Beyond Recycling: Embedding Circular Economy and Social Values in Urban MSMEs of Malang

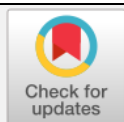## Siti Markhamah * �ID , and Budi Eko Soetjipto ID

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ABSTRACT

Growing global awareness of environmental issues has led to the increasing adoption of circular economy principles as a practical approach to building efficient and sustainable systems. In Indonesia, particularly in Malang City, micro, small, and medium enterprises (MSMEs) play a vital role in the national economy, contributing over 60% to the gross domestic product (GDP) and employing more than 97% of the workforce. This study aims to examine the relationship and influence of green technology adoption and human resource (HR) training on customer satisfaction, within the context of resource optimization through circular economy practices. Using a quantitative approach, the study surveyed 100 MSMEs selected through simple random sampling to ensure sectoral diversity and minimize sampling bias. Data were processed using Statistical Package for the Social Sciences (SPSS) software. The results indicate that HR training does not have a significant effect on customer satisfaction among MSMEs in Malang City. In contrast, the implementation of green technology and circular economy practices positively contributes to performance improvement, particularly when linked to customer satisfaction and sustainability outcomes across economic, environmental, and social dimensions.

1. Introduction

The growing global awareness of environmental challenges has brought increasing attention to circular economy practices as a viable approach for building more efficient and sustainable systems. In Indonesia, and particularly in Malang City, micro, small, and medium enterprises (MSMEs) form a critical backbone of the local economy. These enterprises function not only as economic drivers but also as agents of change in promoting sustainable business practices. MSMEs contribute over 60% to Indonesia's gross domestic product (GDP) and absorb more than 97% of the national workforce (Suhaili & Sugiharsono, 2019).

As global resource pressures intensify and the demand for environmentally responsible products rises, MSMEs must adapt to the circular economy paradigm. This approach emphasizes reducing resource use, reusing materials, and recycling waste to improve efficiency and minimize environmental impacts.

In this context, even small innovations can generate significant change. By encouraging innovation and collaboration, MSMEs have the potential to enhance their competitiveness while simultaneously contributing to social and environmental welfare. Accordingly, this study addresses not only economic dimensions but also the social and environmental responsibilities embedded in MSME practices within a circular economy framework.

Sustainable management is crucial for MSMEs not just to survive, but to thrive in a competitive and environmentally conscious market. Effective and innovative management enables more responsive resource utilization that is in line with increasing consumer environmental awareness. By adopting green technologies and implementing context-sensitive marketing strategies, MSMEs can strengthen their market positioning.

Malang City, known for its cultural richness and ecological diversity, hosts numerous MSMEs that have begun to embrace circular economy principles. Through innovations in resource management, these enterprises have been able to reduce waste and improve operational efficiency. For instance, MSMEs in the food and beverage (F&B) sector have introduced production methods that reduce waste by using locally sourced, eco-friendly materials. Similarly, craft-based MSMEs frequently incorporate recycled materials, resulting in products that are not only sustainable but also distinctive.

Table 1 presents the distribution of MSMEs across Malang City's sub-districts from 2021 to 2023.

Table 1. Number of MSMEs by Sub-district in Malang City

Sub-district	2023	2022	2021
Kedungkandang	4,402	1,069	855
Sukun	6,011	1,478	1,462
Klojen	3,850	875	868
Blimbing	5,347	1,479	1,459
Lowokwaru	9,448	3,019	2,339
Total (Malang City)	**29,058**	**7,920**	**6,983**

Source: (Badan Pusat Statistik Kota Malang, 2024)

As shown in **Table 1**, the number of MSMEs in Malang City has steadily increased from 6,983 in 2021 to 29,058 in 2023. The dominant sector among these enterprises is the food and beverage industry. This rapid growth is not incidental; proactive government policies support it. Notably, the Circular of the Mayor of Malang City No. 5 of 2021 prioritizes the use of MSME products and

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creative industry actors in public procurement through platforms such as East Java Bejo and Bela Procurement (Pemerintah Kota Malang, 2022).

The Malang City Government, through the Department of Youth, Sports, and Tourism (Dinas Kepemudaan Olahraga dan Pariwisata Kota Malang, 2023), has also provided training on digital packaging, branding, and marketing. Held in February 2023, these initiatives are intended to enhance the competitiveness of emerging entrepreneurs in the digital era. Government support and positive engagement have accelerated MSME development in the region.

Nevertheless, several challenges persist. Many MSMEs lack adequate understanding and access to technologies that support sustainable practices. Therefore, it is essential to examine how MSMEs in Malang can optimize their resources and integrate circular economy concepts more effectively.

This study aims to analyze the best practices currently implemented by MSMEs in Malang City, identify existing challenges, and propose recommendations to enhance their resilience within the broader sustainability ecosystem. A clearer understanding of how MSMEs can improve resource efficiency will contribute to the formulation of policies and development strategies that support local economic sustainability. Through collaborative engagement among government entities, businesses, and local communities, a more sustainable and competitive circular economy can be achieved.

2. Literature Review
2.1. Systems Theory

Systems theory is an analytical framework that conceptualizes an entity as a set of interrelated and interacting components. This perspective is particularly relevant in the context of micro, small, and medium enterprises (MSMEs) and circular economy actors, as it facilitates a comprehensive understanding of how government policies, business operations, and community participation collectively form an ecosystem that supports sustainability.

Central to systems theory is the notion that each element within the system has a distinct role and is interdependent with others. Effective implementation of a circular economy model within MSMEs, therefore, requires not only individual initiatives but also systemic support from the community, private sector, and government institutions. Systems theory enables researchers to analyze the dynamic relationships among various economic, social, and environmental factors that influence the success of circular economy initiatives.

Moreover, systems theory provides insights into how organizations can respond and adapt to external pressures and internal challenges. In the context of MSMEs, adaptability to sustainable practices and innovation is essential for business continuity. This theoretical lens also assists in understanding organizational decision-making, including how internal decisions can affect overall system performance and long-term outcomes.

2.2. The Concept of Circular Economy

The circular economy is an economic model that prioritizes resource efficiency and the minimization of waste. As defined by the Ellen MacArthur Foundation, it seeks to preserve materials, maintain product value, and retain resources within the economy for as long as possible, thereby significantly reducing the volume of waste generated (Ellen MacArthur Foundation, 2021). This model is particularly relevant for MSMEs, which often operate with constrained access to raw materials and limited resources.

2.3. Sustainable Management

Sustainable management refers to the practice of integrating economic, social, and environmental considerations into organizational decision-making. For MSMEs, this approach is vital for enhancing competitiveness amid global sustainability challenges. By adopting sustainable management principles, MSMEs not only improve their operational efficiency but also contribute meaningfully to community welfare and long-term resilience.

2.4. The Role of MSMEs in the Economy

In the Indonesian economy, MSMEs play a critical role in employment generation and contribute significantly to gross domestic product (GDP). In Malang City, MSMEs exhibit considerable diversity and demonstrate a strong potential for integrating circular economy practices into their operations. Therefore, understanding the unique characteristics and constraints of these enterprises is essential to advancing sustainability in the local economic landscape (Pemerintah Kota Malang, 2022).

2.5. Integration of Circular Economy and Sustainable Management

The integration of circular economy principles with sustainable management practices has the potential to generate synergies that enhance the overall well-being of MSMEs. According to Nugroho, sustainability must be embedded across the entire value chain, from sourcing raw materials to the distribution of final products (Nugroho, 2019). MSMEs that implement these integrated strategies are more likely to experience improvements in efficiency, competitiveness, and environmental performance.

2.6. Hypotheses Development
2.6.1. Hypotheses Development

Within the circular economy (CE) framework, micro, small, and medium enterprises (MSMEs) face increasing pressure to optimize resource utilization while adhering to sustainable management practices. The circular economy emphasizes waste reduction, material reuse, and the regeneration of natural systems (Ellen MacArthur Foundation, 2012). As sustainable business models evolve, the integration of green technology and human resource (HR) training has emerged as a key strategy to enhance both customer satisfaction and operational efficiency.

In the case of MSMEs in Malang City, the alignment of green technology and HR development supports more effective resource optimization, a fundamental driver of productivity and cost efficiency. Efficient management of materials, energy, and labor not only lowers operational costs but also promotes environmentally responsible production. These outcomes increasingly align with consumer preferences, as modern customers value not only the functional performance of products but also the ethical and environmental standards of their production.

MSMEs in Malang serve as essential contributors to local economic development, positioning them as ideal candidates for the adoption of circular economy principles. Research indicates that firms adopting circular practices tend to experience increased efficiency, reduced costs, and improved long-term sustainability (Geissdoerfer et al., 2017). This suggests a positive relationship in which circular economy implementation enhances resource optimization and supports sustainability outcomes for MSMEs.

Furthermore, the interaction between green technology and HR training may facilitate a synergistic effect that strengthens organizational performance. By focusing on Malang City, this study also accounts for local conditions such as infrastructure, policy environment, and the

entrepreneurial ecosystem. These factors are likely to influence the success of circular economy adoption. The proposed model thus provides a framework for identifying key enablers and barriers, and for guiding policy development that supports green innovation in resource-limited enterprises.

2.6.2. Research Hypotheses

Based on the theoretical review and the contextual background of circular economy practices among micro, small, and medium enterprises (MSMEs) in Malang City, this study formulates the following hypotheses. These hypotheses are grounded in the assumption that both green technology adoption and human resource (HR) training play a strategic role in enhancing customer satisfaction and optimizing resource use within sustainable management frameworks.

H1: The application of green technology and human resource training has a significant relationship with customer satisfaction.

H2: The application of green technology and human resource training has a significant relationship with customer satisfaction in the context of resource optimization under circular economy practices.

These hypotheses will be empirically tested using quantitative methods to assess the extent of their influence and to determine whether resource optimization mediates the relationship between organizational practices and customer satisfaction in MSMEs.

2.7. Conceptual Framework

Figure 1 illustrates the conceptual framework guiding this research. It highlights the interconnections between green technology, HR training, customer satisfaction, and the implementation of circular economy practices, with a focus on resource optimization within MSMEs in Malang City.
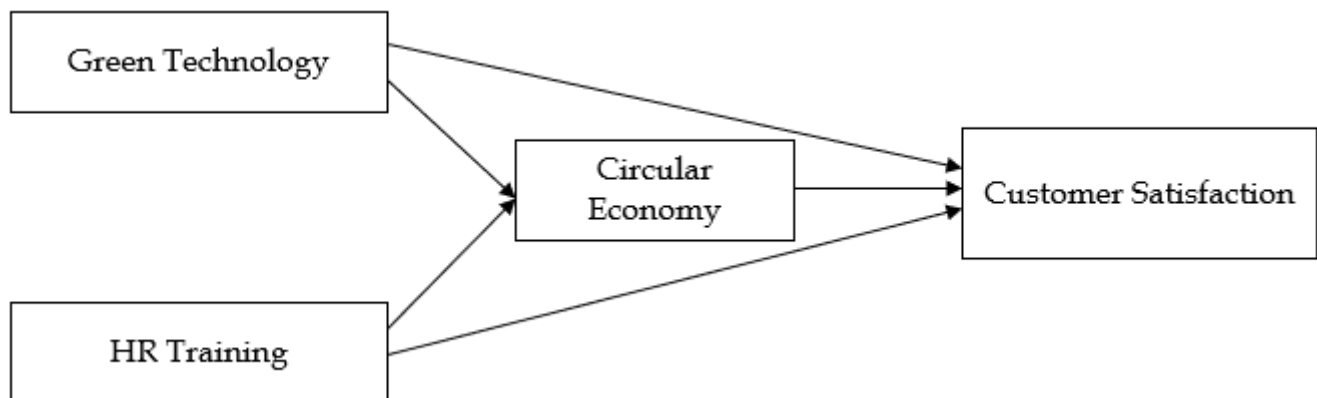
Figure 1. Conceptual Research Framework

3. Research Methodology

This study employed a quantitative research design using a survey method to investigate the understanding and implementation of circular economy principles and sustainable management among micro, small, and medium enterprises (MSMEs) in Malang City. The survey approach was selected for its effectiveness in efficiently collecting data from a large number of respondents, allowing for the analysis of patterns and trends in existing business practices.

The target population comprised all MSMEs registered with the Malang City Cooperative and Micro Enterprise Office. According to the most recent data provided by the office, 29,098 MSMEs operate across various sectors, including services, handicrafts, and food and beverage production. This population was selected due to MSMEs' strategic role in supporting the local economy and their potential to adopt circular economy practices and sustainable management approaches.

A simple random sampling technique was used to ensure unbiased selection and adequate representation of different business types and sizes. A total of 100 MSMEs were chosen from the registered population. This sampling strategy was intended to minimize selection bias and enhance the generalizability of the findings within the local context.

Data collection was carried out using structured questionnaires, and the responses were subsequently processed and analyzed using the Statistical Package for the Social Sciences (SPSS). The analysis focused on identifying relationships among variables such as green technology adoption, human resource training, customer satisfaction, and resource optimization within the framework of circular economy practices.

4. Results
4.1. Linear Regression Analysis

Table 2 presents the results of the linear regression analysis for the first model, which examines the influence of human resource (HR) training and green technology adoption on customer satisfaction among micro, small, and medium enterprises (MSMEs) in Malang City.

Table 2. Regression Results for Equation Model I

Variable	Standardized Coefficients (Beta)	Result
HR Training	-1.039E	Insignificant
Green Technology	1.724E-13	Significant
Dependent Variable**: Customer Satisfaction**		

Source: Data by Researchers (2025)

Based on the results shown in **Table 2**, the regression equation for Model I can be formulated as:

Customer Satisfaction = -1.039E × HR Training + 1.724E-13 × Green Technology + e_1

The regression coefficients indicate that HR training has a negative but statistically insignificant effect on customer satisfaction, whereas green technology shows a positive and statistically significant relationship. This finding suggests that, within the MSME context in Malang City, the current HR training initiatives may not effectively contribute to customer satisfaction. This outcome may point to deficiencies in the relevance, quality, or delivery of the training programs.

In contrast, the adoption of green technology appears to be a key factor in improving customer satisfaction. These results underscore the importance of innovation and environmentally conscious practices in meeting consumer expectations. Accordingly, MSMEs should prioritize the implementation of green technology while reassessing and enhancing their training programs to better align with customer-oriented outcomes.

Table 3 presents the results of the regression analysis for the second model, which examines the influence of HR training, green technology, and customer satisfaction on the adoption of circular economy practices.

Table 3. Regression Results for Equation Model II

Variable	Standardized Coefficients (Beta)	Result
HR Training	-3.126E-8	Insignificant
Green Technology	1.361E-12	Significant
Customer Satisfaction	9.585	Significant
Dependent Variable: **Circular Economy**		

Source: Data by Researchers (2025)

The corresponding regression equation for Model II is as follows:

Circular Economy = -3.126E-8 × HR Training + 1.361E-12 × Green Technology + 9.585 × Customer Satisfaction + e_2

This equation reveals that, although HR training again shows an insignificant effect, both green technology and customer satisfaction exhibit significant and positive influences on the implementation of circular economy practices. In this context, customer satisfaction acts as a reinforcing factor in promoting circular economy adoption. These findings suggest that MSMEs can enhance their environmental and operational performance by focusing on technological innovation and customer-oriented practices.

Additionally, while HR training does not directly influence outcomes in either model, it remains important to assess and improve training design to ensure it aligns with sustainable development goals and enhances service quality over time.

4.2. Classical Assumption Test
4.2.1. Normality Test

The normality test was conducted using the Kolmogorov–Smirnov (K–S) method to evaluate whether the residuals in the regression models were normally distributed. **Table 4** presents the results for both regression models.

Table 4. Kolmogorov–Smirnov Test Results

Regression Model	Asymp. Sig. (2-tailed)
Equation I	0.200
Equation II	0.200

Source: Data by Researchers (2025)

As shown in **Table 4**, the significance values (Asymp. Sig.) for both regression models are 0.200, which exceeds the alpha threshold of 0.05. This indicates that the residuals in both models follow a normal distribution, thus satisfying the assumption of normality required for regression analysis.

4.2.2. Multicollinearity Test

To examine the potential presence of multicollinearity among the independent variables, the variance inflation factor (VIF) was assessed. **Table 5** displays the VIF values for both regression equations.

**Table 5. Multicollinearity Test Results (VIF Values)**

Variable	Equation I	Equation II
HR Training	5.031	5.035
Green Technology	5.031	6.326
Consumer Satisfaction	,	2.173
	Dependent Variable: Consumer Satisfaction (Equation I)	**Dependent Variable**: Circular Economy (Equation II)

Source: Data by Researchers (2025)

All VIF values are well below the commonly accepted threshold of 10, indicating that multicollinearity is not a concern in either regression model. Therefore, the independence assumption among predictor variables is considered to be satisfied (Hair et al., 2019).

4.2.3. Heteroscedasticity Test

The heteroscedasticity test was conducted to assess whether the variance of the residuals is constant across levels of the independent variables. **Figure 2** shows the residual scatterplots for both regression models.

a) Model I   b) Model II
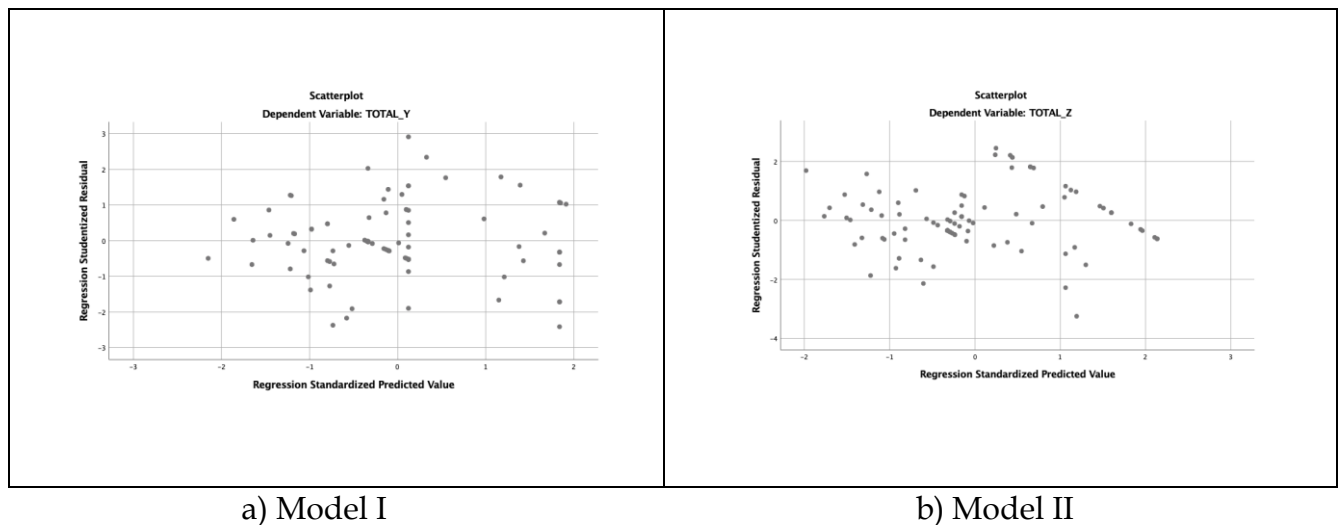
Figure 2. Residual Plots for Heteroscedasticity Test
Source: Data by Researchers (2025)

Visual inspection of the scatterplots in **Figure 2** reveals a random distribution of residuals without distinct patterns or clustering. The residuals are evenly dispersed around the horizontal axis, suggesting that heteroscedasticity is not present. Thus, the assumption of homoscedasticity is met.

4.3. Hypothesis Testing
4.3.1. Partial Test (t-test)

The partial test (t-test) was conducted to examine the significance of each independent variable in the regression models.

Table 6. Partial Test Results for Regression Model I

Variable	t	p-value	Result
HR Training	-0.270	0.788	Insignificant
Green Technology	4.971	0.000	Significant
Dependent Variable: Customer Satisfaction			

Source: Data by Researchers (2025)

As shown in **Table 6**, the HR training variable does not have a statistically significant effect on customer satisfaction, with a p-value of 0.788 (> 0.05). This indicates that H1 is not supported. Conversely, green technology has a significant positive effect on customer satisfaction, with a p-value of 0.000 (< 0.05), thereby confirming H2.

Table 7. Partial Test of Regression Model Equation II

Variable	t	p-value	Result
HR Training	0.942	0.349	Insignificant
Green Technology	2.384	0.019	Significant
Customer Satisfaction	6.190	0.000	Significant
Dependent Variable: Circular Economy			

Source: Data by Researchers (2025)

According to **Table 7**, both green technology and customer satisfaction have statistically significant effects on the circular economy variable, as their p-values are less than 0.05. In contrast, HR training remains statistically insignificant. These results further confirm the relevance of green innovation and customer satisfaction in advancing circular economy practices within MSMEs in Malang City.

4.3.2. Coefficient of Determination

The coefficient of determination (R^2) was used to assess the proportion of variance in the dependent variable explained by the independent variables in the model.

Table 8. Coefficient of Determination (R^2)

| Regression Model	R^2
Equation I	0.540
Equation II	0.726

Source: Data by Researchers (2025)

As shown in **Table 8**, the R^2 value for Equation I is 0.540, which means that 54% of the variation in customer satisfaction can be explained by green technology and HR training. In comparison, other unobserved variables influence the remaining 46%.

Meanwhile, the R² value for Equation II is 0.726. This suggests that 72.6% of the variation in circular economy practices is explained by HR training, green technology, and customer satisfaction, with the remaining 27.4% accounted for by other external factors not included in the model.

4.4. Path Analysis

Path analysis was employed to examine both direct and indirect effects of the independent variables on the circular economy variable, using customer satisfaction as a mediating factor. The resulting structural model is presented in **Figure 3**.
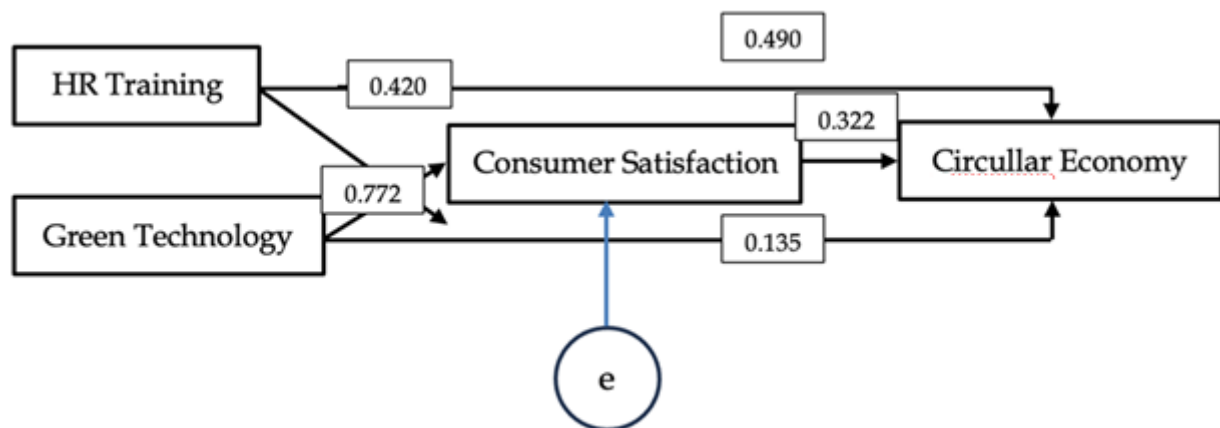
Figure 3. Path Diagram
Source: Data by Researchers (2025)

Based on **Figure 3**, HR training has a direct effect on circular economy practices with a coefficient of 0.420. However, the indirect effect, mediated by customer satisfaction, has a higher coefficient of 0.490. This indicates that customer satisfaction enhances the influence of HR training on circular economy adoption.

In contrast, green technology exhibits a stronger direct effect on the circular economy (coefficient = 0.772) compared to its indirect effect through customer satisfaction (coefficient = 0.135). This implies that customer satisfaction does not significantly mediate the relationship between green technology and circular economy implementation.

Additionally, the t-test results reinforce the findings of the path analysis. HR training does not significantly affect customer satisfaction (p = 0.788), which means H1 is not supported. Conversely, green technology significantly influences customer satisfaction (p = 0.000), providing further support for H2.

5. Discussion
5.1. The Influence of HR Training on Customer Satisfaction in MSMEs in Malang City

The initial hypothesis proposed that customer satisfaction is shaped by the quality of employee–customer interactions, which are often enhanced through consistent and targeted human resource (HR) training. In micro, small, and medium enterprises (MSMEs) in Malang City, HR training is expected to improve staff competencies, communication skills, and problem-solving abilities, factors directly linked to customer satisfaction.

Well-trained employees are better prepared to meet customer expectations, address complaints effectively, and create a positive service experience. Satisfaction is determined not only by the product or service quality but also by how customers are treated during interactions.

Employees who have received proper training are more likely to exhibit professionalism, empathy, and attentiveness, all of which enhance the customer journey.

However, the regression analysis indicates that HR training does not have a statistically significant impact on customer satisfaction ($p = .788$; $t < 1.66055$). This result suggests that H1 is not supported. Conversely, green technology demonstrates a significant positive effect on customer satisfaction ($p < .001$), highlighting the importance of environmentally responsible practices in consumer evaluations.

Although HR training did not show a direct influence, it still plays an indirect role. As noted by Armstrong and Taylor, effective HR development fosters employee engagement and motivation, which are essential for high-quality service delivery (Armstrong & Taylor, 2020). Employees who feel valued in their development are more committed to their roles, which improves service outcomes and, consequently, customer satisfaction.

Human resource management involves the strategic development of employee capabilities to achieve business objectives (Armstrong & Taylor, 2020). In the context of MSMEs, this requires adaptation to global demands through skill enhancement and the integration of technology to increase productivity. In this regard, customer satisfaction should be used as a benchmark to evaluate the effectiveness of training programs.

HR training should not be limited to technical skills but should also encompass soft skills such as communication, emotional intelligence, and responsiveness. These attributes are particularly relevant in MSMEs, where personal interactions are crucial for building customer loyalty. Research by Zeithaml et al. supports the strong link between service quality and customer satisfaction, with HR training being a critical factor in maintaining service standards (Zeithaml et al., 1996).

In addition, training programs that include the adoption of digital tools such as customer relationship management (CRM) systems and digital marketing techniques can enhance the customer experience. Radicic and Petković found that digital technology improves operational efficiency and increases customer satisfaction, suggesting that technology-focused training provides a competitive advantage (Radicic & Petković, 2023).

Training that emphasizes product innovation also contributes to employees' ability to respond to market needs. As highlighted by Kotler and Keller, product innovation is essential for satisfying consumer expectations and driving business growth (Kotler & Keller, 2022). Therefore, HR training should also address market trends and consumer insights to improve product development.

Another key factor is a strong service-oriented culture, reinforced through HR training. Employees who understand the strategic importance of customer satisfaction are more proactive and responsive. Heskett et al. demonstrated that companies investing in employee training consistently report higher customer satisfaction levels due to internalized service quality values (Heskett et al., 2010).

Despite these theoretical expectations, the empirical findings from this study suggest that HR training in MSMEs in Malang City has not yet translated into measurable improvements in customer satisfaction. This is consistent with the findings of Suwandi and Komariyah, who observed that many SME owners and employees still lack structured training and rely heavily on trial-and-error approaches, often resulting in suboptimal product quality and inconsistent service (Suwandi & Komariyah, 2023).

Kuntowicaksono, as cited in Apriliani and Adi, categorizes five traditional sources of knowledge: belief systems, authoritative testimony, sensory experience, rational thought, and

intuition (Apriliani & Adi, 2015). Many MSMEs continue to operate based on instinct or inherited practices rather than structured knowledge, which limits their capacity to innovate and adapt.

Although this study did not show a significant effect on customer satisfaction, HR training remains an essential component for achieving broader organizational goals, including the implementation of circular economy practices. In MSMEs in Malang City, training has been introduced to promote sustainable business models and improve awareness of environmental concerns.

Nevertheless, these findings contrast with those of Virmani et al., who found that HR management significantly enhances MSME operational efficiency, particularly when integrated with digital technologies (Virmani et al., 2022). This suggests that HR training in Malang may still be in its developmental phase and requires refinement in design and delivery to achieve tangible customer-oriented outcomes.

In conclusion, while HR training currently does not show a statistically significant relationship with customer satisfaction, its potential contribution remains critical. Future training initiatives should align more closely with business strategy, emphasize customer-focused values, and support digital transformation to strengthen the competitiveness and sustainability of MSMEs in Malang City.

5.2. The Effect of Green Technology on Customer Satisfaction in MSMEs in Malang City

In an era marked by heightened environmental consciousness, the adoption of green technology by micro, small, and medium enterprises (MSMEs) in Malang City has emerged as a strategic approach to improving customer satisfaction. Green technology refers to the use of environmentally friendly methods and innovations in production and resource management, aiming not only to minimize negative ecological impacts but also to align with evolving consumer expectations.

One key reason for the positive relationship between green technology and customer satisfaction is the increasing public concern over environmental issues. Consumers are progressively inclined to support products and brands that demonstrate sustainability in their production processes. Research shows that environmentally conscious consumers prefer goods from businesses that actively implement eco-friendly practices (Peattie & Crane, 2005). By adopting green technologies, MSMEs in Malang City can appeal to this segment, thereby improving customer satisfaction levels.

Furthermore, products developed using green technology are often perceived as having superior quality. For example, goods made from organic materials or through low-waste production processes are generally seen as safer and more valuable. Research supports the idea that environmentally friendly products enhance consumers' perceptions of quality, contributing to greater satisfaction (Dangelico & Pontrandolfo, 2015).

Green technology also enhances transparency and fosters consumer trust. MSMEs that communicate their sustainability practices clearly tend to establish stronger relationships with their customers. Consumers are more likely to trust brands that openly demonstrate their commitment to sustainability. Transparent environmental practices have been found to increase customer trust and satisfaction significantly (Uludag et al., 2024).

In addition to reputational benefits, green technology helps MSMEs reduce operational costs over time. Efficient resource use and waste reduction lead to lower production costs, which can enable businesses to offer more competitive pricing. These savings often translate into added value for consumers, further enhancing satisfaction. Evidence suggests that firms that implement

environmentally sustainable operations frequently experience increased efficiency and cost reduction (Zhu et al., 2005).

The findings of this study confirm that the use of green technology has a positive and significant effect on customer satisfaction among MSMEs in Malang City. This trend reflects a broader consumer shift toward prioritizing health, ethical production, and environmental sustainability in their purchasing decisions. The integration of recyclable materials, compostable waste management systems, and minimal-impact production processes addresses these values while also improving product appeal.

The adoption of circular economy principles further reinforces this relationship. Advanced waste processing techniques and resource recovery practices support environmental goals while meeting consumer demand for responsible production. These practices not only improve customer experience but also enhance brand reputation and loyalty. Research has shown that Indonesian consumers place a high value on businesses that demonstrate environmental responsibility (Judijanto et al., 2023).

Environmental sustainability is no longer a peripheral issue; it has become central to purchasing behavior across global markets. Companies that incorporate sustainability into their core operations are more likely to earn long-term consumer trust, loyalty, and satisfaction. For MSMEs in Malang City, the adoption of green technology thus serves not only environmental objectives but also provides clear competitive and relational advantages.

5.3. The Influence of Circular Economy as an Intervening Variable Between Green Technology and Customer Satisfaction in MSMEs in Malang City

Amid growing awareness of environmental sustainability and the need for business competitiveness, micro, small, and medium enterprises (MSMEs) in Malang City are increasingly adopting circular economy practices to address environmental challenges while enhancing customer satisfaction. The circular economy promotes efficient use of resources and waste minimization, principles highly relevant for MSMEs that often operate with limited capital and materials.

Green technology is a core component of the circular economy model. It includes innovations designed to reduce environmental harm through improved waste management systems, renewable energy sources, and the use of sustainable raw materials. In Malang City, many MSMEs have begun to integrate these technologies. For example, some food producers now use recyclable, biodegradable packaging to replace conventional plastic materials, reducing waste and strengthening their brand image among environmentally conscious consumers.

The relationship between circular economy practices and green technology is evident. MSMEs that adopt circular principles often find that green technologies improve resource efficiency, helping to reduce production costs. This allows businesses to offer higher-quality products at more competitive prices, which are key drivers of customer satisfaction in a value-sensitive market.

Consumer satisfaction improves when customers recognize that the products they purchase are made sustainably. Environmentally conscious consumers feel a sense of contribution when supporting businesses that reduce waste and adopt eco-friendly practices. Research indicates that consumers are more likely to remain loyal to brands that demonstrate social and environmental responsibility (Yuniarta & Purnamawati, 2024).

Several MSMEs in Malang have successfully integrated circular economy principles. For instance, some agricultural enterprises have implemented organic farming and water-saving irrigation systems, leading to improved product quality and reduced environmental impact.

Consumers who value quality and sustainability report higher satisfaction levels and are more likely to become repeat customers.

Sustainability is increasingly seen as a core regional and national development priority. Within this framework, circular economy adoption serves as a strategic pathway to strengthen MSMEs' resilience. This study highlights how circular economy integration not only sustains business operations but also generates long-term benefits for both firms and consumers.

These findings align with research by Goenadhi and Santoso, which notes that although circular practices have been widely promoted in Indonesia, especially within the handicraft sector, implementation remains inconsistent (Goenadhi & Santoso, 2023). Where circular economy principles are systematically applied, however, businesses tend to achieve better financial outcomes and consumer engagement.

The overall results of this study demonstrate that implementing circular economy practices significantly contributes to customer satisfaction among MSMEs in Malang City. By combining technological innovation and environmental stewardship, these enterprises can meet the expectations of consumers who increasingly value sustainable consumption.

The role of the circular economy as an intervening variable is particularly noteworthy. It strengthens the influence of green technology on customer satisfaction by fostering deeper alignment between production practices and consumer values. As noted by Yuniarta and Purnamawati, circular economy adoption not only reduces environmental impact but also lowers production costs and improves operational efficiency, thereby opening up new economic opportunities for MSMEs in competitive markets (Yuniarta & Purnamawati, 2024).

6. Conclusion

This study demonstrates that the integration of circular economy practices and innovation can enhance the performance of micro, small, and medium enterprises (MSMEs) in Malang City, particularly through the adoption of green technology and the strengthening of customer satisfaction. While human resource (HR) training did not show a significant direct impact on customer satisfaction, its strategic role remains relevant in promoting sustainable business practices across economic, environmental, and social dimensions.

The findings underscore the need for MSMEs in Malang City to be continuously encouraged to adopt circular economy principles and to innovate in product design and production processes. These efforts are essential for improving long-term competitiveness and ensuring sustainability. The ability to align business operations with environmental responsibility is becoming increasingly critical in markets where consumer preferences are shifting toward ethical and sustainable consumption.

However, the study's scope is limited by the sample size, which consists of only 100 respondents drawn primarily from MSMEs in the industrial, culinary, and tourism sectors. As such, the results may not fully capture the experiences and practices of MSMEs operating in other sectors within Malang City. Therefore, caution should be exercised in generalizing these findings to the broader MSME population.

The regression analysis reveals that HR training does not significantly influence customer satisfaction among MSMEs in Malang. This result appears to be shaped by consumer preferences that are more heavily oriented toward product quality and service performance. Nevertheless, HR training remains important for equipping employees with the knowledge and values necessary to support circular economy goals. Its long-term contribution may be indirect, particularly in fostering a sustainable organizational culture.

Green technology, on the other hand, demonstrates a significant positive effect on customer satisfaction. As consumer awareness around health, sustainability, and environmental protection continues to grow, green innovations help businesses meet evolving market expectations. Implementing green technology in MSMEs not only benefits the surrounding environment but also enhances product appeal, particularly through the use of recyclable and eco-friendly materials. In some cases, waste can even be processed into compost, reinforcing a circular production model.

Moreover, the study confirms that the adoption of circular economy practices significantly contributes to customer satisfaction. By combining environmentally responsible practices with technological innovation, MSMEs in Malang City are able to meet consumer expectations while also playing an active role in preserving ecological balance. These practices illustrate how the alignment of market demand with sustainable business strategies can yield mutual benefits for enterprises and society at large.

In conclusion, while HR training requires further refinement and alignment with practical business needs, the adoption of green technology and circular economy strategies presents a clear pathway for enhancing MSME performance and customer satisfaction. This research contributes to the growing body of evidence that sustainability-oriented practices are not only environmentally beneficial but also strategically advantageous for local enterprises.

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8. Declaration of Conflicting Interests

The authors have declared no potential conflicts of interest regarding this article's research, authorship, and/or publication.

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