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A Circular Economy Model for ESG-Driven Sustainable Management Practices: Lessons from Community-Based Irrigation Waste Management

Masduki Masduki[1*], Moch. Febri Sayidil Umam[2], Alan Rusdiana[3], Anisa Nurul Hidayah[4]
Univeritas Majalengka, Majalengka, Indonesia[1,2,3,4]
masdukimsi67@unma.ac.id[1*], mochamad_febri@unma.ac.id[2], alanrusdiana123@unma.ac.id[3], anisanurulh12@gmail.com[4]

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Abstract
Purpose: This study examines the role of circular economy implementation in fostering Environmental, Social, and Governance (ESG)-oriented sustainable management practices within community-based irrigation waste management in Indonesia.
Research Methodology: A quantitative approach was employed using survey data collected from community members involved in irrigation-waste management activities. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) with SmartPLS software to evaluate the relationships among circular economy practices, ESG dimensions, and sustainable management practices.
Results: The findings indicate that the implementation of a circular economy positively and significantly influences ESG performance and sustainable management practices. In addition, ESG dimensions significantly mediate the relationship between circular economy practices and sustainable management outcomes, demonstrating that ESG strengthens the effectiveness of circular economy implementation at the community level.
Conclusions: Integrating circular economy principles with ESG frameworks effectively supports sustainable community-based environmental management practices. ESG serves as an evaluation framework and a strategic mechanism to enhance sustainability outcomes.
Limitations: This study was limited by its cross-sectional design and focus on community-based irrigation waste management.
Contributions: This study extends the application of ESG from corporate settings to community-based sustainability contexts and offers a replicable model for sustainable environmental management strategies.

Keywords: *Circular Economy, Community-based, ESG, Sustainable Management, Waste Management*

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1. Introduction

Sustainable environmental management has become a critical global concern in response to increasing environmental degradation, resource scarcity and waste accumulation (Masrokhah, 2024; Setiono, 2024). Rapid population growth, urbanization, and intensified economic activities have significantly increased waste generation, placing pressure on natural ecosystems and public infrastructure in China. In developing countries, environmental challenges are often exacerbated by limited institutional

capacity, inadequate waste management systems, and low public awareness, particularly in rural and semi-rural regions. These conditions necessitate innovative and inclusive approaches to sustainability that extend beyond conventional top-down environmental policies (Durst, Hinteregger, & Zöller, 2025). The circular economy is an emerging paradigm that has gained significant attention in sustainability discourse.

Unlike the traditional linear economic model "of take make dispose," the circular economy emphasizes resource efficiency, waste minimization, reuse, recycling, and value recovery throughout the production and consumption cycles (Hadianto, 2024; Setiono, 2024). Circular economy practices are widely recognized for their potential to reduce environmental impacts while simultaneously generating social and economic benefits (X. Yang & Han, 2024). However, the effectiveness of circular economy initiatives depends not only on technical solutions but also on social engagement and governance mechanisms that support their implementation and continuity. In community-based environmental management contexts, circular economy principles may be reflected through localized resource circulation systems in which waste materials are continuously reused, processed, and reintegrated into productive community activities.

In parallel with the development of circular economy concepts, the Environmental, Social, and Governance (ESG) framework has emerged as a comprehensive approach for evaluating sustainability performance (R. R. Hasibuan, 2024, 2025; R. R. H. Hasibuan, Suliyanto, & Novandari, 2025). ESG integrates environmental protection, social responsibility, and governance quality into a single evaluative framework, enabling a more holistic assessment of sustainability. While ESG has been extensively applied in corporate sustainability reporting and investment decision-making, its application remains largely concentrated within organizational and financial market contexts (Khandelwal, Sharma, & Chotia, 2023). Consequently, limited attention has been paid to the potential of ESG as an operational and evaluative framework for community-based sustainability initiatives. In this study, ESG is positioned as an integrated sustainability construct rather than as a separate analytical dimension.

From a theoretical perspective, the integration of circular economy and ESG frameworks offers a promising avenue for advancing sustainable management practices. The circular economy provides the operational foundation for resource efficiency and circulation, while the integrated ESG framework captures the institutional, social, and governance conditions that enable sustainability to be embedded within local systems (Ikhwan & Barros, 2024; Pratiwi & Ardian, 2024; Triwibowo & Yusuf, 2024). Stakeholder and institutional theories suggest that sustainability outcomes are shaped by the interactions between technical practices and social-institutional arrangements (Kurniawan & Rokhim, 2023). Without adequate social participation and governance structures, circular economy initiatives risk fragmentation, short lifespan, or ineffectiveness. Empirically, previous studies on circular economy and ESG have predominantly focused on corporate performance, urban waste management systems, and industrial supply chains. These studies provide valuable insights into how sustainability practices improve environmental efficiency and organizational performance (Nicolas, Desroziers, Caccioli, & Aste, 2024). However, a notable gap remains in empirical research examining how circular economy and ESG frameworks operate in community-based and rural contexts, particularly in relation to environmental infrastructure such as irrigation systems.

Irrigation channels play a vital role in agricultural productivity and rural livelihoods; however, they are frequently exposed to waste disposal problems due to weak management systems and limited public oversight. In many rural communities, irrigation waste accumulation leads to water pollution, reduced irrigation efficiency, flooding risk, and declining agricultural output. These challenges are often compounded by insufficient coordination among stakeholders, weak governance structures, and low community participation. Conventional waste management approaches that rely solely on government intervention frequently fail to address these complex and localized issues. Consequently, community-based waste management models have gained increasing attention as more adaptive and sustainable solutions (Borah, Iqbal, & Akhtar, 2022). Within this context, adopting circular economy practices in community-based irrigation waste management offers significant potential for developing a localized

resource circulation system. Practices such as waste segregation, recycling, composting, and material reuse not only reduce environmental pressure but also enable waste materials to be reintegrated into local agricultural and community activities, thereby creating environmental and socio-economic value (R. R. Hasibuan, Suliyanto, & Novandari, 2026).

In this community-based mechanism, irrigation waste is not merely removed from the environment but transformed into reusable resources through collective participation and continuous utilization processes. Although implemented on a localized scale, these practices reflect essential circular economy principles through resource recovery, waste minimization, and value regeneration within rural environmental management systems. However, the success of these practices depends heavily on social acceptance, collective action and effective governance. The integrated ESG framework is particularly relevant as it provides a structured approach to evaluate and strengthen environmental outcomes, social engagement, and governance effectiveness simultaneously (Yadav, Sharma, & Kathuria, 2025).

Despite its relevance, empirical evidence on the mediating role of ESG in linking circular economy practices to sustainable management outcomes at the community level is limited. Most existing studies treat ESG as an outcome variable rather than as a mechanism that facilitates sustainability (Pradal-Cano et al., 2020). This creates a research gap in understanding how the integrated ESG framework functions as an enabling factor that translates circular economy initiatives into long-term sustainable management practices.

Addressing this gap is particularly important for developing countries, where sustainability challenges are deeply embedded in the social and institutional contexts. Community-based irrigation waste management represents a unique empirical setting for examining these dynamics, as it involves collective resource use, shared environmental risks, and the need for coordinated governance. By focusing on this context, the present study responds to calls for more inclusive and context-sensitive sustainability research (P. Yang, Hao, Wang, Zhang, & Yang, 2024).

The novelty of this study lies in empirically positioning the integrated ESG framework as a mediating mechanism between circular economy practices and sustainable management outcomes in community-based environmental management settings. Unlike prior research that emphasizes corporate ESG performance, this study extends the ESG framework to the grassroots level and demonstrates its explanatory power beyond the organizational boundaries. By integrating the circular economy and ESG within a single analytical model, this study offers a more comprehensive understanding of how sustainability can be operationalized in community-based systems.

Furthermore, this study contributes methodologically by applying a structured empirical model to evaluate sustainability practices in irrigation waste management, an area that remains underexplored in the sustainability literature. The findings are expected to provide actionable insights for policymakers, local governments, and community organizations seeking to design effective and inclusive sustainable interventions.

Based on these considerations, this study had three objectives. First, we examine the effect of circular economy practices on integrated ESG performance in community-based irrigation waste management. Second, we analyze the influence of circular economy practices and integrated ESG performance on sustainable management outcomes. Third, the mediating role of the integrated ESG framework in the relationship between circular economy implementation and sustainable management practices was investigated. By addressing these objectives, this study aims to contribute, both theoretically and practically, to the advancement of sustainable environmental management in community-based contexts.

2. Literature Review and Hypotheses Development

2.1 Circular Economy

The circular economy refers to a sustainability oriented economic system that emphasizes reducing waste, reusing materials, recycling resources, and extending product life cycles to minimize

environmental degradation. Unlike the traditional linear economic model that follows the "take make dispose" pattern, the circular economy focuses on maintaining the value of resources for as long as possible through regenerative and restorative processes. Circular economy practices contribute significantly to environmental sustainability by promoting efficient resource utilization, waste minimization, and resource recovery mechanisms (Ren, Wu, Lim, & Tseng, 2023).

In recent years, the circular economy has become an important strategic framework for addressing environmental challenges and supporting sustainable development goals. The implementation of circular economy principles has expanded beyond industrial sectors to community-based environmental management systems. This development reflects the growing awareness that sustainability requires both technical innovation and collective participation. Therefore, the circular economy has become a critical concept in contemporary sustainability management research (B. Kumar, Kumar, Sassanelli, & Kumar, 2025).

From a theoretical perspective, the circular economy provides an operational foundation for sustainable management practices. The theory suggests that environmental sustainability can be achieved through localized closed-loop systems that reduce resource dependency and environmental pressure. In community-based irrigation waste management, circular economy practices include waste segregation, recycling, composting, and the reuse of materials. These activities not only reduce waste accumulation but also enable waste materials to be reintegrated into agricultural and community activities through resource-circulation mechanisms.

Circular economy initiatives create positive sustainability outcomes when supported by social participation and institutional coordination (Temouri, Shen, Pereira, & Xie, 2022). This perspective aligns with stakeholder theory, which emphasizes collaboration among multiple actors in achieving sustainability goals (B. Kumar et al., 2025). Circular economy practices are expected to strengthen integrated Environmental, Social, and Governance (ESG) performance within community-based management systems. Previous empirical studies have consistently demonstrated the positive impact of circular economy implementation on sustainability outcomes.

That circular economy practices significantly improve environmental efficiency and sustainability-oriented organizational performance (Ren, Wu, Lim, & Tseng, 2023). Similarly, sustainability-oriented operational practices positively influence governance quality and innovation performance (Denia, Fernández-Yáñez, & Forés, 2025). These findings indicate that the circular economy contributes not only to environmental improvement but also to stronger social participation and governance mechanisms. In rural and community-based contexts, circular economy practices may strengthen collaborative environmental management and promote institutional sustainability. Therefore, the following hypothesis is proposed:

H_1: Circular economy implementation positively affects ESG performance

2.2 Environmental, Social, and Governance (ESG)

Environmental, Social, and Governance (ESG) refers to an integrated framework used to evaluate sustainability performance based on environmental responsibility, social engagement, and governance quality. ESG was initially developed within the context of corporate sustainability and investment to assess non-financial organizational performance. ESG integrates environmental protection, social accountability, and governance effectiveness into a comprehensive sustainability framework (Abdi, Li, & Càmara-Turull, 2022). In recent years, ESG has gained increasing attention as organizations and communities seek more holistic approaches to sustainability management (B. Kumar et al., 2025). The framework is widely recognized as an important mechanism for achieving long-term sustainability objectives. In this study, ESG is positioned as an integrated sustainability construct rather than as separate analytical dimensions. Therefore, ESG provides a comprehensive perspective for evaluating sustainable management. Within the context of sustainability theory, ESG serves as an enabling mechanism that connects environmental initiatives with institutional and social capacities. ESG strengthens the effectiveness of sustainability programs by ensuring that environmental practices are supported by community participation and governance structures (Aimwata & Sunde, 2025). In

community-based irrigation waste management, the integrated ESG framework helps ensure that waste management activities are socially inclusive, environmentally responsible and institutionally coordinated. ESG performance is strongly influenced by organizational and social capabilities that support sustainability-oriented transformations (Wei & Zheng, 2024). This aligns with institutional theory, which suggests that sustainability outcomes depend on operational practices and governance legitimacy. Therefore, ESG plays a critical role in translating circular economy initiatives into sustainable management.

Empirical evidence supports a positive relationship between ESG performance and sustainability outcomes. ESG practices significantly improve long-term organizational sustainability and stakeholder trust (Wang & Xia, 2024). Strong ESG performance enhances resilience and sustainability. These findings suggest that integrated ESG performance contributes to sustainable operational and institutional practice (Kurniawan & Rokhim, 2023). In community-based environmental management, ESG can improve coordination, participation and accountability among stakeholders. Consequently, ESG is expected to positively influence sustainable management practices. Based on these arguments, the following hypothesis is proposed.

H_2: ESG performance positively affects sustainable management practices

2.3 Sustainable Management Practices

Sustainable management practices refer to organizational and community activities that balance environmental preservation, social well-being, and economic continuity (Lutfi et al., 2023). These practices aim to ensure that current resource utilization does not compromise future environmental or social conditions. Sustainable management emphasizes efficiency, resilience, participation and institutional sustainability. Sustainable management practices involve the integration of sustainability principles into operational and governance systems. In environmental management, sustainable practices include resource conservation, waste reduction, stakeholder engagement, and long-term planning (Dash, Gupta, Singh, & Sharma, 2025). Such practices are particularly important in rural and community-based systems, where environmental resources directly affect local livelihoods. Therefore, sustainable management practices represent a critical outcome of sustainability-oriented initiatives (Raina, Sharma, Taheri, Dev, & Chavriya, 2026).

From a theoretical perspective, sustainable management practices result from the interaction between environmental innovation, social participation, and governance effectiveness. Circular economy practices provide operational mechanisms for environmental improvement, whereas ESG ensures that these initiatives are supported institutionally and socially (Wei & Zheng, 2024). In community-based irrigation waste management, sustainable practices are reflected through improved waste handling, stronger governance coordination, and enhanced community participation. According to stakeholder theory, sustainability outcomes are achieved when multiple stakeholders collaborate effectively on resource management processes (Yadav, Sharma, & Kathuria, 2025). Therefore, sustainable management practices are the ultimate outcome of integrated sustainability frameworks.

Previous studies have provided empirical evidence supporting the relationship between sustainability-oriented practices and management performance. Sustainability-based management systems significantly improve organizational resilience and environmental performance (Mang'ana & Nade, 2026). Sustainability transformation positively affects long-term ESG outcomes and institutional continuity. These findings indicate that integrated sustainability approaches improve operational efficiency and governance. In community-based contexts, sustainable management practices contribute to environmental protection and social resilience. Therefore, sustainable management is an important indicator of successful sustainability implementation.

2.4 The Mediating Role of ESG

ESG is increasingly recognized as a sustainability evaluation framework and a mediating mechanism that strengthens the relationship between environmental initiatives and sustainable outcomes (Wang & Xia, 2024). In the context of circular economy implementation, an integrated ESG framework ensures that technical environmental practices are supported by social participation and governance quality.

Without effective governance and community engagement, circular economy initiatives may fail to generate long-term sustainable impacts. ESG strengthens sustainability performance by integrating institutional legitimacy and stakeholder participation into environmental initiatives (Yadav et al., 2025). Therefore, ESG serves as a strategic bridge between circular economy practices and sustainable management.

From the perspective of stakeholder and institutional theories, ESG mediates sustainability relationships by aligning operational practices with social expectations and governance structures (B. Kumar et al., 2025). Circular economy initiatives alone may improve environmental efficiency, but ESG ensures continuity, accountability and collective involvement. In community-based irrigation waste management, ESG mechanisms encourage transparency, participation, and shared responsibility in waste management (Ren et al., 2023). This integrated approach increases the effectiveness and sustainability of circular economy implementations. Therefore, ESG plays a critical intermediary role in sustainability-oriented management.

Previous empirical studies support the mediating role of ESG in sustainability. ESG significantly strengthens sustainability transformation and long-term organizational continuity (Wang & Xia, 2024). Similarly, ESG mechanisms enhance the effectiveness of sustainability-oriented initiatives in achieving sustainable outcomes (Dash et al., 2025). These findings indicate that ESG is not merely an outcome variable but also an enabling factor in sustainability management. In community-based contexts, ESG can strengthen collaboration, institutional resilience, and environmental accountability, as can be seen in Figure 1. Based on these arguments, the following hypothesis is proposed.

H3: Circular economy implementation positively affects sustainable management practices

H4: ESG mediates the relationship between circular economy implementation and sustainable management practice

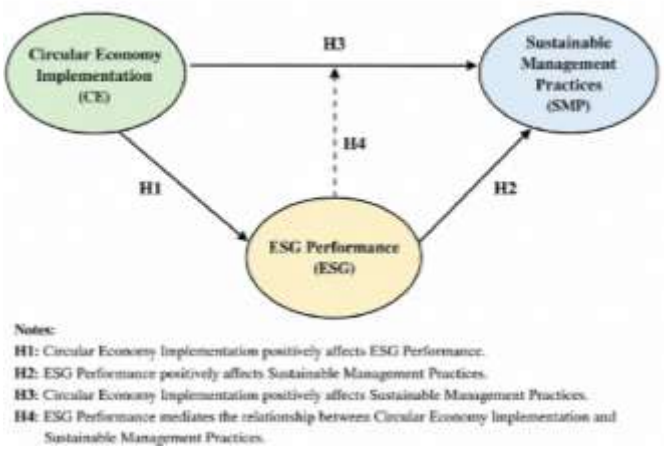

Figure 1. Research model

3. Methodology

This study adopts a quantitative empirical approach to examine the relationship between circular economy implementation, integrated Environmental, Social, and Governance (ESG) performance, and sustainable management practices within community-based irrigation waste management. A quantitative design is considered appropriate because this study aims to test the theoretical relationships among latent constructs systematically and measurably, consistent with sustainability and management research traditions (Ghozali, 2018). By employing an empirical modeling approach, this study seeks to generate evidence-based insights that bridge sustainability theory and community-level environmental practices (Hair, Hult, Ringle, & Sarstedt, 2022).

3.1 Research Design and Type

Based on its objectives, this study is classified as explanatory research, focusing on identifying and explaining causal relationships among variables through hypothesis testing. The main constructs examined include circular economy implementation as an exogenous variable, integrated ESG performance as a mediating variable, and sustainable management practices as an endogenous variable. The unit of analysis is community-based irrigation waste management organizations, while the unit of observation consists of community members actively involved in waste collection, processing and institutional decision-making. This context was selected because community-based waste management exhibits distinctive governance and participation characteristics that differ from corporate or municipal settings, requiring a context-sensitive analytical framework (Hair et al., 2022).

3.2 Research Procedure

The research procedure was conducted in several systematic stages. First, a comprehensive literature review was conducted to develop the conceptual framework and research hypotheses related to circular economy, ESG, and sustainable management practices. This stage ensured theoretical grounding and construct clarity (Abdi et al., 2022). Second, the research variables were operationalized into measurable indicators and compiled into a structured questionnaire using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree).

Circular economy indicators capture localized resource circulation practices, including waste reduction, recycling, reuse, composting, and value-recovery activities within irrigation waste management systems. Integrated ESG performance was measured using indicators that reflect environmental responsibility, social participation, and governance coordination in community-based waste management activities. Sustainable management practices were operationalized using indicators related to operational continuity, institutional sustainability, stakeholder coordination, and long-term community environmental management effectiveness. To improve measurement transparency, the operationalization of the variables and sample measurement items are presented in Table 1.

Table 1. Operationalization of research variables

Variables	Indicators	Sample Measurement Items	Sources
Circular Economy (CE)	Waste reduction	The community actively reduces irrigation waste accumulation.	(Ren et al., 2023); (B. Kumar et al., 2025)
	Recycling practices	Waste materials are separated and processed for reuse.	
	Material reuse	Reusable waste materials are utilized for productive community activities.	
	Composting and value recovery	Processed waste generates environmental or economic benefits for the community.	
Integrated ESG performance	Environmental responsibility	Waste management activities improve environmental cleanliness and sustainability.	(Abdi et al., 2022); (Wang & Xia, 2024)
	Social participation	Community members actively participate in irrigation waste management activities.	
	Governance coordination	Waste management decisions are conducted transparently and collaboratively.	
Sustainable Management Practices (SMP)	Operational sustainability	Community-based waste management activities are conducted continuously.	(Dash et al., 2025); (Lutfi et al., 2023)

	Institutional sustainability	The waste management system is supported by effective institutional coordination.	
	Community sustainability	Waste management activities contribute to long-term environmental and community welfare.	

Third, data collection was conducted through a survey administered directly to respondents meeting the inclusion criteria, namely, active involvement in community-based irrigation waste management activities. To enhance data accuracy and respondent understanding, data collection was accompanied by brief explanations when necessary, following the best practices in applied social research (Hair et al., 2022).

The study population comprised community members actively involved in irrigation waste management programs across three rural irrigation areas in Majalengka Regency, Indonesia. Based on field records obtained from local community management units, the total number of active members was 168. Using the Slovin formula with a 5% margin of error, the minimum required sample size was 118 respondents. To enhance the statistical power and improve the model stability for the PLS-SEM analysis, this study collected data from 132 respondents who met the inclusion criteria. The sampling technique employed was purposive sampling, as respondents were selected based on their direct involvement, experience, and decision-making role in irrigation waste management activities. This sampling approach is considered appropriate for sustainability research involving specific community-based organizational contexts (Hair et al., 2022).

3.3 Data Analysis Technique

Data analysis was performed using Partial Least Squares structural equation modeling (PLS-SEM). This technique was selected because of its suitability for predictive analysis, complex structural models, and relatively small sample sizes, as well as its ability to handle non-normal data distributions. The analysis followed a two-stage evaluation process, as described below. The first stage involved the assessment of the measurement model, including tests of convergent validity, discriminant validity, and construct reliability using indicator loadings, Average Variance Extracted (AVE), Composite Reliability, and Cronbach's alpha. The second stage focused on evaluating the structural model, examining path coefficients, coefficient of determination (R^2), effect size (f^2), and predictive relevance (Q^2) to determine the strength and significance of relationships among constructs (Hair et al., 2022). Through this analytical approach, this study aims to provide robust empirical evidence regarding the role of circular economy and ESG integration in supporting sustainable management practices at the community level.

4. Results and Discussions

4.1 Research Results

This section presents the empirical results of the study examining the relationship between circular economy implementation, Environmental, Social, and Governance (ESG) dimensions, and sustainable management practices in community-based irrigation waste management. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM), enabling the simultaneous evaluation of the measurement and structural models (Hair et al., 2022). Overall, the results indicate that the proposed research model is supported empirically. Circular economy implementation has a significant positive relationship with ESG performance and sustainable management practices. Furthermore, ESG dimensions act as a mediating mechanism that strengthens the effect of circular economy practice on sustainable management outcomes.

4.2 Measurement Model Evaluation

The measurement model was evaluated to assess its construct validity and reliability. Convergent validity was examined using indicator loadings and Average Variance Extracted (AVE), while reliability was assessed through Composite Reliability (CR) and Cronbach's alpha. As shown in Table

2, all constructs met the recommended threshold values, indicating adequate convergent validity and internal consistency (Hair et al., 2022).

Table 2. Measurement model evaluation results

Construct	Cronbach's Alpha	Composite eliability	AVE
CE	0.872	0.913	0.639
ESG dimensions	0.891	0.926	0.675
SMP	0.864	0.908	0.621

All constructs demonstrated strong internal consistency, with Cronbach's alpha values ranging from 0.864 to 0.891 and Composite Reliability values exceeding 0.90, indicating excellent reliability. Furthermore, the Average Variance Extracted (AVE) values ranged from 0.621 to 0.675, exceeding the recommended threshold of 0.50, confirming adequate convergent validity. In addition, all indicator loadings exceeded the minimum acceptable value of 0.70, confirming that each indicator reliably represented its respective latent construct. These findings indicate that the measurement model satisfies the required criteria of reliability and convergent validity and is therefore suitable for subsequent structural model evaluations (Hair et al., 2022).

4.3 Structural Model Evaluation

Structural model evaluation focuses on examining the hypothesized relationships among constructs. Path coefficients, significance levels, and explanatory powers were assessed using bootstrapping procedures. The results of the structural models are summarized in Table 3.

Table 3. Structural model results

Hypothesized Path	Coefficient	T-stat	P-value	Result
CE → ESG	0.682	9.214	0.000	Supported
ESG → SMP	0.543	6.832	0.000	Supported
CE → SMP	0.312	3.741	0.000	Supported
CE → ESG → SMP	0.371	5.129	0.000	Supported

The structural model results indicate that circular economy implementation has a strong positive effect on ESG performance ($\beta = 0.682$, $p < 0.001$), demonstrating that circular practices significantly enhance environmental, social, and governance outcomes. ESG performance also has a significant positive influence on sustainable management practices ($\beta = 0.543$, $p < 0.001$). Furthermore, the direct effect of the circular economy on sustainable management practices remained significant ($\beta = 0.312$, $p < 0.001$). Importantly, the indirect effect of the circular economy on sustainable management practices through ESG is also significant ($\beta = 0.371$, $p < 0.001$), confirming the mediating role of ESG. These findings indicate that ESG functions as a key mechanism through which circular economy practices translate into improved sustainable management outcomes, thereby strengthening the theoretical integration between the circular economy and ESG frameworks.

4.4 Discussion

The findings of this study provide strong empirical support for the integration of circular economy practices and integrated Environmental, Social, and Governance (ESG) performance in strengthening sustainable management practices within community-based irrigation waste management. The statistical results indicate that the implementation of the circular economy has a stronger influence on ESG performance than the direct effect of the circular economy on sustainable management practices. This finding suggests that the effectiveness of circular economy initiatives at the community level depends not only on technical waste management activities but also on the extent to which these practices strengthen social participation, environmental responsibility, and governance coordination. Therefore, the circular economy should be understood as a systemic sustainability mechanism rather than merely a technical waste reduction approach (B. Kumar, Kumar, Sassanelli, & Kumar, 2025) and (Ren, Wu, Lim, & Tseng, 2023).

From an environmental perspective, the findings demonstrate that circular economy implementation contributes directly to reducing waste accumulation in irrigation channels through waste separation, recycling, reuse, composting, and localized value recovery activities. These practices improve irrigation functionality and environmental quality, while simultaneously reducing ecological pressure within rural agricultural systems. The relatively strong effect of the circular economy on ESG performance indicates that environmental improvements are immediately visible and collectively experienced by community members. This finding supports previous studies emphasizing that circular economy practices improve environmental efficiency and sustainability-oriented operational performance when implemented consistently (Ren et al. 2023). In the context of irrigation systems, environmental improvements contribute indirectly to agricultural productivity and local environmental resilience.

From a social perspective, the findings reveal that community participation plays a central role in strengthening the relationship between circular economy implementation and sustainable management practices. The active involvement of community members in waste management activities increases collective awareness, social cohesion, and shared responsibility for environmental resources. Compared to purely technical approaches, participatory sustainability initiatives tend to generate stronger long-term impacts because they create social ownership and collaboration. This finding is consistent with previous studies highlighting that participatory and sustainability-oriented management practices improve institutional adaptability and long-term program effectiveness (Temouri, Shen, Pereira, & Xie, 2022; Wei & Zheng, 2024). In community-based irrigation waste management, social participation is particularly important because environmental sustainability depends heavily on collective behavioral consistency.

The governance dimension also emerged as a critical mechanism for explaining sustainable management outcomes. The findings indicate that governance coordination, transparency, and accountability strengthen the effectiveness of circular economy implementation by ensuring continuity and institutional legitimacy. The mediating effect of ESG shows that sustainable management practices are more effectively achieved when environmental initiatives are supported by governance structures and community coordination mechanisms. This finding explains why the indirect effect through ESG is more meaningful for long-term sustainability than relying solely on direct operational improvements alone. Previous ESG studies similarly emphasize that governance quality significantly determines sustainability effectiveness and organizational continuity (Chen & Xie, 2022; Wang & Xia, 2024). In community-based irrigation waste management, governance mechanisms reduce coordination failures and strengthen stakeholder trust, thereby improving sustainability.

One of the most important findings of this study is the confirmation of ESG as an enabling and mediating mechanism between circular economy implementation and sustainable management practice. The mediation results indicate that circular economy initiatives alone are insufficient to generate sustainable long-term outcomes without environmental accountability, social participation and governance support. The stronger mediating role of ESG suggests that sustainability outcomes in rural community contexts are shaped not only by operational efficiency but also by institutional and social capacities. These finding advances sustainability research by demonstrating that integrated ESG performance functions as a bridging framework that connects technical environmental initiatives with participatory and institutional sustainability mechanisms. This interpretation is consistent with stakeholder theory, which emphasizes that sustainability objectives are achieved through alignment of operational practices, stakeholder involvement, and governance legitimacy (Kurniawan & Rokhim, 2023).

Compared to previous studies that predominantly examine the circular economy and ESG within corporate, industrial, or urban contexts, this research extends the applicability of these frameworks to a community-based rural environmental management setting. The findings demonstrate that ESG principles are not limited to corporate governance systems but can also operate effectively at the grassroots level through collective participation and localized governance arrangements. This extension contributes to the sustainability literature by addressing the limited empirical evidence on ESG implementation in rural and community-based environmental systems.

Furthermore, the findings suggest that sustainable management practices are multidimensional outcomes shaped by the interactions between technical environmental practices, social dynamics, and governance arrangements. Sustainable management is reflected not only through operational continuity and environmental efficiency but also through institutional resilience and long-term community sustainability. The relatively lower direct effect of the circular economy on sustainable management practices than its influence on ESG performance indicates that sustainability outcomes require broader institutional reinforcement beyond technical environmental interventions alone. This finding supports the view that sustainability should be understood as an integrated and systemic outcome rather than a single operational performance indicator (L, Singh, & Singh, 2026).

The discussion demonstrates that the integration of the circular economy and ESG frameworks provides a robust model for sustainable environmental management at the community level. The model proposed in this study explains how localized resource circulation practices can simultaneously strengthen environmental quality, social participation, and governance capacity. These findings are particularly relevant for developing countries, where sustainability challenges are closely linked to institutional limitations, collective resource dependency, and the need for participatory environmental governance.

5. Conclusions

5.1. Conclusion

This study contributes to sustainability and management literature by providing empirical evidence that the integration of circular economy practices and Environmental, Social, and Governance (ESG) dimensions significantly enhances sustainable management practices in community-based irrigation waste management. The findings confirm that the implementation of a circular economy positively affects ESG performance and sustainable management outcomes, while ESG functions as a mediating mechanism that strengthens this relationship.

The principal novelty of this research lies in extending ESG from a predominantly corporate-oriented evaluation framework to a community-based sustainability framework. By empirically positioning ESG as an explanatory and enabling mechanism rather than merely a performance indicator, this study advances the existing sustainability models. Furthermore, this study strengthens methodological transparency by providing complete statistical evidence using PLS-SEM analysis, thereby enhancing the robustness and credibility of the proposed model.

From a practical and policy perspective, the proposed model offers an evidence-based and replicable framework for local governments, policymakers, and community organizations to design circular economy initiatives that are aligned with ESG principles. The results emphasize that investments in community governance capacity and social engagement are essential for achieving long-term sustainability impacts, particularly in rural and developing country contexts where institutional resources are limited.

5.2. Research Limitations

Despite these contributions, this study has several limitations. First, the cross-sectional research design restricts the ability to capture the dynamic changes in sustainability practices over time. Second, the empirical setting was limited to community-based irrigation waste management, which may constrain the generalizability of the findings to other environmental management contexts. Third, the study relies on perceptual survey data, which may be subject to respondent bias and may not fully capture the objective sustainability performance indicators.

These limitations indicate that the current findings should be interpreted within a specific research context. Expanding the scope of analysis and incorporating diverse methodological approaches may improve the comprehensiveness and external validity of future sustainability studies.

5.3 Suggestions and Directions for Future Research

Future research should employ longitudinal research designs to examine the long-term sustainability effects of circular economy and ESG integration. Comparative studies across different regions, sectors,

and environmental management systems are recommended to enhance the generalizability of the findings.

Future studies should incorporate qualitative or mixed-method approaches to provide deeper insights into institutional dynamics, stakeholder collaboration, and community governance processes that underpin sustainable management practices. Researchers are also encouraged to explore additional variables, such as technological readiness, policy support, environmental awareness, and social innovation, to enrich the understanding of sustainability-oriented management frameworks in community-based contexts.

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Author Contribution
MM contributed to the conceptualization of the study, research design development, supervision of the research process, and final manuscript review. MFSU was responsible for the methodology development, statistical analysis using PLS-SEM, interpretation of empirical findings, and manuscript editing. AR contributed to literature review development, theoretical framework construction, data interpretation, and drafting of the discussion section. ANH was responsible for data collection, questionnaire distribution, data tabulation, and administrative research support. All authors have read, reviewed, and approved the final version of this manuscript for publication.

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