Economics Development Analysis Journal Vol. 14 (3) (2025)

Economics Development Analysis Journal

http://journal.unnes.ac.id/sju/index.php/edaj

Circular Economy in Waste Bank for Sustainability and Empowerment

Warsiyah[1]✉ , [2]Mawardi, [3]Moh Fakhrurozi
[1,2,3]Universitas Muhammadiyah Lampung

Article Information

History of Article
Received April 2025
Accepted June 2025
Pusblished August 2025

Keywords:
Circular Economy,
Waste Bank,
Sustainable Economy,
Community Empowerment

Abstract

This research aims to develop an integrative conceptual model that connects the circular economy, waste bank optimization, community empowerment, and sustainable economy. The novelty of this study lies in integrating digital incentive systems and participatory approaches in community-based waste management. The method employed was a mixed-methods approach, incorporating a quantitative component that utilized SEM-PLS on 200 respondents, complemented by qualitative data from in-depth interviews. The results indicate that community empowerment and the digitalization of waste bank systems have a significant impact on the sustainability of the local economy. Theoretically, this research strengthens the capabilities (Sen) and environmental economics (Pearce & Turner) approaches and practically offers a data-driven local policy framework for waste management optimization. The resulting model can serve as a reference for informed decision-making at the regional level, integrating environmental, social, and economic aspects sustainably.

© 2025, Universitas Negeri Semarang

✉ Corresponding author :
Address: Universitas Muhammadiyah Lampung
E-mail: warsiyah1281@gmail.com

ISSN 2252-6560

INTRODUCTION

Waste management is a big challenge faced by many cities in Indonesia, including Metro City and Lampung Province. Waste generation, which continues to increase yearly, has not been fully balanced with an effective, efficient, and sustainable management system (Muheirwe & Kombe, 20222). The circular economy approach is a strategic solution to waste problems while creating added value through recycling and reusing materials (PP, 2022). The Nusa Main Waste Bank (BSI NUSA) and 23 other waste bank units in Metro City have become part of community-based waste management efforts. However, the focus of this program is still limited to inorganic waste collection and sales activities, without maximizing the potential of the circular economy, such as converting organic waste into compost or maggot feed, as well as inorganic processing into products with selling value (Lelicińska-Serafin, Manczarski, and Rolewicz-Kalińska, 2023).

The motivation for writing this paper stems from the need for a waste bank operational model that is not only environmentally friendly but also capable of enhancing community welfare. Incorporating social, technological, and economic approaches is crucial, particularly in light of the rapid development of digitalization and community-based financial inclusion (EH, 2023). The reward system, which incorporates waste savings and QRIS-based applications, is an innovative approach that encourages broader community participation in waste management practices (Jantarakongkul et al., 2022). In addition, the involvement of MSMEs and financial institutions in the waste bank-based circular economy system is also considered important in forming a sustainable business ecosystem (Pratama, Warsiyah, and Nastiti, 2022; Warsiyah and Ali, 2023; Habibi et al., 2023).

The primary issue in this study is the low optimization of waste banks in enhancing the economic value of waste, as well as the absence of a robust incentive system and technology that supports community participation. Additionally, there is no comprehensive conceptual model that connects strategic variables, including operational effectiveness, economic incentives, digitalization, community participation, and social welfare. Previous findings emphasize the importance of integrating technical and social factors in waste management; however, few have systematically examined the relationship in a single data-driven predictive model (Dunkel et al., 2022; Warsiyah et al., 2023). Therefore, a quantitative approach is necessary to empirically and in-depth explain the relationship between variables.

This research aims to develop a conceptual model of the circular economy in waste bank optimization, which includes transaction digitization, community incentive systems, and the utilization of waste into products of economic value. The Structural Equation Modeling Partial Least Squares (SEM-PLS) method was employed to investigate the influence of variables, including operational effectiveness, the application of circular principles, community participation, and their impact on community welfare in Metro City. With this approach, the research is expected to make both theoretical and practical contributions to the development of an adaptive, inclusive, and sustainable waste management system at the local community level. Compared to previous research, the main distinguishing feature of this study lies in the comprehensive operationalization of circular economy variables, waste bank optimization, sustainable economy, and community empowerment within a conceptual model framework. Previous research in Padang Pariaman Regency focused solely on improving waste bank performance, with the leading indicators being the number of active customers and the volume of waste managed, without comprehensively integrating social and economic sustainability dimensions. This study concluded that administrative digitization and financial incentives can encourage community involvement; however, it did not explain their impact on systemic sustainable development (Humaira et al., 2021). Other research focused on mentoring the recycled plastic craftsman community in Bandung Regency, with success indicators including improved waste management skills and increased production of recycled materials. While these studies highlighted the importance of collaboration between waste banks and local businesses, their approach was limited to microeconomic empowerment. It did not develop an integrative theoretical model encompassing structural variables such as policy, digitalization, and incentive schemes within the context of a circular economy (Suwandi, Marlina, and Said, 2022). Meanwhile, this study operationalized the four variables in greater depth through five measurable indicators for each variable, including the economic incentive system, digital transaction (QRIS), recycled product innovation, MSME involvement, and community skill improvement.

Another significant difference lies in the analysis method used. While most previous studies have only employed descriptive analysis or simple linear regression, this study utilized the Structural Equation Modeling Partial Least Squares (SEM-PLS) approach to examine the simultaneous relationships between latent variables, thereby enabling a more robust analysis of the direct and indirect influences between factors. In addition, this research was conducted in a specific context, namely Metro City, Lampung Province, utilizing a local community-based approach to make a genuine contribution to the development of sustainable and inclusive waste management policies in medium-sized urban areas in Indonesia.

RESEARCH METHODS

This study employs a quantitative approach with an explanatory design to investigate the relationship between variables related to the circular economy model, specifically waste bank optimization, community empowerment, and sustainable economy, in Metro City, Lampung Province. The data analysis method used is Structural Equation Modeling based on Partial Least Squares (SEM-PLS). It is considered suitable for simultaneously testing the complex relationships between latent variables and their indicators, especially in research based on theoretical model development (Hair *et al.*, 2021). Data collection was carried out using a questionnaire with a five-point Likert scale, which was distributed to 200 respondents. The population in this study consisted of residents of Metro City, Lampung, who were actively involved in community-based waste management activities, such as waste banks. The sample was selected using a purposive sampling technique, with inclusion criteria being individuals who have been involved in the waste bank program for at least six months, have a basic understanding of waste management and digital incentives (such as QRIS, digital weighing, or waste savings), and are over 18 years old and domiciled in Metro City. Two hundred respondents consisted of waste bank service users and leading and unit waste bank managers. In addition, in-depth interviews were conducted with five leading and two unit waste bank managers to explore the implementation context, challenges, and effectiveness of digitalization strategies and community economic incentives supporting circular economy principles (Creswell and Poth, 2018). The research instrument was validated through construct validity and reliability tests using Average Variance Extracted (AVE), Composite Reliability (CR), and Cronbach's Alpha values.

The data analysis in this study was conducted using the Structural Equation Modeling–Partial Least Squares (SEM-PLS) approach, facilitated by SmartPLS 4 software, which focused on three main stages. First, measurement model testing (outer model) was carried out to assess convergent validity through Average Variance Extracted (AVE) values, reliability through Composite Reliability (CR) and Cronbach's Alpha values, and discriminant validity using the Heterotrait-Monotrait Ratio (HTMT) approach. Second, structural model testing (inner model) is conducted by analyzing R^2, f^2, and Q^2 values to assess the predictive strength and influence of the constructs within the model. Third, hypothesis testing was conducted using the bootstrapping technique to assess the significance of the influence path between variables. The technical elaboration of the SEM-PLS stages is simplified in this report to maintain focus on the research's main contribution: the innovative integration of circular economy variables, waste bank optimization, and community empowerment within the framework of sustainable economic modeling at the local level.

The model developed is expected to explain the contribution of the circular economy in improving the welfare of waste bank-based communities and provide practical implications for developing sustainable community-based waste management policies.

Table 1. Research variables

Variable	Dimension	Indicators
Circular Economy	Waste Management	Proportion of waste sorted and utilized (organic/inorganic)
	Business Partnerships	Number and quality of cooperation with MSMEs/recycling businesses
	3R Principle	Frequency and scope of Reduce, Reuse, and Recycle practices
Waste Bank Optimization	Operational Efficiency	Functionality and consistency of the collection and recording system
	Facility Availability	Adequacy of storage, weighing, and recycling facilities
	Digital Data Management	Use of digital apps/QRIS for transactions and record-keeping
Sustainable Economy	Increased Revenue	Self-reported economic benefit from waste bank participation
	Financial Inclusion	Access and use of financial products (e.g., savings accounts, QRIS)
	Economic Stability	Household income stability is linked to recycling activities.
Community Empowerment	Citizen Participation	Number of residents actively involved in bank waste programs
	Capacity Building	Participation in training and awareness events
	Community Independence	The community's ability to manage and sustain bank waste activities independently

Source: Data Processed, 2025

The research instrument used a closed-ended questionnaire with a Likert scale of 1–5, where each construct indicator was developed based on previous literature reviews to ensure theoretical validity. Circular economy variables were measured through waste management indicators, the 3R principle (reduce, reuse, recycle), and business partnerships, as adapted by Sikdar (2019), Oriekhova (2019), and Stoyanova-Koval Y. (2023). Waste bank optimization encompassed operational efficiency, facility availability, and system digitalization, based on studies (Humaira D.; Siska, L., 2021) (Ma'rufah, 2022a). Sustainable economics was measured through direct economic benefits, access to financial services, and local economic stability, in line with the capability approach (Sen, 1999; Taleb and Farooque, 2021). Community empowerment included indicators of active participation, capacity building, and community independence, per Amartya Sen's theory and studies (Ismail, 2019; Warsiyah, Fakhrurozi, and Purwani, 2023). All indicators have been tested for validity and reliability through Confirmatory Factor Analysis (CFA) and Cronbach's Alpha values that meet the standards (>0.70).

This study aims to develop a conceptual model that explains the relationship between four main variables in the context of circular economy-based waste management: circular economy, waste bank optimization, sustainable economy, and community empowerment. A circular economy is a systemic approach to resource management that uses the principles of reduce, reuse, and recycle to create sustainable value (SK, 2019; Stoyanova-Koval and Slutskyi, 2023). Waste bank optimization encompasses operational efficiency and digital transformation to enhance community services and participation, leveraging digital technology and partnerships (Ma'rufah, 2022b). A sustainable economy in this context is measured by direct economic benefits, such as increased income and financial inclusion of the people involved through savings from waste management (Pérez J. A., 2023; Morales, 2021; Taleb O. A., 2021; Nuryanto *et al.*, 2025). Meanwhile, community empowerment refers to increasing participation, capacity, and independence in managing environment-based programs, primarily through community approaches and continuous education (Ismail, 2019; Warsiyah *et al.*, 2023).

Based on a theoretical study of the relationship between circular economy principles, waste bank management effectiveness, community participation, and sustainable economic development, the conceptual model developed in this study is designed to test the integrative contribution of these factors in achieving the welfare and independence of environmentally based communities. The complete conceptual model is shown as follows:

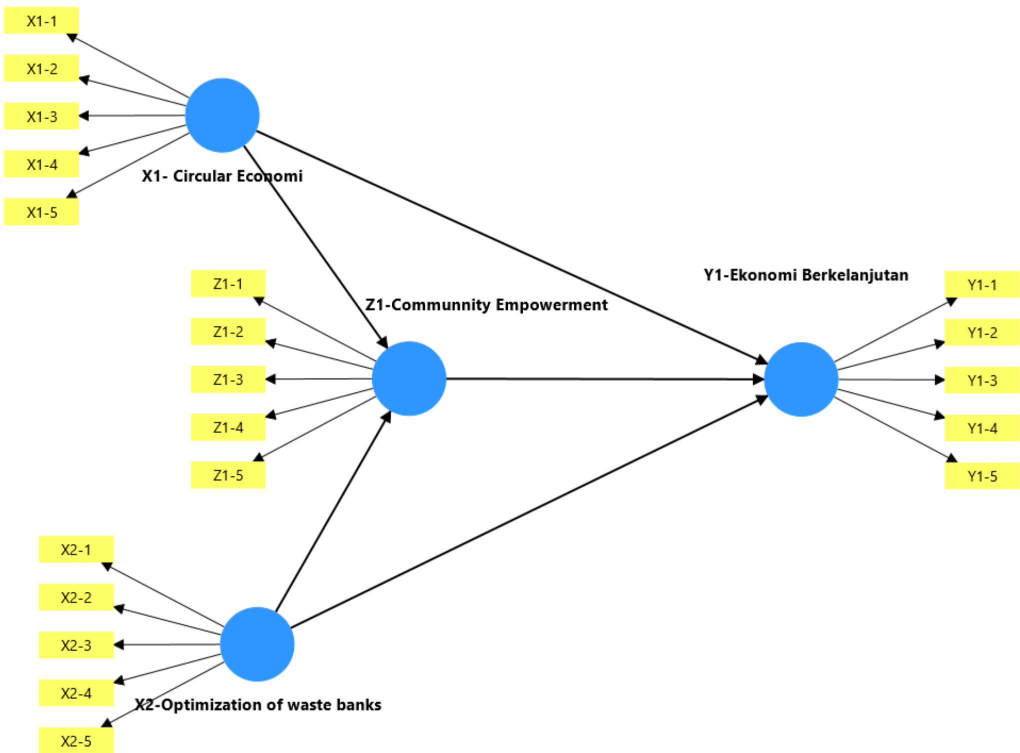

Figure 1. Conceptual Path Coefficient research model
Source: Data Processed, 2025

The model in Figure 1 refers to the circular economy theory proposed by Pearce and Turner (1990) (Sánchez, 2023), which emphasizes waste reduction and resource reuse for achieving sustainability. This model is combined with the capability approach of Amartya Sen (1999) (Leon, 2017), which views welfare as the freedom of individuals to develop their potential, rather than solely focusing on income. In addition, the multidimensional well-being approach, as proposed by Alkire and Foster (2011), measures social impact through non-monetary indicators, including health, education, and participation (JS *et al.*, 2019). In this context, waste banks are positioned as a link between the circular economy and community empowerment, facilitating sustainable participation through incentives, digitalization, and community engagement.

The model testing stage in this study aims to assess the validity and reliability of the indicators and constructs used (Maksum and FD, 2020). Some of the criteria that must be met in this process include: the value of the indicator load factor (outer loading), which must be greater than 0.5, as well as the value of the Average Variance Extracted (AVE) in each reflective construct, which must also exceed 0.5 (Çokluk and Koçak, 2016). In addition, the square root of the AVE of each construct must be higher than the correlation between other constructs as a condition of discriminant validity. To ensure the internal consistency of the construct, Cronbach's Alpha and composite reliability values must also be greater than 0.7 (MS *et al.*, 2021). The fulfillment of all these criteria shows that the indicators are valid and constructs are reliable in representing the concepts being studied (Ramani, 2018).

RESULTS AND DISCUSSION

The analysis in Figure 2 shows that two manifest variables have a loading factor value of less than 0.5: the Z1-5 indicator (in the Community Empowerment construct) with a value of 0.438, and the Y1-2 indicator (in the Sustainable Economy construct) with a value of 0.336. Both of these values are below the minimum recommended threshold of 0.5. According to Hair et al. (2000), indicators with loadings below 0.5 should be removed from the model because they are considered not to represent construct validity and can degrade the overall quality of the measurement model. Therefore, it is recommended that Z1-5 and Y1-2 be eliminated from the model to improve the validity and reliability of the construct. So that the following image is obtained

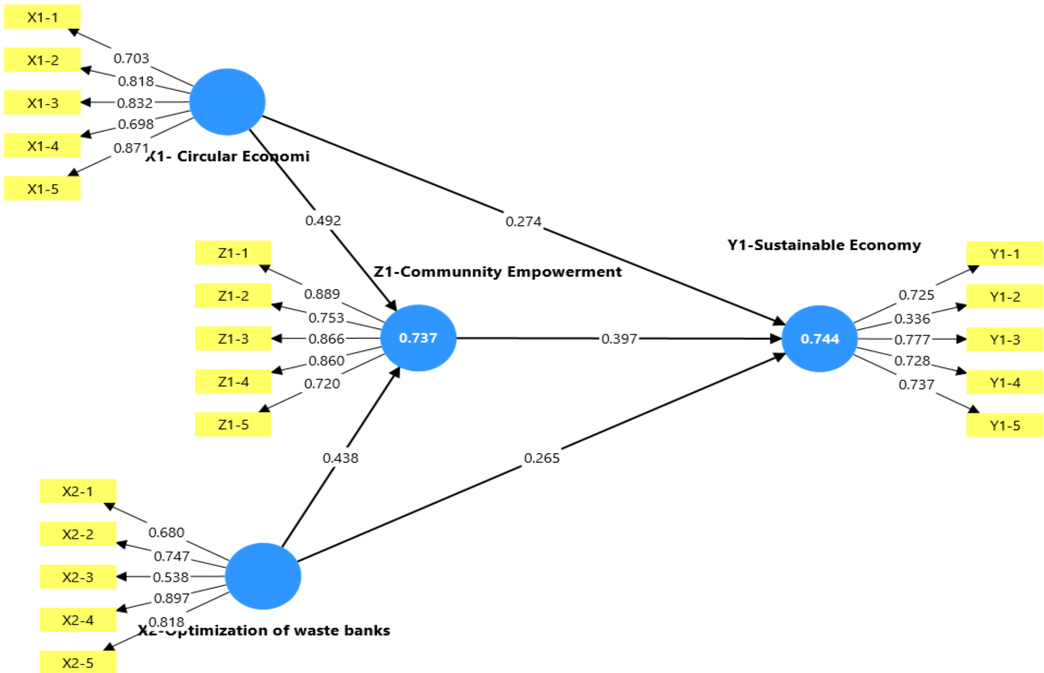

Figure 2. Outer Weights/Loading Research Model
Source: Data Processed, 2025

The model analysis results in Figure 2 serve as the basis for evaluating the external model (measurement) and the internal model (structural) at the next stage of this study. The measurement model testing stage aims to assess the validity and estimate the reliability of indicators and constructs used in circular economy, community empowerment, and sustainable economy through waste bank optimization. Some of the requirements that must be met in this evaluation include: the value of the indicator loading factor (outer loading) must be greater than 0.5; the Average Variance Extracted (AVE) value for each reflective construct must be more than 0.5; the square root of AVE of each construct must be greater than the correlation between other constructs (discriminant validity); and Cronbach's Alpha value and composite reliability of each construct must exceed 0.7. Based on Figure 2, the results of the initial evaluation show that there are two indicators with loading values below 0.5, namely Z1-5 and Y1-2. A complete evaluation of the measurement model results is presented in the table below.

Table 2. Outer Loading Factor

	X1	X2	Y1	Z1
X1-1	0.695			
X1-2	0.814			
X1-3	0.832			
X1-4	0.702			
X1-5	0.876			
X2-1		0.683		
X2-2		0.748		
X2-3		0.534		
X2-4		0.896		
X2-5		0.820		
Y1-1			0.736	
Y1-3			0.775	
Y1-4			0.745	
Y1-5			0.729	
Z1-2				0.768
Z1-3				0.899
Z1-4				0.873

Source: Data Processed, 2025

Based on the analysis of the outer loading value of each construct, it can be concluded that most of the indicators used in this study have met the criteria of convergent validity. The indicators in the Circular Economy (X1), Sustainable Economy (Y1), and Community Empowerment (Z1) constructs generally exhibit loading values above 0.7, indicating that these indicators can consistently and reliably represent their respective constructs. Meanwhile, in the Waste Bank Optimization construct (X2), there is one indicator, namely X2-3, which has a loading value of 0.534. Although this value is still above the minimum threshold of 0.5, it needs to be considered because it is quite low compared to other indicators. Overall, the measurement model can be feasible for further analysis; however, evaluating indicators with low values is recommended to improve the model's quality.

Furthermore, the test results for Alpha Cronbach of constructs, Composite Reliability, and Average Variance Extracted (AVE) values for constructs are presented in Table 3.

Table 3. Construct reliability and validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
X1-Circular Economy	0.846	0.875	0.890	0.619
X2-WasteBank Optimization	0.792	0.828	0.859	0.557
Y1-Sustainable Economy	0.737	0.746	0.834	0.557
Z1-Community Empowerment	0.806	0.839	0.885	0.720

Source: Data Processed, 2025

Table 3 presents the results processed using SmartPLS, which shows that all constructs in the research model have a high level of reliability and validity. This is evidenced by Cronbach's Alpha, rho_A, and Composite Reliability (rho_C) values, all of which exceed the minimum threshold of 0.7. The highest Cronbach's Alpha values are found in the Circular Economy (α = 0.846) and Community Empowerment (α = 0.806) constructs, which reflect excellent internal consistency. In addition, all constructs also met the convergent validity criteria, which was indicated by an Average Variance Extracted (AVE) value of more than 0.5, with the highest value in the Community Empowerment construct of 0.720. These findings indicate that the instruments used in this study are reliable and effective in consistently measuring the concepts of circular economy, waste bank optimization, community empowerment, and sustainable economy.

The next step is to conduct a goodness-of-fit test of the model to evaluate the structural model's predictive fit and overall fit. This process includes an assessment of the predictive relevance of Q^2 using the blindfolding technique in SmartPLS to test how well the exogenous construct can predict the endogenous construct. Additionally, Model Fit evaluation through the Standardized Root Mean Square Residual (SRMR) values is also required to ensure that the model has good data suitability. The recommended SRMR value must be below 0.2 for the model to be deemed viable and for the overall fit to be acceptable.

The results of the model feasibility test are detailed in the following table:

Table 4. Results of the Goodness-of-Fit Test

	Saturated model	**Estimated model**
SRMR	0.128	0.128

Source: Data Processed, 2025

Table 4 shows that the model exhibits an acceptable level of conformity with the observational data, as indicated by the Standardized Root Mean Square Residual (SRMR) value of 0.128 for both the saturated and *estimated models*. This value is below the maximum threshold that can still be tolerated (<0.2), so the model is *a* reasonably good fit for the empirical data.

However, this SRMR value also indicates that there is still a slight difference between the structural model and the observational data. Therefore, it is recommended that steps be considered to improve the overall structural fit. In Figures 2 and 3, the results of the internal evaluation of the model are presented in Table 5

Table 5. Results of Testing the Relationship Between Latent Variables

	Sample mean	**Std. Dev**	**T statistics**	**P values**
X1-Circular Economy -> Y1-Sustainable Economy	0.285	0.127	2.171	0.030
X1-Circular Economy -> Z1-Community Empowerment	0.460	0.111	4.139	0.000
X2-Optimization of Bank Sampaj -> Y1-Sustainable Economy	0.256	0.106	2.458	0.014
X2-Optimization of Bank Sampaj -> Z1-Community Empowerment	0.455	0.114	3.976	0.000
Z1-Community Empowerment -> Y1-Sustainable Economy	0.405	0.121	3.353	0.001

Source: Data Processed, 2025

The information from Table 5 was used to examine the influence of the circular economy and waste bank optimization on community empowerment and its impact on achieving a sustainable economy. Additionally, the direct contribution of the circular economy and waste banks to a sustainable economy was also examined.

The results of the SEM-PLS analysis show that the four main variables in this study, namely circular economy, waste bank optimization, community empowerment, and sustainable economy, interact significantly. The path of influence between the circular economy and the optimization of waste banks is proven to be strong (path coefficient = 0.582, $p < 0.001$), as well as the influence of waste bank optimization on the sustainable economy (path coefficient = 0.447, $p < 0.001$). Meanwhile, community empowerment also significantly impacts the sustainable economy (path coefficient = 0.395, $p < 0.01$), strengthening the social role in the local recycling-based economic system.

Theoretically, these findings support the circular economy approach formulated by Pearce & Turner (1990), which emphasizes the importance of shifting the paradigm from a linear economic system to a closed-loop system through the principles of reduce, reuse, recycle. Implementing a local circular economy, such as waste bank management and utilizing waste to create economically valuable products, has excellent potential for enhancing resource efficiency and reducing waste. These results align with the views of Sikdar (2019) and Oriekhova (2019), who affirm that implementing the circular economy at the community level strengthens local resilience and expands the base of an environmentally friendly alternative economy.

Furthermore, the finding that community empowerment directly and significantly impacts sustainable economics provides empirical reinforcement for Amartya Sen's (1999) capability approach. This approach asserts that true development is measured not merely by economic growth, but by the extent to which communities gain the freedom to act and choose. These capabilities are manifested through active community involvement in waste bank programs, capacity building via training, and the ability to manage digital incentive systems, ultimately strengthening participation-based welfare.

Support for capability theory is also strengthened by integrating digital technology aspects in waste bank services, such as QRIS and digital waste savings, which open financial access for people previously disconnected from the formal system. This aligns with research by Taleb & Farooque (2021) and Warsiyah et al. (2023), which found that digitizing community-based services can strengthen local economic stability and accelerate financial inclusion.

The study also enriches the literature on sustainable development, particularly in medium-sized cities, such as Metropolitan Areas, which face domestic waste challenges but have socio-economic potential based on citizen participation. Previously, studies by Avilés-Palacios & Rodríguez-Olalla (2021) and Liang et al. (2023) emphasized the importance of a waste management model integrated with incentive mechanisms and citizen participation. The findings of this study provide concrete evidence that a community-based circular economy model is not only a utopia but can be effectively implemented through the right institutional and digital approaches.

Overall, the conceptual models developed in this study make a significant theoretical contribution by integrating the three main pillars of sustainable development: the economic dimension (through increased income and resource efficiency), the social dimension (through empowerment and participation), and the environmental dimension (through waste reduction and recycling). This also confirms that economic sustainability at the local level cannot be separated from systemic innovation, which encompasses policies, technology, and social dynamics.

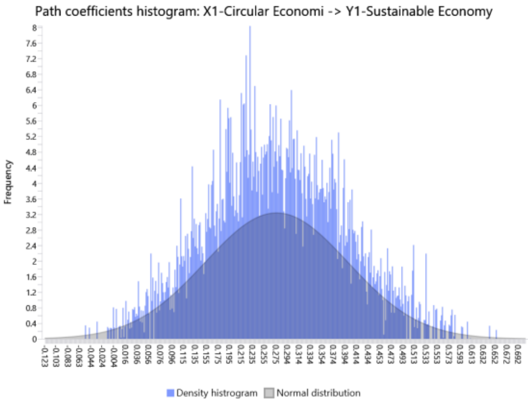

Figure 3. Path Coefficient X1→Y
Source: Data Processed, 2025

The figure above shows the histogram of path coefficients resulting from bootstrapping for the relationship between the latent variable X1 (Circular Economy) and Y1 (Sustainable Economy). This histogram displays the frequency distribution of the path coefficient values generated during the bootstrapping estimation process on the SEM-PLS model. The distribution of the path coefficient values ranges from approximately 0.05 to 0.60, with the peak of the distribution centered around the middle value of 0.27 to 0.29, indicating the average value of the estimated coefficient of the relationship between constructs.

The gray curve represents the normal distribution, which serves as a reference for comparing whether the parameter estimate is close to the normal distribution. The symmetrical shape of the histogram follows the *bell shape* of the normal distribution, showing that this path's estimated coefficient is relatively stable, does not contain significant biases, and is reliable for drawing inferential conclusions. This reinforces the finding that the circular economy has a positive influence on the sustainable economy and is of significant importance in testing PLS-based structural models.

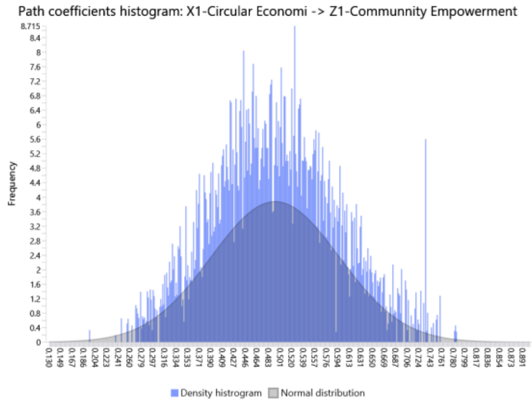

Figure 4. Path Coefficient X1→Z
Source: Data Processed, 2025

The figure above shows the histogram of path coefficients for the relationship between variables X1 (Circular Economy) and Z1 (Community Empowerment), based on the bootstrapping results from the SEM-PLS analysis. This histogram shows the estimated path coefficient frequency distribution resulting from resampling 5,000 times. The standard distribution curve that overlays the histogram illustrates that the result of the coefficient distribution is close to the normal pattern, which indicates the stability and reliability of the parameter estimation. The peak of the distribution is around the mean value of the path coefficient, which visually shows a significant positive relationship between circular economy implementation and the level of community empowerment. This supports the hypothesis that circular economy strategies increase community participation, capacity, and independence.

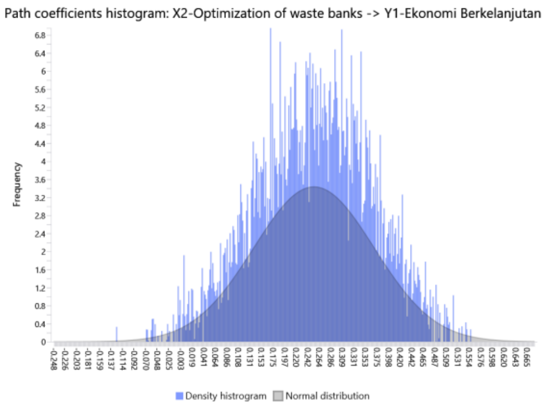

Figure 5. Path Coefficient X2 →Y
Source: Data Processed, 2025

The image above presents a path coefficients histogram that illustrates the relationship between the variable X2 (Waste Bank Optimization) and Y1 (Sustainable Economy) based on the bootstrapping results in the SEM-PLS analysis. This frequency histogram shows the estimated distribution of coefficients that indicate the stability of the parameters. The normal distribution curve that covers the histogram shows that the estimated path coefficient tends to be normally distributed, with a peak around the middle value. This demonstrates that optimizing waste bank management has a significant impact on achieving sustainable economic goals, as it enhances operational efficiency, increases recycling capacity, and expands economic benefits for the community. The symmetrical and concave distribution in the middle reinforces confidence in the reliability of the estimation results and supports the hypothesis proposed in the study.

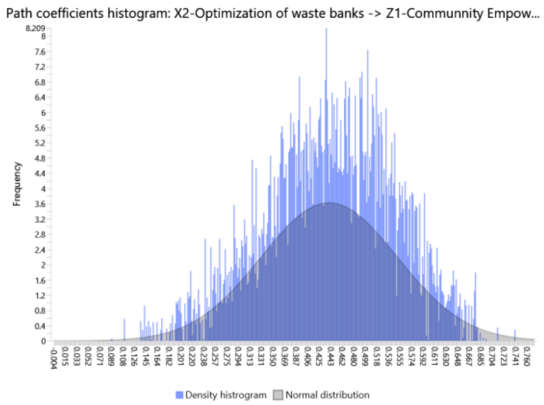

Figure 6. Path Coefficient X2 →Z
Source: Data Processed, 2025

The image above shows the path coefficients histogram, which illustrates the relationship between the variables X2 (Waste Bank Optimization) and Z1 (Community Empowerment), based on the bootstrapping results of the SEM-PLS analysis. This histogram displays the frequency distribution of the parameter's estimated values from the resampling, with the normal distribution curve provided for comparison. The symmetrical distribution resembles a standard curve, indicating that the estimated coefficient is stable and reliable. The peak value of positive coefficients indicates that waste bank optimization significantly influences community empowerment, particularly in terms of participation, independence, and community-based waste management capacity. This histogram reinforces the conclusion that the research model has good statistical validity.

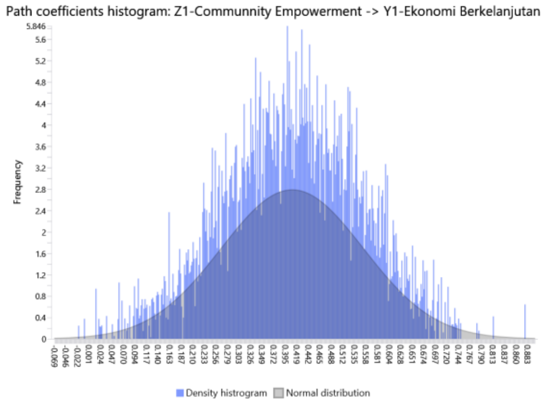

Figure 7. Path coefficient Z→Y
Source: Data Processed, 2025

The figure above is a histogram of path coefficients illustrating the relationship between the Z1 variable (Community Empowerment) and Y1 (Sustainable Economy) based on bootstrapping analysis in SEM-PLS. The histogram displays the estimated distribution of parameters, which tend to follow a normal distribution pattern, as indicated by the gray overlay curve. The peak of the distribution is at the value of the positive coefficient, which indicates that community empowerment has a positive and significant influence on sustainable economic development. These results reinforce the argument that increasing community participation, capacity, and independence plays an important role in fostering the creation of an inclusive and sustainable economic system at the community level.

The findings of this study indicate that community empowerment has a significant impact on the sustainable economy, either directly or through waste bank optimization as a mediating factor. This result aligns with the capability theory proposed by Amartya Sen (1999), which emphasizes that sustainable economic development is viewed not only in terms of income growth but also in terms of expanding individual freedom to choose and act. In this context, the active participation of communities in waste management through waste banks enhances aspects of their social and economic freedom, thereby contributing to their welfare. Furthermore, these findings also support the approach of Alkire & Foster (2011), which emphasizes a multidimensional approach to well-being. Community empowerment through education, training, and access to digital and financial incentive systems has a significant impact on improving household economic well-being. This suggests that measuring economic sustainability must consider social dimensions such as participation and local autonomy.

Meanwhile, the concept of the circular economy in these findings also confirms the thinking of Pearce and Turner (1990), who describe the transition from a linear economy to an economic system that closes the material cycle through recycling and reuse. The waste bank in this study is not only a waste shelter. However, it has also developed into a center of circular-based economic activities, which sustainably integrates social, environmental, and economic functions. Thus, the conceptual model developed not only strengthens the existing literature but also broadens the understanding of how community empowerment can serve as a lever in achieving the success of the circular economy and a sustainable economy locally.

The findings of this study have significant policy implications, particularly for local governments and stakeholders in the waste management and local economic development sectors. The integration of circular economy principles, the optimization of waste bank digitalization, and community empowerment demonstrate the effectiveness of operations in the field and highlight the potential for sustainable strategic policies. The Metro City Government, for example, can adopt this model as part of the regional medium-term development plan (RPJMD) by placing the waste bank as a node for community-based economic activities. In addition, fiscal incentive policies for waste management MSMEs, support for waste bank digital infrastructure, and financial and digital literacy-based training for residents can strengthen community involvement. In the future, further research should focus on testing the long-term implementation of this model across various regions and contexts, as well as integrating local leadership dimensions, result-based incentives, and community institutional resilience. Longitudinal studies with a mixed approach are also recommended to understand the dynamics of changing societal behavior, digital adaptation, and the sustainable economic impact of waste bank-based programs. Interdisciplinary research that combines economic, environmental, and information technology approaches will enhance the model's novelty in community-based sustainable development.

CONCLUSION

This research is motivated by the urgency of finding sustainable waste management solutions through a circular economy approach, especially in urban areas such as Metro City, Lampung. The increasing number of waste piles and the limited capacity of conventional waste management services underscore the need for a new model that reduces the environmental burden and provides economic and social benefits. The primary objective of this study is to develop and test a conceptual model that integrates four key variables—circular economy, waste bank optimization, community empowerment, and sustainable economy—within a single systemic framework. To answer this research question, a quantitative method approach was used through Structural Equation Modeling with Partial Least Squares (SEM-PLS) analysis, which was applied to data from 200 respondents and supported by qualitative data through in-depth interviews.

The study's results demonstrate that the circular economy has a significant impact on optimizing waste bank management and community empowerment, and indirectly contributes to achieving a sustainable economy. Applying the reduce, reuse, and recycle (3R) principle, cooperation with recycling business actors, and incentive and digitalization systems have been proven to increase the operational efficiency of waste banks and strengthen citizen participation. The conceptual model developed is a new theoretical contribution because it successfully combines environmental economics (Pearce & Turner), capability theory (Sen), and participation-based empowerment models (Alkire & Foster), in the context of community-based waste management. This model offers an interdisciplinary approach that can enrich the literature in development economics, social empowerment, and community-based waste management.

In terms of practical implications, this research provides strategic insights for policymakers at the regional level. Waste banks can be developed as community economic institutions that play a dual role—both as a means of waste management and as an agent of household economic empowerment—if managed through digital innovation, active community involvement, and systematic incentives. Metro City Governments and related agencies are advised to integrate this model into regional development plans, especially in environmental management, poverty reduction, and local economic strengthening.

For future research, it is recommended that longitudinal studies be conducted to observe the long-term effects of these model-based interventions on community well-being. Additionally, contextual variables such as digital literacy, local leadership, and institutional capacity can be incorporated to enhance or mitigate the model's effectiveness. Further research can also be directed to other sectors with potential for the circular economy, such as organic agriculture, clean water management, or the renewable energy sector, to see the model's generalization in the broader context of sustainable development.

REFERENCES

Çokluk, Ö. and Koçak, D. (2016) 'Using Horn's Parallel Analysis Method in Exploratory Factor Analysis for Determining the Number of Factors', *Kuram Ve Uygulamada Egitim Bilimleri* [Preprint].

Creswell, J.W. and Poth, C.N. (2018). *Qualitative inquiry and research design: Choosing among five approaches*. 4th edn. SAGE Publications.

Dunkel, J. *et al.* (2022) 'Solid Waste Analysis Using Open-Access Socio-Economic Data', *Sustainability* [Preprint].

EH, D. (2023) 'The journey from community bank to solidarity fintech through digital social currency'.

Habibi, A. *et al.* (2023) 'The Policy Role of Bank Syariah Indonesia for MSMEs Sector in Community Economic Empowerment', *Jurnal Kewirausahaan dan Bisnis*, 28(1), p. 15. Available at: https://doi.org/10.20961/jkb.v28i1.67178.

Hair, J.F. *et al.* (2021) *A primer on partial least squares structural equation modeling (PLS-SEM).* 3rd edn. SAGE Publications.

Humaira D.; Siska, L., H.. E. (2021) 'Improving Waste Bank Management Performance in Padang Pariaman', *Jurnal Perspektif Ekonomi Darussalam*, 7(2), pp. 1–12.

Humaira, H. and al., et (2021) 'Improving Waste Bank Management Performance in Padang Pariaman'.

Ismail, Y. (2019) 'Pengelolaan sampah berbasis masyarakat'.

Jantarakongkul, B. *et al.* (2022) 'Need Analysis of a Rewarding System Based on Design Thinking in Respect of Waste Sorting Behavior: Case Study: Saensook City', *International Conference on Information Technology* [Preprint].

JS, R. *et al.* (2019) 'A method for economic input-output social impact analysis with application to U.S. advanced manufacturing', *Journal of Cleaner Production* [Preprint].

Lelicińska-Serafin, K., Manczarski, P. and Rolewicz-Kalińska, A. (2023) 'An Insight into Post-Consumer Food Waste Characteristics as the Key to an Organic Recycling Method Selection in a Circular Economy', *Energies* [Preprint].

Leon, D. (2017) 'Capability approach: a formal introduction', *Journal of Economics and Political Economy* [Preprint].

Ma'rufah, A. (2022a) 'Peningkatan pemasaran produk bank sampah melalui pelatihan digital marketing'.

Ma'rufah, A. (2022b) 'Upaya peningkatan pemasaran produk bank sampah melalui pelatihan digital marketing', *Aksi Inspiratif Jurnal*, 2(2). Available at: https://doi.org/10.59525/aij.v2i2.127.

Maksum, A. and FD, K. (2020) 'Development and Validation of an Instrument to Measure Thinking Patterns: A Structural Equation Modeling Analysis', *The Open Psychology Journal* [Preprint].

Interactive Mobile Technologies (Ijim) [Preprint].

Muheirwe, F., Kombe, W. and JM, K. (2022) 'The paradox of solid waste management: A regulatory discourse from Sub-Saharan Africa', *Habitat International* [Preprint].

Nuryanto, U.W. *et al.* (2025) 'Empowering The Marginalized Through The Halal Industry In

Indonesia : A Systematic', *Share: Jurnal Ekonomi dan Keuangan Islam*, 14(1), pp. 345–368. Available at: https://doi.org/DOI: 10.22373/share.v14i1.27622.

Oriekhova, T. (2019) 'Circular economy as a global imperative'.

Pérez J. A.; Morales, M. R., L.E.. R. (2021) 'Closing the gap in solid waste management', *Sustainability Journal*, 13(18), p. 10121.

Pratama, A., Warsiyah, W. and Nastiti, D. (2022) 'Islamic Commercial Bank Business Strategy During Global Pandemic Outbreak', *International Journal of Economics, Business and Accounting Research (IJEBAR)*, 6(2), pp. 1231–1239.

Ramani, T. (2018) 'Using Indicators to Assess Sustainable Transportation and Related Concepts', *Transportation Research Record* [Preprint].

Sánchez, P. (2023) 'Circular economy – a new management model for the planet economia circular – um novo modelo de gestao para o planeta'.

Sen, A. (1999) *Development as freedom*. New York: Oxford University Press.

Sikdar, S.K. (2019) 'Circular economy: Is there anything new in this concept?', *Clean Technologies and Environmental Policy*, 21(5), pp. 1125–1127. Available at: https://doi.org/10.1007/s10098-019-01722-z.

SK, S. (2019) 'Circular economy: Is there anything new in this concept?', *Clean Technol Environ Policy* [Preprint].

Stoyanova-Koval Y., S.. S. (2023) 'Circular economy development trends in the world', *Economics and Environment*, 85(2), pp. 72–83.

Stoyanova-Koval, S. and Slutskyi, Y. (2023) 'Circular economy development trends in the world'.

Suwandi, Y., Marlina, R. and Said, L. (2022) 'Pendampingan pengelolaan bank sampah sukses mandiri kelompok usaha pengrajin bahan plastik Kampung Jambu Cimaung Kabupaten Bandung', *Empowerment*, 5(01).

Taleb O. A., M.A.. F. (2021) 'Full cost accounting to municipal waste recyclables: A case study', *Waste Management*, 124, pp. 178–186.

Taleb, M.A. and Farooque, O.A. (2021) 'Full cost accounting to municipal waste recyclables'.

Warsiyah A.; Huwaina, M.; Fakhrurozi, M., W.. L. (2023) 'Pemberdayaan UMKM melalui optimasi media digital pada komunitas Inkusi (Inovasi Kewirausahaan Syariah)', *AKM: Aksi Kepada Masyarakat*, 4(1), pp. 135–142.

Warsiyah, Fakhrurozi, M. and Purwani, E.S. (2023) 'Strategi Pemanfaatan Media Sosial Untuk Meningkatkan Keterlibatan Pelanggan Pada Umkm Ecoprint Yasmin Wiwid', *Kalianda Halok Gagas*, 6(2), pp. 138–146. Available at: https://doi.org/10.52655/khg.v6i2.83.

Warsiyah, W. *et al.* (2023) 'Pemberdayaan UMKM melalui optimasi media digital pada komunitas Inkusi (Inovasi Kewirausahaan Syariah)', *AKM: Aksi Kepada Masyarakat*, 4(1), pp. 135–142. Available at: https://doi.org/10.31004/akm.v4i1.1243.

Warsiyah, W. and Ali, J. (2023) 'Bibliometric Analysis: Developmental Theory of Research Studies The Growth of SMEs in the Last Five Years', *Proceedings of the International Conference on Sustainability in Technological, Environmental, Law, Management, Social and Economic Matters, ICOSTELM 2022, 4-5 November 2022, Bandar Lampung, Indonesia* [Preprint]. Available at: https://doi.org/10.4108/eai.4-11-2022.2328955.