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Assessing the Viability of Circular Economy in Indonesia's MSMEs Agribusiness Sector

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ABSTRACT

The agribusiness industry increasingly emphasises implementing the circular economy, encouraging micro, small, and medium enterprises (MSMEs) to consider economic, environmental, and social aspects. However, this adoption still has the potential to be increased, especially among MSMEs in the agribusiness sector. A research study examines incorporating sustainability and determinants in applying circular economy principles among agribusiness MSMEs in Central Java, Indonesia. This study surveyed agribusiness MSMEs in Central Java, using the Remanufacturing Sustainability Indicator analysis to evaluate sustainability and logistics regression analysis to determine the factors that affect the implementation of the circular economy by agribusiness MSMEs. This research method uses an explanatory approach, determining respondents by simple random sampling by producing 650 Agribusiness MSME entrepreneurs in Central Java. Data collection is based on the results of interviews using a structured closed questionnaire method. The assessment of economic, social, and environmental aspects of the Manufacturing Sustainability Indicators approach in agribusiness MSMEs still needs to be improved, especially in Indonesia. This is a crucial step in facilitating the production of sustainable and high-performance agricultural products derived from products that are remanufactured throughout their life cycle. The findings show that the average agribusiness MSME has applied circular economy principles, with sustainability values exceeding the average Indonesian national standard in economic, social, and environmental indicators. In addition, this study concludes that various independent variables collectively impact the implementation of the circular economy by agribusiness MSMEs, with cultural factors playing a partial role. The results of this study serve as the basis for achieving a circular economy in Indonesia by 2030 by highlighting the importance of cultural principles related to sustainable remanufacturing and waste management in agribusiness MSMEs.

1. INTRODUCTION

Current global environmental challenges emphasise the importance of embracing the circular economy. The circular economy is an economic model that prioritises reducing, reusing, and improving materials throughout the product life cycle, from production and distribution to consumption [1, 2]. This approach can be applied at multiple levels – micro (by companies and consumers), meso (in green industrial estates), and macro (in cities, regions, and countries) – to build a sustainable economy that focuses on environmental quality, economic well-being, and social justice. Only nine per cent of the world's economic activity is based on circular economy principles [3]. In contrast, a linear growth-oriented economic system is closely linked to environmental problems such as deforestation, biodiversity loss, climate change, floods, and pollution (water, soil, and air) resulting from overexploitation and exceeding environmental capacity in both input and output supply chains. The circular economy offers solutions to the problems caused by the linear economy [4].

The circular economy concept focuses on forming an industrial economy that produces minimal waste by utilising two materials: biological materials that can be returned to nature without causing damage and technical materials that can be continuously reused without generating waste [5, 6]. Sustainability is essential for the proper functioning of the circular economy, as it allows for long-term survival. Certain parties need to initiate the formation of a circular economy mechanism. Implementing a circular economy can help mitigate the negative impact of various industries that previously operated under a 'business as usual' model [7]. The agribusiness industry is responsible for the global implementation of the circular economy. Unfortunately, the industry is also one of the main contributors to pollution, after the oil and textile industries. According to global data, agribusiness, particularly the processed food industry, accounts for 15% of global wastewater (water pollution) and 15% of total global carbon emissions (air pollution) [8, 9].

Processed food products end up in solid waste, contributing to 118 million tonnes in landfills, which comprise 74% of total production waste and are buried or burned [10, 11]. Considering this vast negative impact, there is an urgent need to implement a circular economy in agribusiness, especially in producing processed agricultural products.

Indonesia's food processing sector is an integral part of the country's strategy to build a circular economy by 2030. This effort is projected to increase Indonesia's GDP by 2.5%, create 4.4 million jobs, and reduce production waste by up to 40% [8, 9]. Almost all businesses in Indonesia, 62.5 million, are MSMEs, with the trade sector being the largest share. MSMEs contribute 60% to Indonesia's GDP and play an essential role in the country's economy [9]. Indonesia's Coordinating Ministry for Maritime Affairs has set a goal for Indonesia to transition to a developed country, with 14% of the population involved in entrepreneurial activities. In addition, the unemployment rate in Indonesia is reported to reach 6.31% [12].

Entrepreneurship has a vital role in encouraging economic expansion. Entrepreneurship can spur economic progress by creating jobs, increasing incomes, and improving the overall quality of life. This underscores the importance of MSMEs in entrepreneurship because MSMEs are the economic foundation of a region and contribute to growth and job creation [11]. Improving the quality of human resources and capital will increase revenue, labor costs, market share, and profits. Unlike when company longevity was the main driver of revenue with high labor costs and minimal profits, revenue growth now brings considerable increases in labor costs, market share, and profits [9]. Higher income levels provide more significant opportunities for MSMEs to build a circular economy.

The concept of sustainability can be understood through three main aspects: object, goal orientation, and interaction. "Object" refers to a sustainable object or a concrete representation of sustainability. Goal orientation describes the starting point for assessing whether an object or thing is sustainable. This orientation can be absolute or relative, but it is essential to understand the ways and factors that affect sustainability. The relative approach involves identifying current conditions and problems that need to be addressed and gradually improved to achieve sustainability [13, 14]. The third aspect, interaction, involves whether the observed object is static or dynamic. This aspect is based on the idea that external forces and internal factors can cause the observed object to change. From a static perspective, external factors are considered static, even though the analysed object is dynamic.

The Sustainability Indicator System analysis concentrates on the evaluation of sustainable business performance. This study is beneficial for understanding the intricacies of small-scale businesses, especially in the agribusiness sector. Improving inputs, processes, and outcomes is critical to driving business expansion. Difficulties such as obtaining capital and human resources are also important issues. Using a 'Knowledge Transfer' approach, this study aims to find strategies that small business owners can adopt to address similar businesses' economic, social, and environmental challenges.

Implementing the circular economy is particularly concerning in MSMEs, as these companies have faced much criticism for their lack of environmental priorities, inefficient use of resources, and weak compliance with ecological management initiatives [15]. Several research studies have investigated the barriers and supporting factors faced by MSMEs when implementing circular economy practices [14, 16-21]. Chowdhury et al. [22] researched the impact of circular economy innovation, which has more risks than conventional innovation, caused mainly by misinterpretation of the circular economy business model. Furthermore, Chakraborty et al. [23] and D'Amato et al. [24] emphasised the importance of technological advances for effectively applying circular economy principles. Nevertheless, the existing studies have primarily focused on the context of developed countries, with few studies addressing developing countries in this context. In addition, the existing literature is still about applying circular economy principles in MSMEs in general. This study refines the current literature by identifying the main factors that facilitate or hinder the adoption of circular economy practices by MSMEs, and it also analyses the Manufacturing Sustainability Indicators that have implemented circular economy in agribusiness MSMEs. Studies related to the circular economy on agribusiness MSMEs are still minimal, so the impact of this study provides valuable insights for Agribusiness MSME policymakers and stakeholders in increasing the adoption of the circular economy in Indonesia. The circular economy research gap in agribusiness MSMEs revolves around the need to thoroughly understand how circular economy metrics are interconnected and impact regeneration-related choices.

This study aims to evaluate the importance of the Remanufacturing Sustainability Indicator (RSI) for MSMEs in the agribusiness sector and analyse the factors that affect agribusiness MSMEs in adopting circular economy principles. This research is structured based on three main concepts: understanding the research background to identify essential factors in developing sustainability indicators for MSMEs, establishing sustainability indicators for MSMEs by considering the measurement method and scope, and discussing the measurement and framework of sustainability indicators for MSMEs. The goal is to develop a framework of sustainability indicators for agribusiness MSMEs that can guide agribusiness MSMEs in Indonesia and other developing countries. With its potential to assist in monitoring and assessing the impact of circular economy activities at various stages, this framework can be an essential step towards facilitating the production of sustainable, high-performance products derived from remanufactured products throughout their life cycle.

2. RESEARCH METHODS

This study uses descriptive and explanatory methodologies [16]. The data collection and research method in Central Java Province in Figure 1, a province with a high economic growth rate of MSMEs in Indonesia, was carried out by simple random sampling. The number of samples is based on non-probability sampling, which includes Semarang City, Semarang Regency, and Salatiga City. The area is the base for developing agribusiness MSMEs in Central Java, and it has explored the potential for implementing a circular economy in Indonesia [25]. This research took place between July and September 2024.

Figure 1. Agribusiness MSMEs in Central Java, Indonesia

The information used in this study is based on original data obtained from interviews using a structured closed questionnaire on 650 agribusiness entrepreneurs involved in processed and non-processed foods. The descriptive design can be seen from the depiction of the conditions for implementing the circular economy, the level of sustainability, and the sustainable development of agribusiness MSMEs in Central Java. The parameters for determining the sample are MSMEs that have implemented a circular economy based on the study of Dey et al. [26], namely applying one of the principles of reuse, reduce, recycle, replant, replace, and the study of García-Quevedo et al. [27] that divides the stages of the circular economy into, post-industrial waste, pre-customer waste, and postcustomer waste. The explanatory design of this study can be seen from the use of statistical and econometric analysis tools in estimating factors that affect Agribusiness MSME business actors in Central Java in implementing a circular economy in the context of this study, namely the reuse of leftover production.

The research data was gathered using detailed, organised interviews. A quantitative methodology featuring a structured closed questionnaire was utilised to determine the traits of respondents, investigate information regarding the sustainability assessment of agribusiness MSMEs, and perform calculations with RSI. For calculations that cannot be quantified numerically, statements may be used (for the denominators and numerators in the equation).

The companies mentioned are formally recognised by the Cooperatives and MSMEs Office of Central Java Province in Indonesia [25]. Furthermore, supplementary information for this research was gathered from multiple sources, such as earlier studies and other relevant documents. Data for this research were obtained from sources that shared comprehensive details through verbal and written communication.

2.1 RSI

The information collected was then analysed using descriptive statistical methods and RSI. MSMEs that adopt a circular economy are businesses that engage in at least one of the 5R activities: Reduce, Reuse, Recycle, Replace, and Replant [28]. These activities are critical because they are the main strategies MSMEs can use to reduce waste, conserve resources, and promote sustainability. The RSI component in Table 1 comes from a study by Setyorini and Pangarso [17], Fatimah and Aman [29] modified to suit the type of business in the agricultural sector, which concentrates on industries in Indonesia and refers to global journals and literature on sustainability measures in various developing countries. These RSI components are compared to the national average to assess the performance of agribusiness MSMEs.

Table 1. Indicators of remanufacturing sustainability

Sustainability Indicators	Element	Unit	Formula
Economics	Job creation	%	$Job\ creation = \frac{\text{total remain job}}{\text{total formal job}}$
	Salary improvement	%	$CapSI = \frac{\text{improvement salary}}{\text{total salary}}$
	Net profit	IDR	$NP = \text{total revenue} - \text{total lost}$
	Production cost	IDR	$PC = \frac{\text{total cost}}{\text{total revenue}}$
	Productivity	%	$P = \frac{\text{all remanufacturing inputs}}{\text{all remanufacturing products}}$
	Waste treatment cost	IDR	$WsTC = \text{total cost spent for waste}$
Social	Skill level	%	$SL = \frac{\text{total skilled labor}}{\text{total number of employee}}$
	Work injury rate	%	$otalWIR = \frac{\text{total injuries}}{\text{hour worked}}$
	Labor productivity	%	$LP = \frac{\text{total revenue cost}}{\text{total labor cost}}$
	Community complaints	%	$CC = \frac{\text{total people complaint}}{\text{total community}}$
	Customer satisfaction	%	$CS = \frac{\text{satisfied customer}}{\text{total customer}}$
Environment	Material efficiency	kg	$MA = \frac{\text{total reused materials}}{kg\ reman\ product}$
	Used material acquisition	kg	
	Solid waste intensity	kg	$SW = \frac{\text{mass of solid waste produced}}{\text{kg reman product}}$

Focus on goals is the second element of the three concepts that connect the conceptual framework to the operational framework, as outlined by Giraldo et al. [30] and Maun Jamaludin et al. [31]. This parameter establishes measurements based on aspects of the RSI calculation procedure. The next order of calculations is applied:

-Informants with complete information about the RSI indicators, such as production heads or owners, will be interviewed during the screening process.

-The following text provides information about the four elements of the indicator, each with a different role in our understanding of quantification methods (e.g., formulas for calculations), units of measurement (e.g., kilograms, kilowatt-hours), and measurement time frames (e.g., years). In particular, development objectives (e.g., direction of improvement) are essential to this process.

-Define the formula and get the specified unit of measurement from the RSI.

-Examining the key factors that have the most significant impact on the surplus of each sustainability indicator and identifying adverse factors.

2.2 Logistic regression analysis

Logistic regression is a regression model that analyses categorical dependent variables [32]. If the dependent variable is quantitative, classical linear regression can be used. As for the dependent variables, the appropriate model is logistic regression.

Various tests are required to ascertain whether logistic regression is relevant or significant to the problem discussed. These tests include the -2 LogLikelihood statistical test, Goodness of Fit (Nagelkerke R Square value), Hosmer and Lemeshow's Goodness of Fit Test, Omnibus tests of Model Coefficients (simultaneous testing), and partial testing (coefficient test). The method used to analyze the data in this study is binary logistic regression.

The independent variables of this study, derived from previous research, played an essential role in our investigation. These variables consist of X1 corporate responsibility [11], X2 shareholder pressure [3], X3 competitiveness [30], X4 culture [33], and X5 good behaviour [34]. Each variable has been selected because of its potential impact on the dependent variable, namely the Implementation of the circular economy (Y). Furthermore, logistic regression determines the likelihood of a binary outcome (yes/no). Logistic regression was used to explore the correlation between the dependent variables, the Implementation of the circular economy (Y), and the independent variables: corporate responsibility (X1), shareholder pressure (X2), competitiveness (X3), MSME culture (X4), and good behaviour (X5). The formula used for this analysis is as follows:

$$P(Y = 1) = \frac{1}{1 + exp\ (-z)'} \quad (1)$$

$$Y = \beta 0 + \beta 1X1 + \beta 2X2 + \beta 3X3 + \beta 4X4 + \beta 5X5 \quad (2)$$

3. RESULTS AND DISCUSSION

3.1 Agribusiness MSMEs implementing circular economy principles

In this study in Figure 2, various MSMEs, including small, micro, and medium enterprises, have adopted circular economy principles based on their income groups. Of the 650 agribusiness MSMEs sampled, 186 have applied circular economy principles. Of these, 120 have continued the circular process with others, and 66 have managed the rest of their production. The findings regarding the characteristics of agribusiness MSMEs that apply circular economy practices are as follows: their income is not affected by economic conditions; no MSMEs received credit related to circular economy programs; MSMEs are located on the outskirts of the city, away from crowds; and the adoption of circular economy principles initiated by employees who are looking for alternative methods to utilize leftover production.

The 66 agribusiness MSMEs with a higher level of involvement in reusing their production cycles have similar characteristics, such as having the lowest income among their competitors, operating under the same legal entity, located relatively close to the central government office in the Central Java region, owned by men, and run by relatively young MSME owners.

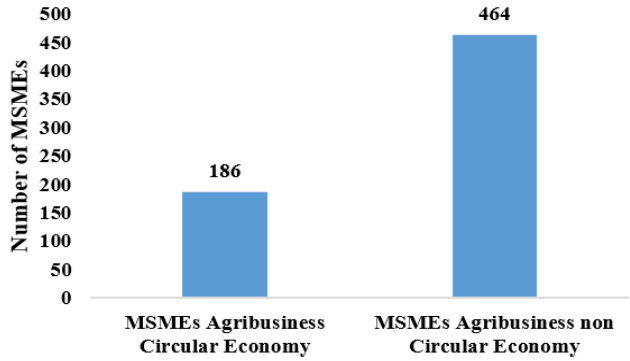

Figure 2. Agribusiness MSMEs implementing circular economy in Central Java

3.2 Agribusiness MSME sustainability indicators

3.2.1 RSI

RSI of agribusiness MSMEs that have adopted circular economy principles shows minimal variability in various aspects. This implies that the difference in RSI values among Agribusiness MSME respondents is insignificant. However, indicators such as job creation, employee wage increases, and skilled labor have relatively high variability. This indicates a diversity of RSI values among agribusiness MSMEs (see Table 2).

The findings in Table 2 show that when agribusiness MSMEs adopt circular economy principles, they positively influence various areas, including job creation, employee welfare, production efficiency, work quality, and environmental management. Promoting and advancing the use of circular economy principles is essential to ensure the expansion and sustainability of MSMEs, which will bring comprehensive benefits to MSMEs, society, and the environment.

In Table 2, agribusiness MSMEs that apply circular economy principles generate an average net profit of Rp. 602,987,710 while maintaining a high level of material acquisition and productivity. This shows efficient utilisation of resources and effective control of production costs. Economic, social, and environmental indicators in the RSI value of agribusiness MSME respondents who have applied circular economy principles are higher than those who have

not. For example, the average value for the job creation indicator is 13.92%, with a maximum value of 120%. This shows significant potential for agribusiness MSMEs to create jobs by applying circular economy principles. The salary increase of 7.12% among agribusiness MSME respondents indicates that salary growth in agribusiness MSMEs oriented towards the circular economy exceeds the average salary increase rate among other MSMEs in Indonesia. This increase is below the average level of job creation in the manufacturing industry. However, as noted by Anzules-Falcones et al. [28], an increase in the number of MSMEs will undoubtedly contribute substantially to job creation.

Economic indicators when applying circular economy principles. This includes increasing productivity and reducing production costs to increase net profit and improve business sustainability. Despite the high average cost of production, there is still potential to increase productivity. Therefore, agribusiness MSMEs in Central Java need to consider these economic factors, such as increasing productivity and reducing production costs, to strengthen business sustainability and increase net profit. By optimising opportunities through circular economy principles, these efforts can contribute positively to the economy in Central Java by creating jobs. According to Palacio et al. [34], the circular economy principle can increase employee salaries, reduce waste treatment costs, and create jobs. In addition, research results from previous study [1] show that businesses engaged in remanufacturing should focus on improving various aspects to ensure the sustainability of their operations.

Table 2 presents the RSI values for social indicators related to employees and society. According to the table, the incidence of work accidents among employees is relatively low, with an average of only 8.18%. On the contrary, labor productivity shows a relatively high average of 12.21%. In addition, 42.21% of the skilled workforce stated the need to improve their skills to improve the company's productivity and performance. Complaints from the community side are very minimal, on average only 0.8%.

Nevertheless, these complaints indicate that the company must address issues related to improved relationships with the surrounding community and business practices. Customer satisfaction is at 0.16. To increase productivity, reduce the risk of work accidents, and improve the company's reputation, MSMEs should focus on upskilling the workforce through training programs and community relations by participating in local events or supporting community initiatives.

Comparing the rate of industrial work accidents in Indonesia will give us a better understanding of how the industry performs in terms of occupational safety. Job-related incidents in respondents' MSMEs, such as minor injuries, are rare. However, it is essential to note that the high rate of work accidents can lead to additional costs and legal problems [35]. Therefore, reducing work accidents benefits employees, companies, and society and is also a critical factor in creating a safer working environment and cost savings. On the other hand, the productivity of small and micro enterprises in Indonesia still needs to be increased to reach around 50% of the productivity of medium and large enterprises (150%). This shows that agribusiness MSMEs that implement a circular economy provide added value up to seven times the total cost of the average worker. This can be influenced by various factors, such as working hours exceeding eight hours per day, the use of new production equipment [36], and some MSMEs that continue to produce on weekends.

Agribusiness MSMEs have a high proportion of trained workers, which are obtained through quality education and support from government and private initiatives that promote workforce skill development. Improving the workforce's skills can lead to a decrease in the unemployment rate and an increase in productivity in the industrial sector. Tsai et al. [37] state that a lack of skilled labor can hinder the growth and sustainability of a company. Therefore, agribusiness MSMEs in Indonesia need to increase the presence of skilled employees who are an integral part of this business and whose role is highly valued.

The number of complaints from Agribusiness MSME customers is relatively low. Most customer complaints are about defective products, including minor issues that can significantly impact the efficiency of agribusiness MSMEs. According to research conducted by Mukherjee et al. [38], public complaints and complaints can negatively impact a company's reputation and reduce customer trust, potentially leading respondents to provide biased answers. However, overall customer satisfaction is high because, on average, MSME products meet consumer expectations.

Table 2 shows the environmental indicators related to material efficiency. This indicates that lower material acquisition values result in better environmental impact, as seen in the 14.19 kg value. The RSI value for acquiring used materials was 8.46 kg, and the intensity of solid waste was 6.28 kg. The lack of material use causes the low RSI value in environmental indicators, so the impact on natural resources and the environment is minor. Therefore, agribusiness MSMEs must focus on reducing the amount of materials used in production by implementing recycling practices and using environmentally friendly materials.

Table 2. Agribusiness MSMEs of Remanufacturing Sustainability Indicators

Indicator	Element	Unit	Min	Max	Average	Std Dev
Economics	Job creation	%	2	120	13.92	41.62
	Salary improvement	%	4	65	7.12	10.81
	Net profit	IDR	68,200,000	2,100,000,000	602,987,710	598,792,872
	Production cost	IDR	5,350,000	380,000,000	89,013,104	81,038,894
	Productivity	%	4	60	6.81	11.79
	Waste treatment cost	IDR	1,500,000	38,000,000	2,872,673	2,108,082
Social	Skill level	%	1	87	42.21	45.63
	Work injury rate	%	0	45	8.18	6.18
	Labor productivity	%	3	64	12.21	18.78
	Community complaints	%	0.6	4	0.8	0.6
	Customer satisfaction	%	0.07	0.82	0.16	0.098
Environment	Material efficiency	kg	0	31	14.19	12.72
	Used material acquisition	kg	0	46	8.46	15.91
	Solid waste intensity	kg	0	12	6.28	4.47

Agribusiness MSMEs in Central Java must focus on six ecDue to various factors, MSMEs often need help to reuse their remaining production. Commercial banks provide MSME loans in the water supply, waste management, and waste recycling sectors, as noted by Abdullah [1] and in a study by Inoue et al. [6] which highlights that credit plays a vital role in supporting circular economies, especially in developing countries. Therefore, the critical role of financial institutions in providing credit that is in line with the principles of the circular and sustainable economy cannot be overstated. Zhang et al. [39] also indicate the potential for a positive relationship between the circular economy and sustainable finance. Therefore, offering credits that prioritise environmental sustainability can encourage the reuse of production and contribute to environmental and social sustainability.

The RSI value, a measure of the circularity of a business model, for environmental indicators shows that these indicators can help MSMEs improve their sustainability. By concentrating on using materials and reducing their operations' environmental impact, MSMEs can build a good reputation with an increasing number of environmentally conscious consumers. In addition, by minimising the use of materials, MSMEs can cut production costs and improve overall business efficiency [28]. However, feedback from survey participants shows that the absence of training and certification for MSMEs is an essential factor that hinders the implementation of circular economy initiatives at large. Although two MSMEs have adopted a circular economy approach due to their employees' desire to pursue opportunities, difficulties in driving business sustainability must be overcome by increasing MSMEs' understanding and ability to embrace circular economy principles.

3.2.2 Comparison of RSI value of agribusiness MSMEs with Indonesia standardization

The results presented in Table 3 show that the average RSI value of agribusiness MSME participants consistently exceeds national standards in various indicators.

The data from Table 3 shows that Indonesia has a higher job creation rate than the national average, which shows the positive influence of agribusiness MSMEs in creating job opportunities. The manufacturing sector also showed a higher rate of job creation, exceeding the national average, highlighting the role of agribusiness MSMEs in contributing to industrial growth and employment. In addition, agribusiness MSME respondents experienced a more significant wage increase than the provincial and national minimum wage. The low rate of work accidents shows the importance of work safety measures by the MSMEs surveyed. In addition, higher productivity levels among small and medium-sized enterprises, which exceed the national average, indicate efficient utilisation of resources and effective business operations. These findings underscore the commendable performance of agribusiness MSMEs in various areas, including job creation, wage growth, profitability, occupational safety, productivity, and professional development. Overall, the comparative results show that MSME respondents have shown strong performance and have exceeded national standards in various aspects, highlighting the potential and contribution of agribusiness MSMEs in supporting economic growth, job creation, improving employee welfare, increasing productivity, and ensuring workplace safety. It is essential to focus on strengthening and expanding the development of agribusiness MSMEs to strengthen Indonesia's micro, small, and medium business sectors.

Table 3. RSI value of agribusiness MSMEs compared to national standardization

Element	Unit	RSI Value of Agribusiness MSMEs (Years)	Average National Standard Value (Years)*	Result	Description
Job creation	%	13.92	2	Achieved	Exceeding the target value standard
Salary improvement	%	7.12	3	Achieved	Exceeding the target value standard
Net profit	IDR	602,987,710	75,000,000	Achieved	Exceeding the target value standard
Production cost	IDR	89,013,104	2,500,000	Achieved	Exceeding the target value standard
Productivity	%	6.81	2.00	Achieved	Exceeding the target value standard
Waste treatment cost	IDR	2,872,673	0	Unachieved	value standard not achieved
Skill level	%	42.21	10	Achieved	Exceeding the target value standard
Work injury rate	%	8.18	0.3	Achieved	Exceeding the target value standard
Labor productivity	%	12.21	2	Achieved	Exceeding the target value standard
Community complaints	%	0.8	1	Unachieved	value standard not achieved
Customer satisfaction	%	0.16	0	Achieved	Exceeding the target value standard
Material efficiency	kg	14.19	5	Achieved	Exceeding the target value standard
Used material acquisition	kg	8.46	2	Achieved	Exceeding the target value standard
Solid waste intensity	kg	6.28	2	Achieved	Exceeding the target value standard

*Standardization: BPS (2022); Ministry of Labor and Transmigration (2020); Ministry of Cooperatives and MSMEs (2020)

3.2.3 RSI ratio of agribusiness MSMEs

The ratio scale was chosen because of its ability to provide comprehensive and precise information when measuring certain variables, such as the RSI value. To use a ratio scale, it is crucial to measure a quantitative variable using comparable units and determine the ratio between the variable value and the significant zero point, as shown in Table 4. Agribusiness MSMEs that implement a circular economy are divided into processed food and non-processed food MSMEs.

Identification of the category of processed food MSMEs is a type of business that produces food and beverage products that consumers directly consume. In contrast, non-processed MSMEs produce raw material products that can be reprocessed into food products and goods.

Table 4. Scale ratio of agribusiness MSMEs implementing circular economy principles

Indicator	Element	Circular Value RSI of Food Processed MSMEs	Circular Value RSI of Non-Food Processed MSMEs	Average RSI of Respondents	Circular Ratio of Food Processed RSI to Respondents	Circular Ratio of Non-Food Processed RSI to Respondents
Economy	Job creation (%)	95	70	8.1	11.73	8.64
	Salary improvement (%)	2	5	2	1	2.5
	Net profit (IDR)	89,700	69,900	401,967	0.22	0.17
	Production cost (IDR)	3,100	6,700	44,616	0.069	0.15
	Productivity (%)	60	30	3.38	17.75	8.87
	Waste treatment cost (IDR)	20,800	16,700	78,982	0.26	0.211
	Average				**5.17**	**3.64**
Social	Skill level (%)	80	120	15.26	5.24	7.86
	Work injury rate (%)	0.08	0.052	0.096	0.83	0.54
	Labor productivity (%)	398	750	409	0.97	1.83
	Community complaints (%)	0.7	0	5	0.15	0
	Customer satisfaction (%)	280	185	88	3.18	2.1
	Average				**2.074**	**2.358**
Environment	Material efficiency (kg)	1.98	2.87	0.83	2.38	3.45
	Used material acquisition (kg)	0.64	0.91	0.022	29.09	41.36
	Solid waste intensity (kg)	0.15	0.073	0.069	2.17	1.05
	Average				**11.21**	**15.28**

Table 4 presents the RSI values for both categories of agribusiness MSMEs that apply circular economy principles, mainly processed and non-processed food MSMEs. Processed food MSMEs that adopt a circular economy approach show an economic performance ratio of 5.17, higher than that of non-processed food MSMEs of 3.64.

Meanwhile, the achievement of social indicators for MSMEs that do not process their products and instead apply the circular reuse economy principle is 2,358, higher than processed MSMEs, which are only 2,074. This shows that processed MSMEs that apply the circular reuse economy principle have a higher RSI value than non-processed MSMEs. This means that MSMEs not following circular principles have a higher-than-average RSI ratio. On the other hand, processed MSMEs that follow circular principles have a lower RSI ratio. The application of circular economy principles related to the achievement of environmental indicators is non-processed MSMEs 15.28, which exceeds the value of 11.21 for processed agribusiness MSMEs.

Employee welfare has become an essential focus for these two categories of agribusiness MSMEs. Reference [34] shows that this emphasis can positively affect employee motivation and productivity. In addition, these companies have excelled in generating sustainable net profits, managing expenses, and achieving improved product efficiency.

The study results show that MSMEs involved in food product processing have a higher RSI value than MSMEs that do not process food products in all economic indicators, except for salary increases. In addition, the average RSI of MSMEs that process circular food is greater than that of MSMEs that process non-circular food, which indicates that MSMEs that process circular food have better performance and adhere to the principles of the circular economy in the economic indicators outlined in Table 4.

In addition, the ratio of RSI for MSMEs that process circular food to the average RSI of respondents across various economic indicators was lower than the ratio of RSI for MSMEs that processed non-circular food to the average RSI of respondents. This shows that MSMEs that process circular food must align with circular economy principles for specific economic indicators. MSMEs can improve their overall performance by integrating circular economy principles into various economic indicators [15].

In addition, MSMEs engaged in agribusiness related to processed foods showed better performance in reducing the incidence of work accidents, consistent with findings [40] that underscored efforts to increase labor productivity. Meanwhile, MSMEs engaged in processing non-food circular products must increase labor productivity levels and reduce the incidence of work accidents to achieve higher performance.

Agribusiness MSMEs have improved efficiency and productivity by applying circular economy principles in their material management. Therefore, other agribusinesses of similar scale can adopt these best practices to improve their environmental performance. Although the RSI ignores certain variables, such as challenges related to managing production residues, MSME actors have raised specific issues related to the results of the first goal.

In today's increasingly crucial circular economy landscape, MSMEs must apply principles that can improve their social and environmental performance [41]. Although circular agribusiness MSMEs have effectively integrated circular economy principles into their material management, there are still opportunities for improvement in other areas. Therefore, agribusiness MSMEs must continue innovating and improving their methods to achieve better social and environmental

outcomes.

3.2.4 Determinants of agribusiness MSMEs in Circular economy implementation

In the initial testing stage (Block 0), the model showed significant results with a p-value of 0.000. Given that the p-value is below 0.05, we can reject the null hypothesis (H0) at a significance level of 5%. This indicates that when independent variables are used together, they will impact the implementation of the circular economy by agribusiness MSME actors. This implies that including independent variables can substantially affect the model, indicating that the model matches.

The independent variables selected for this study are based on previous studies. Corporate responsibility is represented by X1 [11], shareholder pressure by X2 [3], competitiveness by X3 [30], culture by X4 [33], and good behaviour by X5 [34]. These variables impact the perception of company owners when applying sustainability principles. Partial logistic regression was used to estimate these variables in this study. These variables were assessed using the Log Likelihood, Cox & Snell R Square, Nagelkerke R Square, and Chi-Square Hosmer and Lemeshow tests.

The results of data analysis using logistic regression are shown in Table 5. Corporate responsibility, shareholder pressure, competitiveness, culture, and good behaviour all point to a Sig Wald P value > 0.05. This indicates a rejection of H1, indicating that these variables do not significantly affect the implementation of the circular economy partially. However, the Culture variable has a Sig Wald value < 0.05, meaning H1 is accepted. This indicates that the Cultural variable contributes significantly to the partial application of circular economy principles.

Table 5. Results of variable equations in logistic regression

		B	S.E.	Wald	df	Sig	Lower	95% EXP(B)	
								Upper Limit	
Step 1*	*CORP_RESP*	.138	.155	.683	1	.401	1.327	.792	1.495
	SHARE_PRES	.303	.392	1.784	1	.363	1.363	.805	2.934
	COMPTSS	-1.083	2.762	.000	1	.877	.098	.000	.
	CULTURE	.079	.034	2.89	1	.072	.026	1	1
	GOOD_BHVR	.0024	.0052	.000	1	1	.852	.951	1.066
	Constant	-2.873	7.266	2.183	1	.263	.000		

a. Variable(s) entered on step 1: CORP_RESP, SHARE_PRES, COMPTSS, CULTURE, GOOD_BHVR

In this study, cultural variables influence the use of circular economy principles by agribusiness MSMEs. This is in line with the research [8], which shows that commitment to behaviour will be formed into a culture that significantly affects innovation.

Habits of action result from routine activities with zero innovation based on sustainability. The routine of activities in innovating is essential because these habits will become a culture of activities that the company will achieve sustainably. Waste management, of course, requires a skill that will affect business sustainability, especially environmental impacts. According to reference [42], it is stated that if the innovation routine can be managed correctly and in a way that develops businesses based on the circular economy, the culture of implementing circular economy principles can take into account the impact on the economy, society and community. Meanwhile, in calculating the costs of implementing the circular economy and considering the benefits that can be obtained, every MSME will likely use the principles of the circular economy in their business.

The competency variable of applying circular economy principles cannot affect the use of circular economy principles by agribusiness MSMEs. Acquiring competence is a requirement for the primary goal of establishing a business. The competencies obtained will be used to develop business operations and for business expansion activities through various future activities. More importantly, if the skills required to run a business are profitable, the business's survival will be guaranteed.

MSME owners must be able to make integrated plans for all activities that are or will be carried out to ensure that the culture of implementing the circular economy is maintained. However, not all MSMEs maintain it in practice because they have enough capital to run a circular economy. According to Sohal et al. [18], the culture of implementing the circular economy is essential for MSME actors to want to implement it and whether it can provide a revenue stream (additional income) for the business itself. Factors such as corporate responsibility, pressure on business owners, competitiveness, and good behaviour from applying circular economy principles cannot affect the use of circular economy principles by agribusiness MSMEs. Only MSME cultural factors can affect the use of circular economy principles by agribusiness MSMEs. Therefore, it is necessary to conduct further studies by including factors other than those studied above to find further actions to encourage agribusiness MSMEs to be more active in implementing circular economy principles and optimising potential profits from applying these principles.

4. CONCLUSION

The study recognises 14 important circular economy indicators, divided into three sustainability dimensions: economic, environmental, and social. The RSI (Resilience, Sustainability, and Inclusiveness) values of agribusiness MSMEs that apply circular economy principles show that those who follow the RSI have impacted economic, social, and environmental indicators. RSI values show that circular practices benefit business entities and stakeholders around them. The RSI indicator of MSMEs implementing the Circular Economy exceeds the national average. The culture in implementing the circular economy is the factor that influences agribusiness MSMEs to apply circular economy principles. With significant cultural improvement, adopting agribusiness MSMEs to circular economy principles will increase by around 32%.

The concept of a circular economy is becoming increasingly important in today's business world, attracting the attention of professionals and academics alike. However, there is still

room for improvement in its adoption among agribusiness MSMEs. This study introduces the RSI analysis, which improves our understanding of the circular economy in the context of agribusiness MSMEs. This study explains the relationship between circular economy factors. It offers a strategic plan for agribusiness MSMEs to harness the potential of the circular economy for the sustainability of their businesses. The information from this research is poised to advance the circular economy in the Agribusiness MSME sector significantly, promote sustainability and help businesses succeed in the ever-evolving circular economy landscape.

The RSI indicator offers a helpful starting point for agribusiness MSMEs that want to implement circular practices. The recommended implementation order aligns with the RSI model hierarchy. Recognising the impact of higher-level indicators on lower-level indicators is critical as agribusiness MSMEs move forward towards more sustainable and circular supply chain practices. The idea of a circular economy is fundamental not only for agribusiness MSMEs but also for society and the environment. Therefore, thorough research is needed to direct policymakers and MSMEs in facing the challenges and opportunities associated with the implementation of the circular economy by providing supporting facilities to support the implementation of the circular economy and identifying the obstacles experienced by MSMEs in adopting the circular economy for a more sustainable future.

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