more representative and valid data when sampled from several homogeneous regions.

Thus, sampling from districts that have relatively similar economic, cultural, and food and beverage industry characteristics will provide a more accurate picture of the implementation of the circular economy in this sector. The basis for determining 60 samples using formula considerations, Lemeshow Theorem, as follows:

$$\frac{Z^2.P.(1-P)}{E^2}$$

Then, to account for the limited population, the formula is used

$$n' = \frac{N}{1+\frac{n-1}{N}}$$

Where n' is the size of the customized sample. As for N is the target population, Z is the Confidence level, Z is the margin of error, and P is the proportion.

$$n' = \frac{1.96^2.0{,}5.(1-0{,}5)}{0{,}125^2}$$

= 61.28 rounded 60

This study uses an exploratory descriptive method with a case study approach, whose focus is to explore the application of the circular economy to SMEs, especially micro enterprises, in the food and beverage sector in Central Java. This case study approach is considered appropriate because it enables researchers to delve into the specific dynamics of implementing the circular economy in SMEs through direct exploration of these efforts (Yin, 2018). The purposive area sampling technique was applied in the selection of the research area. These regions were deliberately chosen because they are considered to represent the general condition of food and beverage SMEs, especially micro-enterprises, which have unique characteristics and challenges in applying circular economy principles.

The selection of samples was carried out by considering areas with ecosystems and supporting infrastructure, as well as facilitating collaboration between micro-enterprises to improve efficiency and sustainability. This technique ensures that the samples taken are relevant and can provide an accurate picture of the application of the circular economy to micro-enterprises in the food and beverage sector (Ellen MacArthur Foundation, 2015).The respondents of this study consisted of micro and medium enterprises in the food and beverage sector operating in selected cluster areas.

The cluster area was selected based on the potential of the ecosystem that supports the implementation of the circular economy, such as the availability of supporting infrastructure and opportunities for collaboration between micro-business actors. With a focus on microenterprises, this study aims to identify challenges and opportunities in implementing the circular economy in the sector, particularly related to limited resources and innovations that can help microenterprises adapt to a more sustainable economic model (Luthra et al., 2020).

In the context of this research, the focus is directed towards microenterprises, as they often face limitations in accessing capital, technology, and management capacity, which makes the

implementation of the circular economy a challenge. However, microenterprises also have the potential to innovate in the use of raw materials and waste management, which aligns with the principles of sustainability (Geissdoerfer et al., 2017).

The analysis of circular economy indicators refers to the circular economy calculator developed by https://circularitycalculator.nl/#circ. This analysis includes the calculation of circularity, value capture, recycling content, and reuse index.

RESULTS AND DISCUSSION

Using the research sample and the data that had been previously collected, the next step we conducted was calculating the implementation of the circular economy. The implementation of the circular economy can be evaluated through several key indicators that provide an overview of the effectiveness and extent to which circular principles have been integrated into an economic system.

One of the key indicators is the circularity level, which measures the rate of material turnover in the production and consumption cycles, indicating how effectively materials can be reused or recycled in the production process.

Table 1. Circularity Score in Respondents

No	Range	Percentage
1	1-5%	75,5%
2	6-10%	4,5%
3	>10%	20,0%
Total		100%

Source: Data processed, 2024

The next indicator is value capture, which assesses the ability of business actors to maintain the value of materials and products throughout their life cycle, both through reuse, recycling, and increasing added value.

The recycle content indicator, which measures the proportion of recycled materials used in new products, indicating the extent to which production contributes to reducing dependence on primary raw materials. Meanwhile, the reuse index measures the frequency of reuse of products or components across different cycles, serving as a marker of effectiveness in reducing waste and extending product life.

Table 2. Value Capture Score in Respondents

No	Range	Percentage
1	0-1%	91,1%
2	2-4%	6,6%
3	>4%	2,3%
Total		100%

Source: Data processed, 2024

Table 1 shows the value of circularity measured in food industry SMEs in Central Java. The table illustrates the extent to which SMEs in this sector have successfully adopted circular economy practices, as measured by the various indicators mentioned earlier. By understanding these values, it will be possible to evaluate the progress of implementing the circular economy in the food industry sector and identify areas that still require improvement to achieve higher sustainability. Table 1 shows circularity data on the study respondents.

There are several main reasons why circularity scores in food processing SMEs are very low. First, there is limited access to technology that enables the recycling or reuse of materials. The technology is often expensive and inaccessible to SMEs, which typically have

limited capital. Second, a lack of knowledge and understanding of the circular economy concept among business actors.

Many SMEs still rely on traditional linear economy models, where production and consumption end with waste disposal, without considering the potential for reuse or recycling. Third, limited infrastructure, such as efficient and affordable waste treatment facilities, is also a factor inhibiting the increase in circularity.

Table 3. Recycle Content Score in Respondents

No	Range	Percentage
1	0-1%	91,1%
2	2-4%	6,6%
3	>4%	2,3%
Total		100%

Source: Data processed, 2024

To improve the circularity score, integrated and sustainable efforts are needed. First, there is a need for a comprehensive education and training program to increase SMEs' understanding of the benefits and practices of the circular economy. Second, governments and relevant agencies can provide support in the form of easier and more affordable access to the necessary technology and infrastructure, such as recycling and waste treatment facilities.

Third, encouraging collaboration between SMEs in the form of circular industry clusters can be a strategic step. In this cluster, SMEs can share resources and technology, as well as collaborate to manage waste collectively, which can ultimately enhance efficiency and reduce costs. With these measures, it is hoped that SMEs in the food and beverage sector in Central Java can improve their circularity scores and contribute more significantly to realizing a more sustainable economy. Value Capture in the circular economy involves creating, maintaining, and optimizing value throughout the product lifecycle, while ensuring that resources remain used efficiently and waste is minimized. This not only provides economic benefits for the company but also has a positive impact on the environment and society.

Table 4. Reuse Index Score in Respondents

No	Range	Percentage
1	0-1%	95,6%
2	2-4%	0,0%
3	>4%	4,4%
Total		100%

Source: Data processed, 2024

Table 2 provides an overview of the distribution of value capture scores, which are categorized into three main groups: 0-1%, 2-4%, and greater than 4%. The percentages in each of these categories will be further elaborated to provide a deeper understanding of respondents' tendencies in these categories. Table 2 presents the distribution of value capture scores among respondents, based on the percentages obtained from the data processed in 2024.

Table 2 shows that most respondents (91.1%) fall within the low value capture range, which is between 0% and 1%. This suggests that most respondents derive very little value from the activities or initiatives they undertake. As many as 6.6% of respondents fell within the 2-4% range, indicating a slight improvement in their ability to capture value, although this is still relatively low. Only 2.3% of respondents were able to capture a value of more than 4%, indicating that very few of the respondents were effective in maximizing the potential value of the activities carried out. The low value capture

score in the food industry is also caused by suboptimal waste management, where most business actors tend to dispose of waste directly without further processing.

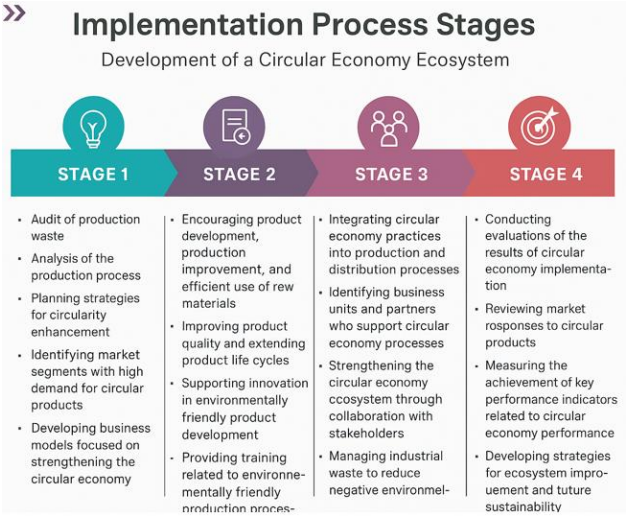

Figure 1. Stages of the Ecosystem Development Implementation Process Circular Economy
Source: Data processed, 2024

This practice results in the loss of potential value that can be obtained from waste that still has a use, such as through recycling or reuse in other forms. In addition, some business actors prefer to hand over their waste to third parties for management, which usually produces minimal added value for the business actors themselves, as third parties benefit more from the waste treatment.

Few businesses choose to process waste independently or through joint management, even though this method has the potential to increase the value they can capture, either through reduced operational costs, the creation of by-products with economic value, or through a better reputation due to the implementation of sustainable business practices. The lack of initiative in managing waste independently or collaboratively indicates a significant opportunity that business actors have not fully utilized to increase value capture in the food industry.

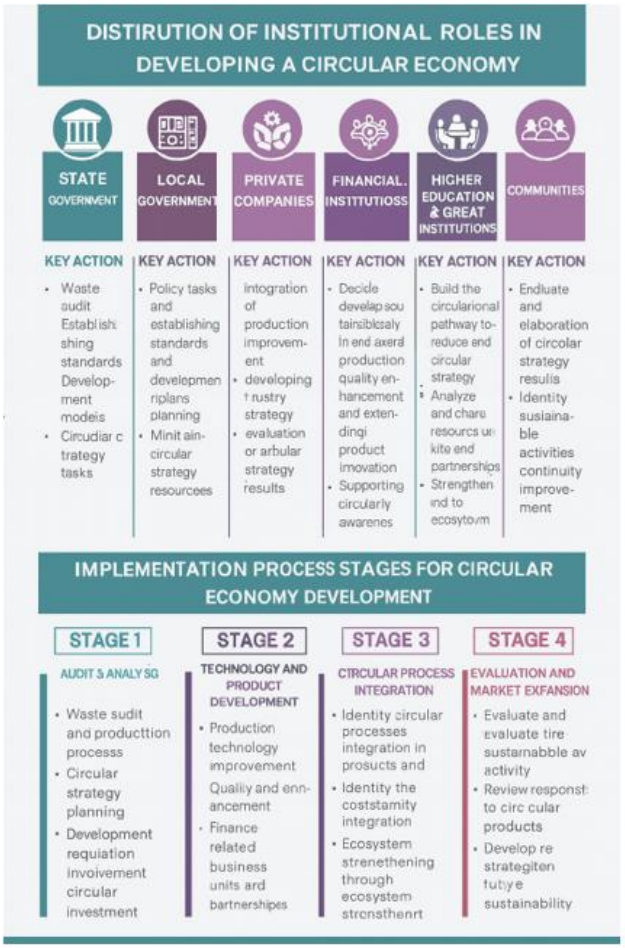

Figure 2. Institutional Role Distribution and Phased Circular Economy Development
Source: Data processed, 2024

The calculation of recycled content illustrates the extent to which business actors in this sector integrate recycled materials in their production processes. Recycle content refers to the proportion of recycled materials used as raw materials in the manufacture of products. The use of recycled materials can be a significant indicator of business actors' commitment to sustainable practices and the implementation of the circular economy. The resulting scores will

provide an overview of the adoption rates of recycled materials across various food businesses, helping to identify opportunities to improve efficiency and sustainability in the industry. Table 3 presents data on the score of recycled content in the food business.

Table 3 reveals that most respondents in the food processing business have a very low score of recycled content, with 91.1% of them using only 0-1% recycled materials in their production. This indicates that most businesses in this sector are still limited in integrating recycled materials into their production processes. Only 6.6% of respondents use 2-4% recycled materials, and even less, at 2.3%, use more than 4% recycled materials.

This interpretation reflects that the application of the circular economy in the food processing business is still in its early stages. Many business actors have not fully understood or adopted the principles of the circular economy, where the use of recycled materials should be a key element. With the limited use of recycled materials, the industry is missing out on opportunities to reduce its reliance on new raw materials, minimize waste, and enhance production efficiency.

In addition, the low recycling content also indicates a lack of infrastructure or access to adequate recycled materials, as well as challenges in changing the production process to be more environmentally friendly. To increase the recycled content score, a greater push for innovation in product design, investment in recycling technology, and education for business actors about the economic and environmental benefits of adopting a circular economy is needed. The calculation of the reuse index measures an entity's effectiveness in reusing materials or products within its production process. In the context of the circular economy, the reuse index is a crucial indicator that reflects a commitment to the principle of resource reuse, with the primary goal of minimizing waste and maximizing the material life cycle.

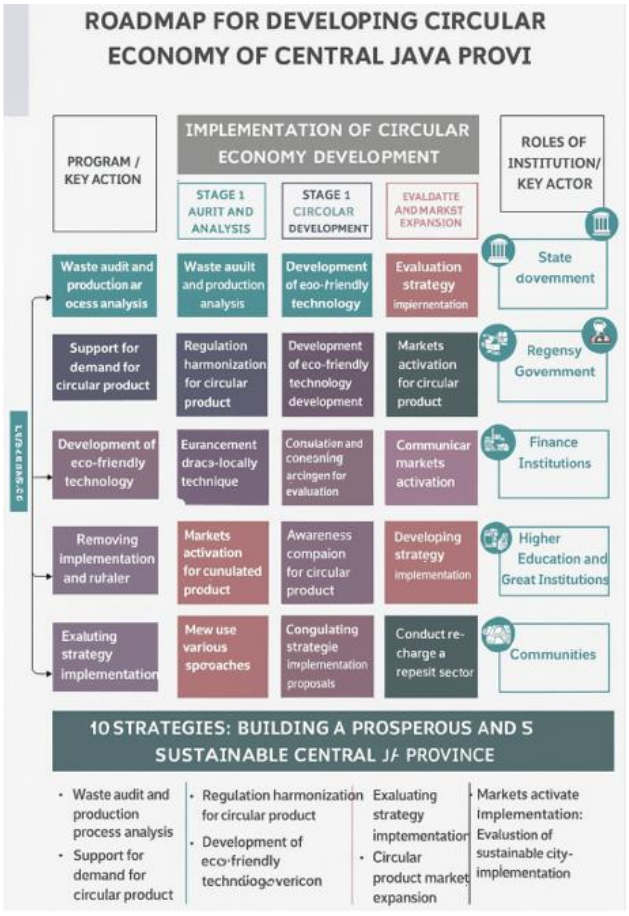

Figure 3. Circular Economy Development Model
Source: Data processed, 2024

. The high application of reuse can reduce the need for new raw materials, reduce waste, and reduce the environmental impact of the production process. The resulting score will provide an overview of the extent to which businesses in the food sector implement reuse practices in their operations and identify areas that need improvement to enhance the integration of circular economy principles into their business. Table 4 presents data on the

reuse index score of respondents in the food industry.

Table 4 shows that the score reuse index in the food industry is relatively low, with 95.6% of respondents recording the reuse of materials or products in the range of 0-1%. This condition indicates that most business actors in the food industry rarely, if ever, reuse materials or products in their business processes. Only 4.4% of respondents reported reusing more than 4%, indicating that very few businesses have started implementing material reuse practices in their business operations.

The reuse index in the food industry is relatively low due to inherent challenges associated with the nature of the product and the production process within the sector. Food products generally have a short shelf life and are prone to contamination, which makes the reuse of the material or product difficult and impractical. In addition, many food businesses operate with highly segmented production systems, focusing on short-term efficiency and thereby ignoring the potential benefits of reuse.

The lack of adequate infrastructure to support the reuse and recycling process is also a significant obstacle. Logistics systems and technologies for managing and processing returned materials have not been adequately developed in most cases. This, coupled with the lack of knowledge and awareness about the long-term benefits of implementing circular economy principles, as well as the lack of economic incentives to invest in this practice, causes business actors to tend to continue using new raw materials and discard leftover products rather than adopting reuse practices. To improve the reuse index score in the food industry, businesses can take several strategic steps that focus on innovation, investment, and cultural changes in operations.

First, companies need to design products and packaging with the principle of reuse in mind, such as creating packaging that can be easily repaired, sterilized, or reused in the same production cycle. Investing in technologies that support treatment and reuse, such as efficient waste treatment systems or recycling equipment, is also critical.

In addition, business actors must develop an effective logistics system to manage returned products and ensure product quality is maintained. A structured effort is necessary to increase knowledge and awareness of the benefits of reuse among employees and stakeholders, through targeted training and education, to encourage the broader adoption of this practice.

The implementation of incentive policies that support reuse, as well as collaboration with suppliers and customers to create systems that support sustainability, will also accelerate the transition to broader reuse practices. These measures, taken together, will help improve the reuse index and support circular economy goals in the food industry.

The application of circular economy principles in food MSMEs presents various significant opportunities and benefits that can be felt from environmental, economic, and social perspectives. The circular economy, which emphasizes waste reduction, reuse, and recycling, presents a distinct approach to traditional linear models. In a linear model, the production and consumption cycles often end with waste disposal, while a circular economy focuses on minimizing waste and maximizing resource reuse.

The application of the circular economy in the food industry can be implemented through various technical efforts, structured into several stages (look at figure 1). In Phase 1, the process begins with conducting a production waste audit and a production process analysis to identify opportunities for improving circularity. This initial step also involves planning a circular strategy and identifying market segments interested in sustainable products.

Policy support that encourages the implementation of the circular economy is also crucial at this stage. Phase 2 focuses on the development of waste treatment and recycling technologies, as well as the creation of new, environmentally friendly products. Companies must adopt innovations in product and process design to utilize more sustainable materials. In Phase 3, efforts should focus on integrating circular processes into the supply chain and operational production.

These efforts include identifying business partners who share the same sustainability vision, optimizing the supply chain for greater efficiency, and adopting environmentally friendly technologies in production and distribution. In Phase 4, it focuses on the periodic evaluation of the results of implementing the circular economy, expanding consumer markets that support sustainability, and building employee capacity through training related to recycling technology and waste management. Specifically, a picture of the phasing fishbone and circular economy is shown in figure 2.

The application of the circular economy in the food business in Central Java can be understood through the role of various institutions working together to achieve common goals. The Provincial Government took the first step by drafting regulations and encouraging the adoption of efficient and environmentally friendly production technology.

The district government can direct the focus on technical support and local waste management, considering that many circular economy activities are within the scope of the district government's fostered activities. Business actors, particularly those that generate significant waste, must integrate circular principles into their production processes, such as reducing waste and utilizing recycled materials.

In addition, financial institutions play a crucial role in providing green financing for companies committed to sustainability, and colleges support the research and development of innovative recycling technologies. In this case, the role of research institutions and institutions tasked with assisting is significant. The focus is not only on efforts to fulfill the quantity of production quality funds, increase profitability and business management, but also on circular principles for sustainability.

The process of implementing this circular economy is divided into several stages. The first stage is an audit and analysis to identify potential improvements in production. The next stage is technology development and product innovation. In the third stage, the integration of circular principles into the production process ensures waste can be reprocessed, improving resource efficiency.

At the evaluation and market expansion stages, this is carried out to ensure the sustainability of implementation, as well as to open opportunities for products that adhere to circular principles to penetrate a broader market. Technically, the roadmap for developing the circular economy is illustrated in figure 3.

The roadmap outlines the flow of problems and solutions related to the development of the circular economy, focusing on the stages of problem identification and solution implementation by various institutions. The issues faced by the circular economy are often not fully identified, especially in the food business sector in Central Java. One of the main challenges is the technical nature of the product, which has a short life cycle, perishability, and low quality due to its environmentally based nature. This indicates the need for a more in-depth evaluation to identify technical issues in production.

Efforts to evaluate circular economy principles are an essential key. This evaluation will lead to a more detailed identification of weaknesses in production, such as non-durable products and environmentally unfriendly raw materials. Following the review, various steps were taken to encourage the implementation of the circular economy, including the development of supportive regulations, the adoption of relevant technologies, the provision of adequate infrastructure, and the provision of assistance to Human Resources (HR) and improved access to financing.

The implementation of the circular economy is then carried out through the cooperation of various institutions with roles that have been divided. Provincial and district governments are responsible for supporting regulations and infrastructure, while private companies are expected to adopt circular economy technologies.

Universities and research institutions play a crucial role in the development of innovation, while communities and entrepreneurial associations are responsible for awareness campaigns and providing technical support. The implementation process is divided into four stages, namely audit and analysis, technology and product development, circular process integration, and market evaluation and expansion. With this stage, it is hoped that the product life cycle can be extended, product quality can be improved, and the environmental impact of the production process can be minimized.

CONCLUSION

The implementation of the circular economy among food and beverage MSMEs in Central Java remains at an early stage and shows a low level of integration with sustainability principles. The measurement results of four key indicators circularity, value capture, recycled content, and reuse index indicate that the majority of businesses still operate within a linear economic framework, where production waste is not optimally processed and the added value of residual materials has not been significantly utilized.

Approximately 75.5% of businesses have a circularity level below 5%, while the scores for value capture, recycled content, and reuse index are mostly in the range of 0–1%. This condition reflects the limited use of recycled materials, minimal material reuse, and unproductive waste management practices.

The main constraints faced by MSMEs include limited access to environmentally friendly technologies, insufficient knowledge of circular economy concepts, and inadequate infrastructure support and green financing. Business actors paradigms, which remain focused on short-term efficiency without considering product life cycle perspectives, further slow the transformation toward a circular economy. Nevertheless, there is

substantial potential to develop a more adaptive ecosystem through synergy among stakeholders, including local governments, financial institutions, academics, research institutions, and business actors.

The analysis shows that the development of an effective circular economy ecosystem should be carried out through four strategic stages. The first stage is waste auditing and analysis, aimed at mapping sources of inefficiency and identifying opportunities for improvement in production processes. The second stage involves the development of technology and product innovation, enabling waste to be transformed into new resources and promoting more environmentally friendly product design.

The third stage includes integrating circular processes into the supply chain through collaboration among business actors and the optimization of logistics and distribution. The fourth stage is the evaluation and expansion of green markets, to ensure the sustainability of circular economy implementation and to stimulate demand for environmentally conscious products.

REFERENCES

Bappenas. 2021. Buku Manfaat Ekonomi, Sosial, dan Lingkungan Ekonomi Sirkular di Indonesia. Accessed in https://lcdi-indonesia.id/wp-content/uploads/2021/09/The-Economic-Bahasa_.pdf

Denia Isetianti Permata & Sekar Arum. (2022). The Future is Circular: Uncovering Circular Economy Initiatives in Indonesia. Jakarta: Bappenas. Lcdi Indonesia

Denis Jurgilevich et al. (2016). Food waste and circular economy: Challenges and opportunities. Resource Recovery Journal. ResearchGate

D. Setyawan et al. (2024). Implementing the Circular Economy in SMEs: A Behavioural Modelling Review from the Indonesian Context. Journal of Indonesian Circular Practice. IJABIM

Edgar Biggs (2020). The Circular Economy in Indonesia: A Comparative Study of EU and Finland. Jurnal Riset & Studi Ekonomi Indonesia, 1(2). Social Science Journal

Ellen MacArthur Foundation. (2015). Towards a Circular Economy: Business Rationale for an Accelerated Transition. Isle of Wight: Ellen MacArthur Foundation.

Institute for Essential Services Reform. (2024). Retrieved from https://iesr.or.id/en/green-economy-central-javas-strategic-steps-towards-a-sustainable-future/

Ishmam Abid, S. M. Zuhayer Anzum Fuad, Mohammad J. Morshed Chowdhury, Mehruba Sharmin Chowdhury, & Md Sadek Ferdous. (2024). A Systematic Literature Review on the Use of Blockchain Technology in Transition to a Circular Economy. arXiv preprint. arXiv

Ishwari Thopte, Agnes Evangelista, Rianne Jenner, & Kim Poldner. (2025). Regenerative Business Practices: Supporting Micro, Small and Medium Enterprises' Transition to a Net-Positive Circular Economy. Journal of Circular Economy, 3(1). Journal of Circular Economy

I. Bigdeloo, T. Teymourian, E. Kowsari, S. Ramakrishna & A. Ehsani. (2021). Sustainability and circular economy of food wastes: waste reduction strategies, higher recycling methods, and improved valorization. Materials Circular Economy, 3(1), 3. ResearchGate

I. Rabbi & M. B. Amin. (2024). Circular Economy and Sustainable Practices in the Food Industry: A Comprehensive Bibliometric Analysis. IOP Conference Series: Earth & Environmental Science. Bohrium

J. Patricio, A. Mendes, F. Ferreira, & A. Pires. (2018). Extended Producer Responsibility in Portugal: The Case of Packaging Waste. Waste Management & Research, 36(7), 605-613. https://doi.org/10.1177/0734242X18780468

Markus Geissdoerfer, Paulo Savaget, Nancy M. P. Bocken, & Erik J. Hultink. (2017). The Circular Economy – A New Sustainability Paradigm? Journal of Cleaner Production, 143, 757-768. https://doi.org/10.1016/j.jclepro.2016.12.048

Ministry of Cooperatives and Small and Medium Enterprises of the Republic of Indonesia. (2008). Law Number 20 of 2008 concerning Micro, Small, and Medium Enterprises (MSMEs). Jakarta: Government of the Republic of Indonesia

.Ministry of National Development Planning. (2024). NATIONAL ROADMAP & ACTION PLAN CIRCULAR ECONOMY INDONESIA 2025–2045. Jakarta: Government of the Republic of Indonesia.

M. Bocken & N. M. P. Bocken. (2016). Circular Economy in Small and Medium-Sized Enterprises — Current Status and Future Agenda. Systems, 13(3). MDPI

M. B. Miles, A. M. Huberman, & J. Saldaña. (2014). Qualitative Data Analysis: A Methods Sourcebook (3rd ed.). Thousand Oaks: SAGE Publications.

Nanang Adie Setyawan, Hadiahti Utami, Bayu Setyo Nugroho, Mellasanti Ayuwardani, & Suharmanto. (2022). Analysis of the Driving Factors of Implementing Green Supply Chain Management in SME in the City of Semarang. arXiv preprint. arXiv

Nanang Setiawan et al. (2023). SMEs on the way to a circular economy: insights from a multi-level perspective. Management Review Quarterly. SpringerLink

Onyeaka Chukwugozie. (2023). How Circular Economy Approaches Can Tackle Food Waste and Promote Sustainability. Sustainability Review, 1(1), 9. sustaine.org

R. K. Yin. (2018). Case Study Research and Applications: Design and Methods (6th ed.). Los Angeles: SAGE Publications.

Saputra, Irzal & Barokatuminalloh, & Wibowo, Arif & Prihono,. (2025). MACROECONOMIC DETERMINANTS OF CIRCULAR ECONOMY INNOVATION ACTIVATION IN CENTRAL JAVA. The International Conference on Sustainable Economics Management and Accounting Proceeding. 1. 2026-2036. 10.32424/je6kht49.

S. Luthra, A. Kumar, E. K. Zavadskas, S. K. Mangla, & J. A. GarzaReyes. (2020). Industry 4.0 as an Enabler of Sustainability Diffusion in Supply Chain: An Analysis of Influential Strength of Drivers in an Emerging Economy. International Journal of Production Research, 58(5), 1505-1521. https://doi.org/10.1080/00207543.2019.1660828

T. Mohammad Khairal Abdullah et al. (2024). Circular Economy Implementation: A Case Study in Indonesia. Jurnal Inovasi Global, 2(2). ResearchGate

UNGA. (2012, September 11). United Nations. Retrieved from United Nations: https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang