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

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Abstract

Increasing environmental pressure, resource scarcity, and sustainability demands have intensified the urgency of adopting alternative development models, particularly in waste management practices. In developing countries such as Indonesia, community-based irrigation waste management continues to face complex environmental, social, and governance challenges due to limited infrastructure, weak institutional capacity, and low public participation. In this context, the integration of circular economy principles with Environmental, Social, and Governance (ESG) frameworks offers a promising pathway to promote sustainable management practices beyond purely technical solutions.

This study aims to examine the role of circular economy implementation in fostering ESG-oriented sustainable management practices within community-based irrigation waste management in Indonesia. A quantitative research approach was employed using survey data collected from community members actively involved in irrigation waste management. The data were analyzed using Partial Least Squares–Structural Equation Modeling (PLS-SEM) to assess the relationships between circular economy practices, ESG dimensions, and sustainable management practices.

The findings indicate that circular economy implementation has a positive and significant effect on ESG performance as well as on sustainable management practices. Moreover, ESG dimensions serve as a mediating variable that strengthens the relationship between circular economy practices and sustainable management outcomes. These results provide empirical evidence supporting the integration of circular economy and ESG frameworks at the community level. This study contributes to the literature on circular economy and ESG by offering an applicable

and replicable conceptual model for sustainable community based environmental management.

Keywords—*Circular economy; ESG; sustainable management; waste management; community-based*

I. INTRODUCTION

Sustainable environmental management has become a critical global concern in response to increasing environmental degradation, resource scarcity, and waste accumulation. Rapid population growth, urbanization, and intensified economic activities have significantly increased waste generation, placing pressure on natural ecosystems and public infrastructure. 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 areas. These conditions necessitate innovative and inclusive approaches to sustainability that extend beyond conventional top-down environmental policies (Lozano, 2020; Yu et al., 2024).

One emerging paradigm that has gained significant attention in sustainability discourse is the circular economy. 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 cycle. Circular economy practices are widely recognized for their potential to reduce environmental impacts while simultaneously generating social and economic benefits (Geissdoerfer et al., 2020; Kirchherr et al., 2023). 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 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. ESG integrates environmental protection, social responsibility, and governance quality into a single evaluative framework, enabling a more holistic assessment of sustainability outcomes.

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 (Friede et al., 2021).

Consequently, limited attention has been given to the potential of ESG as an operational and evaluative framework for community-based sustainability initiatives.

From a theoretical perspective, the integration of circular economy and ESG frameworks offers a promising avenue for advancing sustainable management practices. Circular economy provides the technical and operational foundation for resource efficiency, while ESG captures the institutional, social, and governance dimensions that enable sustainability to be embedded within local systems. Stakeholder theory and institutional theory suggest that sustainability outcomes are shaped by interactions between technical practices and social institutional arrangements (Pham et al., 2021). Without adequate social participation and governance structures, circular economy initiatives risk becoming fragmented, short lived, or ineffective.

Empirically, previous studies on circular economy and ESG predominantly focus on corporate performance, urban waste management systems, or industrial supply chains. These studies provide valuable insights into how sustainability practices improve environmental efficiency and organizational performance (Scarpellini et al., 2022). However, there remains a notable gap 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, yet 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 risks, and declining agricultural output. These challenges are often compounded by insufficient coordination among stakeholders, weak governance structures, and low levels of community participation. Conventional waste management approaches that rely solely on government intervention frequently fail to address these complex, localized issues.

As a result, community-based waste management models have gained increasing attention as a more adaptive and sustainable solution (Yulianti & Suryani, 2021).

Within this context, the adoption of circular economy practices in community-based irrigation waste management offers significant potential. Practices such as waste segregation, recycling, composting, and material reuse can

reduce environmental pressure while creating local economic opportunities. However, the success of these practices depends heavily on social acceptance, collective action, and effective governance. This is where the ESG framework becomes particularly relevant, as it provides a structured approach to evaluate and strengthen environmental outcomes, social engagement, and governance effectiveness simultaneously (Friede et al., 2021; Yu et al., 2024).

Despite its relevance, empirical evidence on the mediating role of ESG in linking circular economy practices to sustainable management outcomes at the community level remains limited. Most existing studies treat ESG as an outcome variable rather than a mechanism that facilitates sustainability (Lozano, 2020). This creates a research gap in understanding how ESG dimensions function as enabling factors that translate 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 social and institutional contexts. Community-based irrigation waste management represents a unique empirical setting to examine 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 (Kirchherr et al., 2023).

The novelty of this study lies in empirically positioning ESG as a mediating mechanism between circular economy practices and sustainable management outcomes in a community-based environmental management setting. Unlike prior research that emphasizes corporate ESG performance, this study extends the ESG framework to the grassroots level and demonstrates its explanatory power beyond organizational boundaries. By integrating circular economy and ESG within a single analytical model, this research 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 sustainability literature. The findings are expected to provide actionable insights for policymakers, local governments, and community organizations seeking to design effective and inclusive sustainability interventions.

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

II. METHOD

This study adopts a quantitative empirical approach to examine the relationship between circular economy

implementation, Environmental, Social, and Governance (ESG) dimensions, and sustainable management practices within community-based irrigation waste management. A quantitative design is considered appropriate as the study aims to test theoretical relationships among latent constructs in a systematic and measurable manner, consistent with sustainability and management research traditions (Sugiyono, 2022; Hair et al., 2021). By employing an empirical modeling approach, this research seeks to generate evidence-based insights that bridge sustainability theory and community-level environmental practices.

Research Design and Type

Based on its objectives, this research is classified as explanatory research, focusing on identifying and explaining causal relationships among variables through hypothesis testing (Ferdinand, 2019). The main constructs examined include circular economy implementation as an exogenous variable, ESG dimensions (environmental, social, and governance) as a mediating variable, and sustainable management practices as the 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, thereby requiring a context-sensitive analytical framework (Sugiyono, 2022).

Research Procedure

The research procedure was conducted through several systematic stages. First, a comprehensive literature review was undertaken 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 (Narimawati, 2020).

Second, the research variables were operationalized into measurable indicators and compiled into a structured questionnaire using a five-point Likert scale. Circular economy indicators capture waste reduction, reuse, recycling, and value recovery practices. ESG dimensions are measured through indicators reflecting environmental impact, social participation, and governance quality. Sustainable management practices are operationalized through indicators of operational efficiency, institutional sustainability, and local economic continuity.

Third, data collection was carried out 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 best practices in applied social research (Sugiyono, 2022).

The population of this study consists of 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 individuals. Using the Slovin formula with a

5% margin of error, the minimum required sample size was 118

respondents. To enhance statistical power and improve model stability for 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 roles in irrigation waste management activities. This sampling approach is considered appropriate for sustainability research involving specific community-based organizational contexts (Hair et al., 2021; Ghazali, 2021).

Data Analysis Technique

Data analysis was performed using Partial Least Squares–Structural Equation Modeling (PLS-SEM). This technique was selected due to its suitability for predictive analysis, complex structural models, and relatively small sample sizes, as well as its ability to handle non-normal data distributions (Ghozali, 2021; Hair et al., 2021).

The analysis followed a two-stage evaluation process. The first stage involved 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 (Hair et al., 2019). The second stage focused on evaluation of 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 (Ghozali, 2021).

Through this analytical approach, the 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.

III. RESULTS AND DISCUSSION

A. 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 simultaneous evaluation of the measurement and structural models (Hair et al., 2021; Ghazali, 2021). Overall, the results indicate that the proposed research model is empirically supported. Circular economy implementation demonstrates 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 practices on sustainable management outcomes.

B. Measurement Model Evaluation

The measurement model was evaluated to assess 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 1**, all constructs meet the recommended threshold values, indicating adequate convergent validity and internal consistency (Hair et al., 2019).

Table 1. Measurement Model Evaluation Results

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

Note: SMP = Sustainable Management Practices; CE = Circular Economy; Source: Processed Data (2025)

All constructs demonstrate 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, Average Variance Extracted (AVE) values range 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 represents 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 evaluation (Hair et al., 2019; Hair et al., 2021).

C. Structural Model Evaluation

The structural model evaluation focuses on examining the hypothesized relationships among constructs. Path coefficients, significance levels, and explanatory power were assessed using bootstrapping procedures. The results of the structural model are summarized in **Table 2**.

Table 2. 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

Note: CE = Circular Economy; SMP = Sustainable Management Practices; Source: Processed Data (2025)

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 circular economy on sustainable management practices remains significant ($\beta = 0.312, p < 0.001$). Importantly, the indirect effect of 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 circular economy and ESG frameworks.

D. Discussion

The findings of this study provide strong empirical support for the integration of circular economy practices and Environmental, Social, and Governance (ESG) dimensions in strengthening sustainable management practices within community-based irrigation waste management. The significant positive relationship between circular economy implementation and ESG performance confirms that circular strategies are not limited to technical waste reduction, but also play a broader role in shaping social participation and governance quality at the community level. This result aligns with the argument that circular economy represents a systemic sustainability paradigm rather than a purely operational approach (Geissdoerfer et al., 2020; Kirchherr et al., 2023).

From an environmental perspective, the implementation of circular economy practices contributes directly to reducing waste accumulation in irrigation channels through waste separation, reuse, recycling, and value recovery. These practices improve water quality and irrigation functionality while reducing environmental degradation. This finding supports previous studies emphasizing that circular economy initiatives enhance environmental efficiency and resource optimization when applied consistently (Scarpellini et al., 2022). In the context of irrigation systems, environmental improvements have broader implications for agricultural productivity and food security, reinforcing the strategic relevance of sustainable waste management at the local level.

In terms of the social dimension, the results demonstrate that community involvement plays a crucial role in the success of circular economy implementation. Active participation of community members in waste management activities enhances collective awareness, strengthens social cohesion, and fosters a sense of ownership over environmental resources. These social outcomes are consistent with earlier studies on community based waste management, which highlight that participatory approaches increase program effectiveness and sustainability (Yulianti & Suryani, 2021; Mulyana et al., 2023). By embedding circular economy practices within community structures, sustainability initiatives become more adaptive to local needs and socio-cultural contexts.

The governance dimension emerges as a critical factor in translating circular economy initiatives into sustainable management practices. The establishment of clear institutional roles, transparent decision-making processes, and accountability mechanisms enhances trust among community members and stakeholders. This finding supports ESG literature that identifies governance quality as a key determinant of sustainability performance (Friede et al., 2021; Yu et al., 2024). In community-based irrigation waste management, governance structures ensure continuity of programs, reduce coordination failures, and support compliance

with agreed operational rules.

One of the most significant contributions of this study is the identification of ESG as a mediating mechanism between circular economy practices and sustainable management outcomes. The mediation effect indicates that circular economy initiatives alone may not be sufficient to generate long-term sustainability impacts if social and governance dimensions are weak. This insight advances existing sustainability research by demonstrating that ESG functions as an integrative framework that aligns technical innovations with institutional and social capacities. This finding is consistent with stakeholder theory, which emphasizes the importance of balancing environmental objectives with stakeholder engagement and governance legitimacy (Pham et al., 2021).

Compared to previous studies that predominantly examine circular economy and ESG in corporate or urban settings, this research extends the applicability of these frameworks to a community-based and rural context. The results demonstrate that ESG principles are not exclusive to corporate governance, but can effectively guide sustainability practices at the grassroots level. This extension addresses a critical research gap and challenges the assumption that ESG frameworks are only relevant for large organizations or financial markets.

Furthermore, the findings suggest that sustainable management practices in community-based irrigation waste management are multidimensional outcomes shaped by interactions between technical efficiency, social dynamics, and governance arrangements. Sustainable management is reflected not only in improved operational efficiency, but also in institutional resilience and local economic continuity. This supports the view that sustainability should be evaluated as a composite outcome rather than a single performance indicator (Lozano, 2020).

Overall, the discussion highlights that the integration of circular economy and ESG frameworks provides a robust and scalable model for sustainable environmental management at the community level. The model proposed in this study demonstrates how sustainability initiatives can be designed to address environmental challenges while simultaneously strengthening social capital and governance capacity. These insights are particularly relevant for developing countries, where institutional limitations and resource constraints require context-sensitive and participatory sustainability strategies.

IV. CONCLUSIONS

This study contributes to the 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 circular economy implementation 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 context. By empirically positioning ESG as an explanatory and enabling mechanism rather than merely a performance indicator, this study advances existing sustainability models.

This study also strengthens methodological transparency by providing complete statistical evidence using PLS-SEM

analysis, thereby enhancing the robustness and credibility of the proposed sustainability 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 aligned with ESG principles. The results emphasize that investments in community governance capacity and social engagement are essential to achieving long-term sustainability impacts, particularly in rural and developing country contexts where institutional resources are limited.

Despite its contributions, this study has several limitations. First, the cross-sectional research design restricts the ability to capture dynamic changes in sustainability practices over time. Second, the empirical setting is limited to community-based irrigation waste management, which may constrain the generalizability of findings to other environmental management contexts. Third, the study relies on perceptual survey data, which may be subject to respondent bias.

Future research is encouraged to employ longitudinal designs to examine the long-term sustainability effects of circular economy and ESG integration. Comparative studies across different regions or sectors are also recommended to enhance generalizability. Additionally, incorporating qualitative or mixed-method approaches could provide deeper insights into institutional dynamics and community governance processes that underpin sustainable management practices.

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