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Adaptive Sustainable Supply Chain Management in Public Procurement: A Case Study of SMEs in the Water Infrastructure Sector

Bagaskara Estiarto[1], Maya Widyana Dewi[2], Budiyono[3]
[1]Student of Management Program, Institut Teknologi dan Bisnis AAS Surakarta, Indonesia, bagaskaraestiarto694@gmail.com
[2]Management Program, Institut Teknologi dan Bisnis AAS Surakarta, Indonesia, widyamine77@gmail.com
[3]Management Program, Institut Teknologi dan Bisnis AAS Surakarta, Indonesia, budiyono_bk@yahoo.co.id

Corresponding Author: bagaskaraestiarto694@gmail.com[1]

Abstract: This study aims to examine how small and medium-sized enterprises (SMEs) implement Sustainable Supply Chain Management (SSCM) principles within the context of government procurement (Business-to-Government/B2G), particularly in the water infrastructure sector. Using a qualitative approach with a case study design, this research focuses on PT Bagaskara Tirta Sejahtera (BTS), a local SME undergoing market reactivation and supply chain restructuring following a period of operational inactivity. Data were collected through in-depth interviews, limited observations, and analysis of internal and external documents. The findings indicate that the development of an adaptive SSCM model occurs incrementally, beginning with supply chain remapping, followed by logistics system improvements, basic digitalization, and culminating in the integration of sustainability values into both operational and communication strategies. The results demonstrate that SSCM implementation in SMEs operating within public procurement systems is non-linear and highly contextual, shaped by internal capabilities and external pressures from government stakeholders. This study contributes by proposing an adaptive SSCM model applicable to SMEs and enriching the literature on sustainable supply chains in developing countries.

Keywords: Sustainable Supply Chain Management, SMEs, Public Procurement, Water Infrastructure, Sustainability

INTRODUCTION

Access to safe, reliable, and sustainable drinking water constitutes a fundamental pillar in achieving Sustainable Development Goal (SDG) 6, which emphasizes universal and equitable access to clean water and sanitation. Beyond its direct implications for public health, water infrastructure plays a critical role in economic productivity, environmental protection, and social equity, particularly in rapidly developing economies. In countries such as Indonesia, the effectiveness of clean water service delivery is highly contingent upon the operational

performance of public water utilities (Perusahaan Daerah Air Minum/PDAM) and, crucially, the efficiency and integrity of procurement systems that govern the acquisition of infrastructure components, materials, and services.

Within this context, government procurement (Business-to-Government/B2G) emerges as a strategic policy instrument through which sustainability principles can be embedded across the supply chain. Procurement decisions not only determine cost efficiency but also shape supplier behavior, technological adoption, and environmental performance across upstream and downstream actors. As such, public procurement in the water sector represents a critical leverage point for advancing Sustainable Supply Chain Management (SSCM) practices at scale.

However, despite its strategic importance, procurement practices in many developing countries remain predominantly driven by short-term cost considerations, with a persistent reliance on lowest-bid selection mechanisms. This price-oriented approach often undermines long-term value creation, including lifecycle cost efficiency, environmental sustainability, and social responsibility (Sánchez, 2025). Consequently, infrastructure projects may suffer from reduced durability, higher maintenance costs, and limited alignment with sustainability objectives.

In response to these challenges, there has been a growing global emphasis on integrating SSCM principles into public procurement systems. This shift encourages procurement stakeholders to incorporate environmental, social, and economic criteria, aligned with the Triple Bottom Line, into supplier selection, contract management, and performance evaluation processes (Piot-Lepetit, 2025). Such integration aims to transform procurement from a transactional function into a strategic mechanism for sustainable development.

Nevertheless, the transition toward SSCM is uneven, particularly among small and medium-sized enterprises (SMEs), which constitute the backbone of local supply chains. While SMEs play a pivotal role in supporting regional procurement systems and ensuring supply continuity, they frequently encounter structural and operational constraints. These include limited access to financial capital, inadequate technological infrastructure, low levels of digital literacy, and insufficient institutional support, all of which hinder their ability to comply with increasingly stringent sustainability requirements (Ben Hassen et al., 2025).

This situation reveals a significant theoretical and empirical gap. From a theoretical perspective, dominant SSCM frameworks, primarily developed and validated in advanced economies, tend to assume the presence of mature institutions, advanced technological systems, and well-resourced firms. As a result, these models often fail to adequately capture the bureaucratic complexity, resource limitations, and informal practices that characterize supply chain operations in developing country contexts (Bobini et al., 2025).

From an empirical standpoint, there remains a scarcity of context-specific studies examining how SSCM is actually implemented within public procurement systems in critical infrastructure sectors such as water supply. This gap is particularly evident in Indonesia, where the intersection between SMEs, public procurement, and sustainability has not been sufficiently explored in academic literature (Kankanamge & Ruparathna, 2024). Addressing this gap is essential for developing adaptive, context-sensitive SSCM models that are both theoretically robust and practically applicable.

METHOD

This study employs a qualitative approach with an exploratory case study design to examine the implementation of Sustainable Supply Chain Management (SSCM) within public procurement in the water infrastructure sector. This approach is appropriate as it enables an in-depth understanding of organizational processes, contextual dynamics, and stakeholder perspectives, particularly in contexts where SSCM practices are still evolving and highly dependent on local conditions.

The study focuses on PT Bagaskara Tirta Sejahtera (BTS), a local SME involved in government procurement (B2G) and actively supplying PDAM. The case was selected purposively due to its ongoing supply chain restructuring following a period of operational inactivity, providing a relevant setting to analyze SSCM adoption in a transitional context.

Data were collected through in-depth semi-structured interviews with key informants, including company management, operational staff, and representatives from PDAM, complemented by limited observations of logistics and administrative processes. In addition, document analysis was conducted on internal records such as SOPs, purchase orders, and digital logs, as well as external procurement-related documents. The use of multiple data sources allows for triangulation and enhances the credibility of the findings.

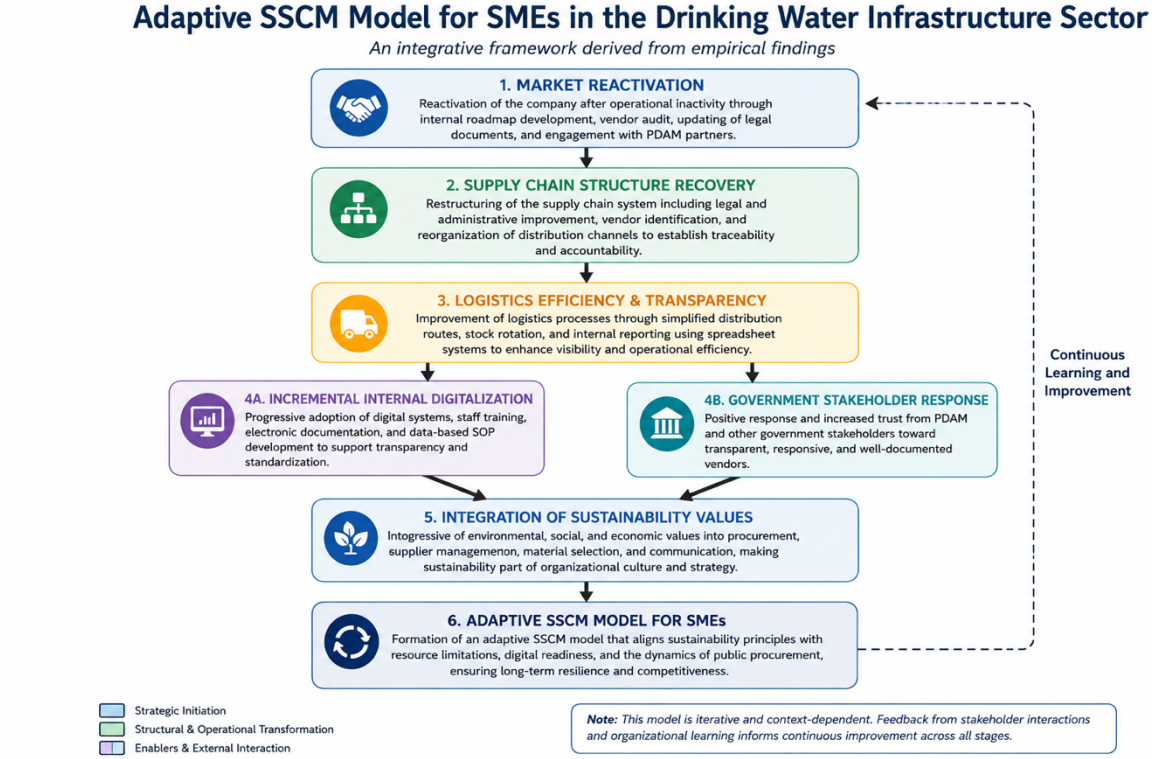
The interview protocol was developed based on the Triple Bottom Line (TBL) framework, covering environmental, social, and economic dimensions of sustainability. Data analysis followed the interactive model of Miles, Huberman, and Saldaña, involving data reduction, data display, and iterative conclusion drawing. To ensure research rigor, the study applied triangulation, member checking, and systematic documentation of the analytical process.

Ethical considerations were maintained through informed consent, confidentiality of participants, and restricted use of sensitive organizational data.

RESULTS AND DISCUSSION

This study aims to provide an in-depth understanding of how small and medium-sized enterprises (SMEs), particularly PT Bagaskara Tirta Sejahtera (BTS), implement Sustainable Supply Chain Management (SSCM) principles within the context of public procurement (Business-to-Government/B2G) in the water infrastructure sector. Consistent with the qualitative case study approach, the findings are organized into six major themes derived from the processes of data reduction, categorization, and thematic interpretation. These themes were developed based on the Triple Bottom Line framework proposed by Seuring and Müller (2008), as well as contemporary perspectives on sustainable public procurement and supply chain governance (Hamilton, 2022; Kankanamge & Ruparathna, 2024).

Figure 4.1. Adaptive SSCM Development Model for SMEs in Public Water Infrastructure Procurement



across its supply chain operations, which constitute essential elements of SSCM implementation.

After stabilizing its operational structure, the company shifted its focus toward logistics efficiency and supply chain transparency. This transformation was reflected in simplified distribution routes, stock rotation practices, and spreadsheet-based reporting systems aimed at improving operational visibility. Although the company had not yet adopted advanced digital infrastructure such as enterprise resource planning (ERP) systems, these initiatives represented an important transitional step toward supply chain visibility and process standardization.

Two parallel developments subsequently emerged from this transformation process. Internally, the company began implementing incremental digitalization initiatives, including staff training on digital documentation, electronic archiving systems, and data-based standard operating procedures (SOPs). Externally, government stakeholders—particularly PDAM—demonstrated a more positive response toward vendors capable of providing transparent, responsive, and well-documented operational practices. This finding suggests that institutional trust within public procurement increasingly depends on organizational transparency and administrative reliability.

These two trajectories eventually converged in the integration of sustainability values into the company's broader business strategy. At this stage, BTS began incorporating environmental, social, and economic considerations into supplier management, procurement communication, and material selection processes. Sustainability was no longer treated solely as an administrative requirement but gradually evolved into part of the company's organizational culture and long-term competitive strategy.

Ultimately, all of these stages contributed to the formation of an Adaptive SSCM Model for SMEs, which represents a sustainability-oriented supply chain framework specifically shaped by the realities of SMEs operating in developing-country procurement environments. Unlike idealized SSCM frameworks commonly discussed in the literature, this model acknowledges practical limitations such as restricted financial resources, uneven digital readiness, and institutional pressures within public procurement systems. Therefore, the model is adaptive and progressive rather than purely normative, aligning with recent SSCM studies emphasizing context-sensitive sustainability implementation in developing economies (Kankanamge & Ruparathna, 2024; Gunawardhana & Karunasena, 2022).

Accordingly, Figure 4.1 not only illustrates a logical sequence of organizational transformation but also reflects a broader process of institutional learning and sustainability-oriented adaptation within a highly bureaucratic and reputation-sensitive public procurement environment.

To further understand how Sustainable Supply Chain Management (SSCM) principles are adapted by SMEs within the context of public water infrastructure procurement, the following section presents the study findings based on thematic analysis derived from the company's strategic transformation process, ranging from market reactivation to the establishment of an adaptive SSCM model .

Figure 4.2. Distribution of SSCM Dimensions in SME Water Infrastructure Procurement

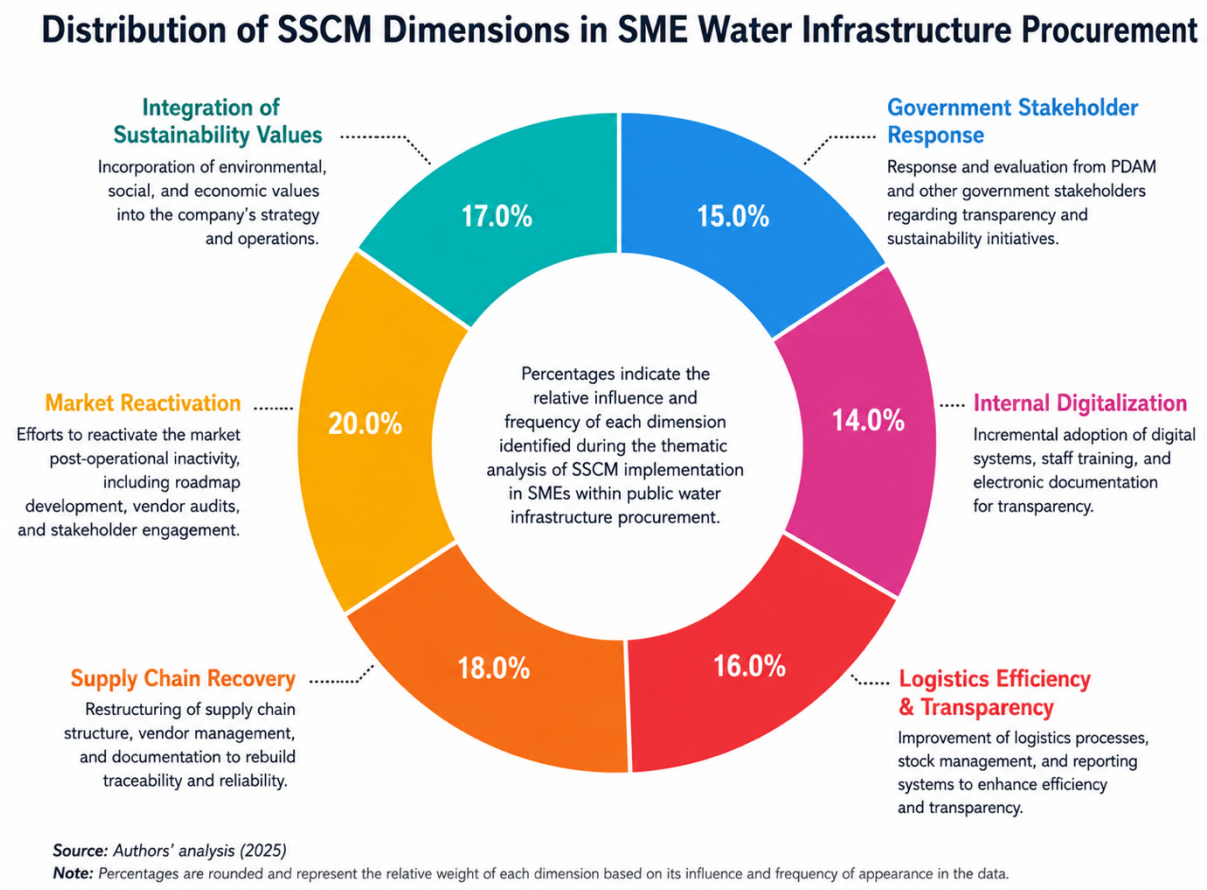


Figure 4.2 illustrates the distribution of the main thematic dimensions identified throughout the data analysis process based on both the frequency of occurrence and the relative influence of each theme on organizational transformation. The findings indicate that the dimensions of Market Reactivation (20%) and Integration of Sustainability Values (17%) emerged as the most dominant components. This suggests that the company's initial efforts to restore its position within the B2G market, combined with the gradual integration of sustainability principles into operational and strategic activities, constituted the primary foundation for developing an adaptive SSCM framework.

These dominant dimensions were followed by Supply Chain Recovery and Logistics Efficiency, highlighting the importance of stabilizing supply chain structures, improving operational transparency, and rebuilding distribution reliability following a period of organizational inactivity. Meanwhile, the dimensions of Internal Digitalization and Government Stakeholder Response also demonstrated substantial influence, particularly in strengthening organizational legitimacy, administrative credibility, and long-term competitiveness within the public procurement ecosystem.

Post-Inactivity Supply Chain Transformation

The first major finding reveals that prior to the company's reactivation process, BTS operated with a relatively linear and informal supply chain structure that relied heavily on long-standing personal relationships with vendors. Most operational procedures were undocumented, resulting in limited supply chain visibility and weak traceability mechanisms. This condition created significant vulnerabilities, particularly in responding to the increasing transparency requirements imposed by electronic government procurement systems (e-procurement).

During the reactivation phase, the company initiated a comprehensive restructuring process using a bottom-up approach. Based on its internally developed 90-day recovery roadmap, BTS conducted vendor audits, updated legal and administrative procurement documents, and redesigned distribution pathways from warehouse facilities to project locations. These initiatives marked the beginning of a more structured and accountable supply chain system.

Importantly, this transformation was not merely administrative but strategic in nature. By improving supplier verification and distribution documentation, the company gradually established stronger traceability and accountability practices, which are central components of SSCM implementation. This finding aligns with Govindan et al. (2015), who emphasize that supply chain visibility and supplier accountability are critical prerequisites for sustainable procurement systems.

Logistics Strategy Transformation Toward Efficiency and Transparency

In line with SSCM objectives aimed at enhancing operational efficiency while reducing environmental and economic inefficiencies, BTS implemented several changes within its internal logistics system. Interview findings revealed that the company began adopting stock rotation mechanisms, shipment grouping based on regional proximity, and simplified inventory coordination procedures.

Although the company had not yet implemented advanced technologies such as Enterprise Resource Planning (ERP) systems or real-time monitoring dashboards, it utilized interconnected spreadsheet systems and internally developed standard operating procedures to improve logistics coordination. This gradual approach demonstrates how SMEs can adapt sustainability-oriented logistics practices despite limited technological capacity.

The transformation also reflects the economic dimension of SSCM, where operational efficiency must be balanced with supply reliability and service consistency. In this regard, digital simplification served as an accessible and practical entry point for supply chain modernization. This finding supports Bobini et al. (2025), who argue that even basic forms of digitalization can significantly improve SME supply chain performance and organizational responsiveness.

Challenges in SSCM Implementation at the SME Level

Despite observable progress, the implementation of SSCM at BTS continues to face several structural and organizational challenges. One of the primary obstacles relates to supplier readiness, as several raw material vendors still lack environmental certifications or formally recognized sustainability standards. This situation complicates the company's efforts to strengthen supply chain compliance and sustainability assurance.

Internally, interviews revealed that sustainability is still frequently perceived by operational staff as an administrative burden rather than a strategic business advantage. Resistance toward procedural standardization and digital reporting practices also emerged, particularly among employees unfamiliar with technology-based workflows. These findings indicate that organizational culture and sustainability literacy remain critical barriers to SSCM adoption.

The findings reinforce the argument proposed by Gunawardhana and Karunasena (2022), who emphasize that internal capabilities, technological readiness, and managerial awareness constitute major determinants of SSCM transition success among SMEs. Therefore, sustainability transformation in SMEs should be understood as a gradual organizational learning process rather than an immediate operational shift.

Government Stakeholder Evaluation of Sustainability Initiatives

One of the study's key contributions lies in revealing how government stakeholders, particularly PDAM, evaluate vendor sustainability initiatives within the B2G procurement environment. Interviews with PDAM representatives indicated that BTS's efforts to conduct follow-up visits, update legal documentation, and provide clearer information regarding product origins significantly contributed to rebuilding institutional trust.

However, stakeholders also expressed concerns regarding the company's long-term environmental accountability and traceability systems. This suggests that sustainability within public procurement is no longer perceived merely as an added value, but increasingly as a compliance requirement and institutional expectation.

This finding supports Sánchez (2025), who argues that public procurement systems are gradually incorporating Environmental, Social, and Governance (ESG) considerations into vendor assessment frameworks. Consequently, SMEs seeking long-term participation in government procurement markets are increasingly required to demonstrate not only competitive pricing, but also transparency, accountability, and sustainability commitment.

Internal Capacity for Digitalization and Transparency

Digitalization emerged as one of the most critical dimensions in the company's supply chain modernization efforts. Although BTS has not yet adopted integrated supply chain management software, the company has started building a foundational digital ecosystem through interconnected spreadsheets, online documentation systems, and internal digital training initiatives.

Nevertheless, several limitations remain evident, including low employee familiarity with digital reporting systems and limited technological infrastructure. These constraints indicate that digital readiness among SMEs remains uneven and highly dependent on managerial commitment and organizational adaptability.

The findings support Piot-Lepetit (2025), who emphasizes that digitalization within SSCM should be approached incrementally, particularly in SMEs operating in resource-constrained environments. Furthermore, management involvement was found to play a crucial role in fostering reporting discipline and encouraging organizational acceptance of digital transformation initiatives.

Integration of Sustainability Values into B2G Market Strategy

Overall, sustainability values have gradually become integrated into BTS's broader market strategy, both in formal documentation and in communication practices with government stakeholders. The company increasingly incorporates sustainability narratives into procurement proposals, supplier management processes, and material selection decisions.

This shift reflects a broader transformation in organizational mindset—from a reactive vendor orientation toward a more proactive and strategically adaptive supply chain approach. Although the implementation process remains incomplete, the case demonstrates how SSCM principles can be translated into practical strategies within local SME contexts.

More importantly, the findings indicate that sustainability within B2G markets should not be viewed solely as a regulatory obligation imposed by government institutions. Instead, it represents a strategic opportunity for SMEs to strengthen competitiveness, improve institutional legitimacy, and secure long-term market access within increasingly selective procurement environments.

Collectively, these findings support the Triple Bottom Line-based SSCM framework proposed by Seuring and Müller (2008), while simultaneously extending it through the contextual realities of SMEs operating within Indonesia's public procurement sector. The environmental, social, and economic dimensions of sustainability do not operate independently; rather, they are interconnected through procurement logic, institutional

relationships, and organizational adaptation processes. Consequently, this study reinforces the importance of developing adaptive SSCM models capable of accommodating SME limitations while advancing sustainable public infrastructure procurement in developing countries.

CONCLUSION

This study aimed to examine how small and medium-sized enterprises (SMEs) operating in the public water infrastructure sector, particularly PT Bagaskara Tirta Sejahtera (BTS), develop and implement Sustainable Supply Chain Management (SSCM) practices within the context of government procurement (Business-to-Government/B2G). Using a qualitative case study approach, the research provides a comprehensive understanding of the internal and external dynamics influencing organizational readiness, strategic adaptation, and sustainability-oriented transformation within SME supply chains.

The findings reveal that the process of market reactivation following a period of operational inactivity constituted a critical starting point in rebuilding both organizational legitimacy and supply chain stability. This process extended beyond administrative recovery and involved broader strategic efforts, including the restructuring of legal documentation, direct engagement with PDAM stakeholders, vendor reassessment, and the formulation of a systematic operational recovery roadmap. These initiatives demonstrate that organizational resilience and institutional trust are fundamental prerequisites for SMEs seeking to re-enter highly regulated public procurement markets.

The study further demonstrates that supply chain transformation was gradually internalized through logistics restructuring, vendor remapping, and the establishment of more transparent reporting mechanisms. Although BTS operated under significant resource constraints, the company was able to adopt SSCM principles incrementally through practical and context-sensitive adjustments. This finding highlights that SSCM implementation within SMEs does not necessarily require sophisticated technological systems at the initial stage; rather, adaptive organizational commitment and managerial responsiveness play equally important roles in facilitating sustainability transitions.

In addition, the research identifies several major barriers affecting SSCM implementation. These include limited sustainability awareness among operational staff, insufficient digital readiness, resistance to procedural standardization, and the low compliance of suppliers with environmental and social standards. Such challenges indicate that sustainability transformation in SMEs is not solely a technical issue but also an organizational and cultural process that requires continuous learning and institutional support.

Despite these limitations, positive responses from government stakeholders—particularly PDAM—served as an important incentive for organizational transformation. The findings indicate that transparency, documentation quality, and supply chain accountability increasingly influence vendor evaluation within public procurement systems. Sustainability is therefore no longer positioned merely as a complementary attribute, but rather as an emerging component of procurement compliance and institutional credibility. This trend reflects a broader transition toward value-based procurement, in which environmental, social, and governance (ESG) considerations are progressively integrated into supplier assessment processes.

More importantly, this study proposes an Adaptive SSCM Model for SMEs, which reflects the interaction between internal organizational strategies, external institutional pressures, and continuous organizational learning. Unlike conventional SSCM models that are often developed within large corporations or advanced economies, the model identified in this study acknowledges the contextual realities faced by SMEs in developing countries, including resource limitations, uneven digital infrastructure, and bureaucratic procurement environments. As such, the model contributes both theoretically and practically to the growing literature on sustainable supply chain management in public sector contexts.

Overall, the study demonstrates that SSCM implementation among SMEs should be understood as a gradual, adaptive, and context-dependent process. Sustainability transformation within public procurement systems requires not only organizational willingness but also supportive institutional ecosystems capable of encouraging transparency, accountability, and long-term strategic collaboration.

Recommendations

Based on the findings and conclusions of this study, several recommendations can be proposed for practitioners, policymakers, and future researchers.

For SMEs operating within public infrastructure procurement, sustainability values should be integrated into supply chain management practices from the early stages of organizational development. Initial efforts may include improving documentation systems, strengthening supplier selection procedures, conducting internal sustainability training, and adopting gradual digitalization practices. Importantly, sustainability transformation should not be perceived as an administrative burden or regulatory obligation alone, but rather as a strategic opportunity to enhance competitiveness, institutional legitimacy, and long-term market access within increasingly selective government procurement environments.

For government institutions and regional public utilities such as PDAM, there is a need to develop procurement ecosystems that prioritize not only price efficiency and project completion speed, but also transparency, accountability, and sustainability performance. The gradual incorporation of Environmental, Social, and Governance (ESG) criteria into tender evaluation systems could encourage vendors to adopt more sustainable operational practices. In addition, technical assistance programs, digital capacity-building initiatives, and sustainability-oriented procurement guidelines for SMEs may strengthen institutional readiness and improve overall supply chain quality within public infrastructure sectors.

From an academic perspective, this study opens opportunities for further research on SSCM implementation across different sectors, regions, and organizational scales. Comparative studies involving multiple SMEs or cross-sector analyses would provide broader insights into how adaptive SSCM models evolve under varying institutional and economic conditions. Future studies may also explore the role of digital transformation, regulatory pressure, stakeholder collaboration, and social innovation in accelerating sustainability adoption among SMEs in developing economies.

Finally, this study contributes not only as an empirical case analysis but also as a reflective and practical framework for strengthening sustainable supply chain practices within public procurement systems. By demonstrating how SMEs can gradually adapt sustainability principles despite structural limitations, the study reinforces the importance of context-sensitive SSCM models in supporting more resilient, transparent, and sustainable public infrastructure development.

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