

# MAPPING GREEN PERFORMANCE INDICATORS IN SMALL AND MEDIUM ENTERPRISES (SMEs): A LITERATURE-BASED EXPLORATION OF GREEN SUPPLY CHAIN PRACTICES

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## Abstract

*This study aims to systematically examine the practices of Green Supply Chain Management (GSCM) within the context of small and medium enterprises (SMEs), with a focus on green performance indicators used across various academic studies. The review employs a qualitative approach through a literature review of articles indexed in Scopus. A total of 131 articles were retrieved and through a step-by-step screening process based on relevance to the research questions, 24 articles were selected for in-depth analysis. The findings reveal that the most commonly used green performance indicators include Green HRM, Green Innovation, Environment Performance, Government Intervention Policy, Operational Efficiency, dan Technological Adoptions. However, most studies have not employed standardized measurement frameworks, particularly in the context of SMEs in developing countries. This review identifies a gap in the literature regarding green performance measurement, which can serve as a foundation for developing more contextual and applicable evaluation models for the SME sector. The findings are expected to contribute to the development of more effective and sustainable GSCM implementation strategies and policies.*

**Keywords:** Green Supply Chain Management (GSCM), Small Medium Enterprises (SMEs), Green Performance Indicators, Literature Review

## INTRODUCTION

Indonesia's economic structure is highly dependent on the small and medium industrial sector (SMEs/IKM). As of 2023, the number of SMEs in Indonesia reached approximately 4.19 million business units, accounting for 99.7% of all national industrial enterprises (Alexander, 2024). SMEs also absorb more than 65% of the industrial workforce—around 12.67 million workers—and contribute 21.44% of the total national industrial output (Owo, 2024). This strategic role positions SMEs as the backbone of Indonesia's economy, particularly in generating employment, promoting equitable welfare distribution, and reducing poverty. Moreover, SMEs operate across diverse industrial sectors, with the five largest sectors by number of business units being food manufacturing (1,800,827 units), wood and wood products (654,788 units), apparel manufacturing (623,323 units), textiles (263,304 units), and miscellaneous processing industries (217,183 units) (Reynaldy, 2024). The dominance of these sectors demonstrates that SMEs are not only significant in number but also hold substantial potential to support the national industrial transformation toward greater sustainability.

Despite their scale and contributions, most SMEs have not yet adopted Green Supply Chain Management (GSCM) principles in their operations (Briliana et al., 2020). Environmentally conscious supply chain practices are still not a primary focus, as SMEs

tend to prioritize cost efficiency, business continuity, and fulfilling local market demand. Consequently, production processes, raw material procurement, and product distribution are often conducted using conventional methods, which may lead to adverse environmental impacts and undermine long-term sustainability.

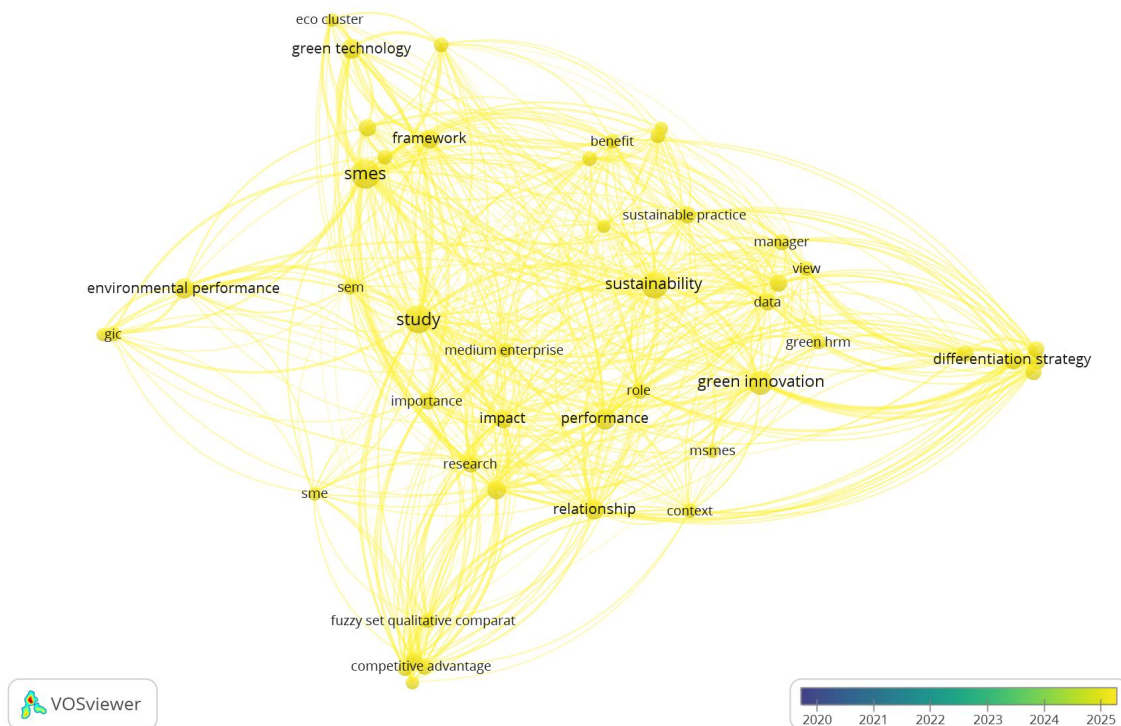
Green Supply Chain Management (GSCM) refers to the integration of sustainability principles into all supply chain activities—including planning, procurement, production, distribution, and waste management (Zhu, Sarkis, & Lai, 2008). GSCM also requires companies to balance economic and environmental performance in order to remain competitive while complying with regulatory and societal pressures (Gawusu et al., 2021). Numerous studies show that GSCM implementation in large firms—such as automotive, electronics, and textiles—has yielded positive impacts on operational efficiency, corporate reputation, and environmental compliance. This is supported by studies conducted by Zhu and Sarkis (2004), Kalyar, Shoukat, and Shafique (2020) and Rupa and Safi (2021), which highlight that firms adopting GSCM can simultaneously enhance both environmental and economic performance. However, these studies predominantly focus on large enterprises with substantial resources, while research on GSCM adoption within the SME sector remains limited.

The limited adoption of GSCM among SMEs has negative consequences at the national level. Without sustainable supply chain practices, SMEs risk becoming major contributors to environmental pollution, natural resource depletion, and rising carbon emissions (Afolabi, Ram, Hussainey, Nandy, & Lodh, 2022). These issues not only damage local ecosystems but also hinder Indonesia's progress toward achieving sustainable development goals and commitments to reducing greenhouse gas emissions (IESR, 2025). Additionally, low GSCM adoption may weaken the competitiveness of SME products in international markets, where consumers and business partners increasingly demand transparency and sustainability in supply chains (Nege & Abegaz, 2024).

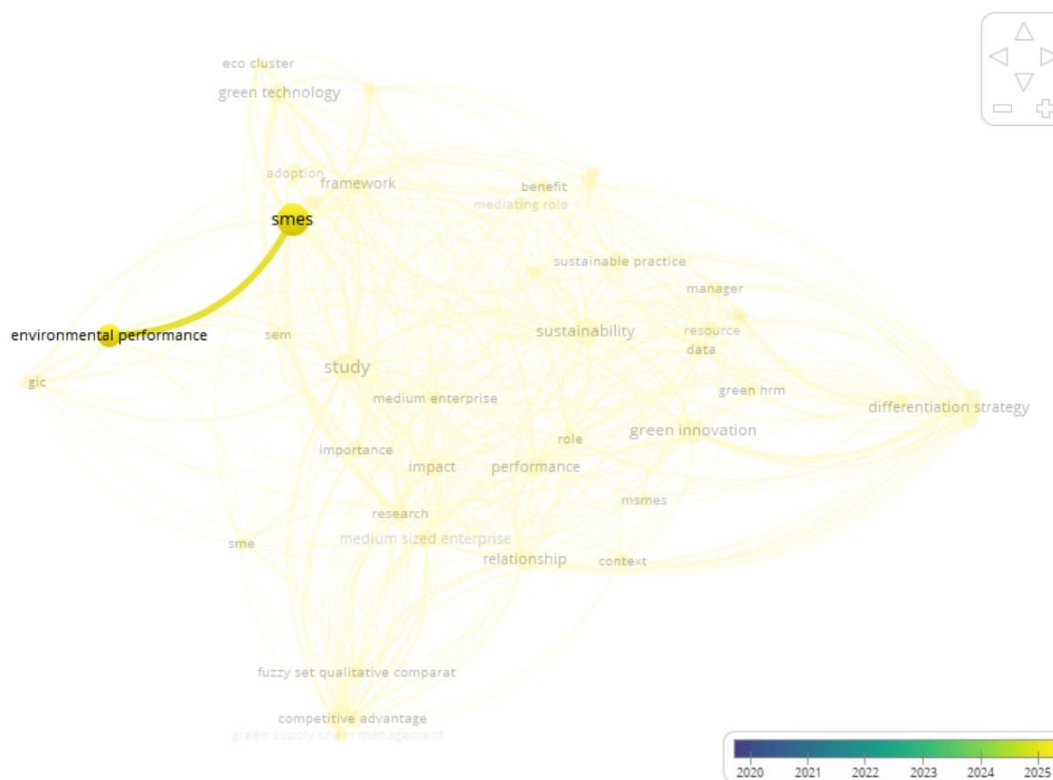
Several key factors contribute to the low adoption of GSCM among Indonesian SMEs. These include limited access to green technologies (Kania & Bukhori, 2025), a lack of knowledge and training related to sustainability practices (Gazali & Zainurrafiqi, 2025; Musa & Chinniah, 2016), and the substantial initial investments required (Ikhtiari, Azis, Ramadani, & Putri, 2024). Many SME owners are not yet aware of the long-term benefits of GSCM, both in terms of operational efficiency and brand value. Moreover, simple organizational structures and limited human resources make the transition toward green supply chains particularly challenging.

In addition, GSCM implementation in SMEs is not yet supported by standardized performance measurement systems. Most SMEs that attempt to adopt green practices rely solely on independently acquired knowledge, without clearly defined and measurable green performance indicators. This makes it difficult to evaluate the effectiveness of GSCM implementation and hampers continuous improvement efforts at both the firm and industry levels.

Consequently, there is a notable gap in the literature regarding green performance measurement for SMEs. Existing studies largely focus on implementation factors, drivers and barriers, or case studies in large corporations. Research specifically addressing how GSCM performance can be measured and evaluated in the SME context remains scarce. Therefore, this literature review aims to fill this gap by examining relevant and applicable green performance measurement approaches for SMEs in Indonesia and by offering recommendations for developing a more structured and contextual evaluation system.



**Figure 1. Research Network Based on Keywords**



**Figure 2. Gap of The Study**

The literature review was conducted in the early stage of this research to clarify the research gap and formulate research objectives. Using the Scopus database, 131 articles were identified using the keywords “SMEs AND Green Supply Chain AND Performance,” filtered for the 2020–2025 period and limited to reputable Scopus-indexed journals. Figure 1 presents the distribution and interrelationships of the keywords visualized using the VOS Viewer application. Prior studies on green practices have primarily focused on measuring environmental performance in large-scale industries. In contrast, the present study explores parameters that can serve as practical references for SME actors seeking to adopt green practices.

The relationship among the keywords SMEs, Green Supply Chain, and Performance was analyzed to identify research gaps, as illustrated in Figure 2. The visualization indicates that research on green practices in SMEs remains limited, with much of the existing literature focusing on green HRM, government intervention policies, green innovation, customer awareness, operational efficiency, environmental performance, and the circular economy. To address this gap, the present study aims to explore green performance indicators that are relevant and applicable to SMEs and to answer two main research questions: (1) What green performance indicators have been identified in SME-related literature? and (2) How relevant and applicable are these indicators in the operational and strategic contexts of SMEs? Identifying these indicators is expected to enrich understanding of sustainability practices within the SME sector, particularly in Indonesia as a developing country. The findings provide a foundation for policymakers, foreign investors, and other stakeholders to design appropriate intervention strategies. The practical contribution of this study lies in supporting the adoption of efficient and environmentally friendly technologies, thereby strengthening green performance and facilitating sustainable transformation within the SME sector.

## **LITERATURE REVIEW**

### **SMEs in Indonesia**

SMEs in Indonesia constitute the backbone of the national economy. They account for approximately 99% of all business entities, absorb more than 97% of the workforce, and contribute around 61% to the country’s Gross Domestic Product (ANTARA News, 2024). A study by Judijanto, Utami, Apriliani, & Rijal (2023) highlights the importance of innovation and sustainability practices in strengthening entrepreneurial performance among SMEs. Their findings indicate that the integration of innovation, sustainability, and digitalization positively influences entrepreneurial outcomes and enhances the competitiveness of SMEs. However, a large proportion of SMEs continue to operate using traditional business models and face significant challenges in accessing resources necessary for product development and innovation, let alone the adoption of green practices.

### **Green Supply Chain Management**

Green Supply Chain Management (GSCM) is a strategic approach that integrates environmental considerations into all supply chain activities, encompassing product design, raw material selection, production processes, distribution, and end-of-life product management (Handfield & Nicholas, 2002). Maheshwari, Jaggi, and Gautam (2025) highlight that GSCM has become a central focus in operations management and

sustainability research, reflecting its growing relevance in organizational practices and policy development.

Complementing this perspective, Herrmann, Barbosa-Povoa, Butturi, Marinelli, and Sellitto (2021) developed a comprehensive conceptual framework for GSCM consisting of three environmental dimensions, 21 categories, and 64 green practices. These practices include green procurement, eco-design, low-emission logistics, recycling, and other sustainability-oriented operational activities. Their framework demonstrates the multidimensional nature of GSCM and offers a structured basis for evaluating the implementation of green practices across different industries.

Furthermore, several empirical studies have shown that the adoption of GSCM practices is positively associated with sustainability performance—comprising environmental, economic, and social outcomes—as well as competitive advantage (Zhan Chin, Kaihan, & Qi, 2024). These findings underscore that GSCM is not merely a compliance-oriented initiative but a strategic capability that contributes to long-term organizational performance.

### **Green Performance Measurement**

Green performance measurement within Green Supply Chain Management (GSCM) represents a critical component in assessing the effectiveness and efficiency of sustainability practices across the supply chain. Cazeria, Ordoñez, and Novaski (2017) emphasize that although GSCM has been increasingly adopted across various industries, performance assessment remains predominantly focused on economic and environmental dimensions, while the social dimension has received considerably less scholarly attention. This imbalance suggests that current evaluation approaches may not fully reflect the holistic nature of sustainable supply chain management.

Tuni, Rentizelas, and Duffy (2018) further identify that the quantitative methods used to measure environmental performance within supply chains lack standardization. Existing assessments generally concentrate on energy consumption, air emissions, and natural resource utilization, yet they often fall short in capturing environmental impacts beyond a firm's immediate supply chain partners. These limitations highlight the need for more robust and integrative measurement frameworks capable of tracing broader ecological consequences.

In addition, Zeng and Zeng (2022) propose the incorporation of Environmental, Social, and Governance (ESG) indicators as a more comprehensive approach to evaluating green supply chain performance. Their findings indicate that operational and environmental dimensions carry greater weight than profitability in determining overall green supply chain performance. This underscores the shifting emphasis from purely financial outcomes to multidimensional sustainability metrics, reflecting broader stakeholder expectations and evolving regulatory pressures.

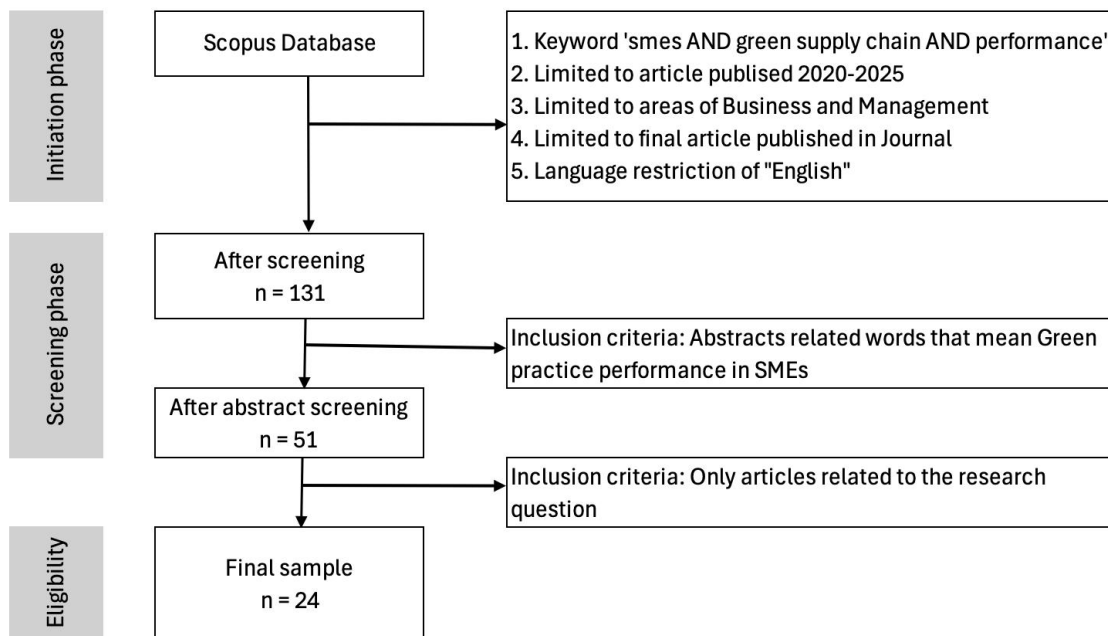
## **RESEARCH METHOD**

This study adopts a qualitative approach through an in-depth systematic literature review (SLR). The process involves searching multiple databases, screening articles for eligibility, assessing the quality of included studies, and synthesizing the results (Shaheen et al., 2023). The primary objective is to identify and synthesize green performance indicators relevant to the sustainable management of Small and Medium

Industries (SMEs). The overall procedure follows a multi-stage protocol which are illustrated in the accompanying flow diagram (Figure 3).

The literature search began with the identification of peer-reviewed journal articles indexed in Scopus, selected because of its comprehensive coverage of credible publications in Business and Management. The search query—‘smes’ AND ‘green supply chain’ AND ‘performance’—was applied with restrictions on publication years (2020–2025), subject area (Business and Management), document type (final journal articles), and language (English). Developing clearly articulated selection criteria is a critical first step in conducting a systematic review, as these criteria function as the central framework guiding the screening and evaluation of studies. By providing consistent decision rules, they help maintain focus, reduce potential errors, and ensure transparency and reproducibility throughout the review process (Martinez et al., 2023). This initial search produced a total of 131 articles, which became the dataset for subsequent screening.

The screening process was conducted systematically in several stages. The first stage involved title screening, during which all 131 articles were examined to determine whether their titles indicated relevance to green practices or SME contexts. Articles deemed irrelevant were removed at this point. The second stage involved reviewing the abstracts of the remaining articles to assess whether they addressed themes related to green practice performance within SMEs; this process narrowed the pool to 51 articles that met the inclusion criteria. The final stage consisted of a full-text eligibility review, in which each of the 51 articles was examined in detail to evaluate its substantive alignment with the research question. After this rigorous assessment, 24 articles were identified as highly relevant and suitable for comprehensive analysis.



**Figure 3. Stage of This Study**

To ensure methodological transparency and replicability, explicit inclusion and exclusion criteria were applied throughout the review process. Articles were included if they discussed green supply chain practices, green performance, or sustainability practices specifically within SME, and if they provided empirical findings, conceptual models, or performance indicators relevant to environmental or operational sustainability. Only English-language journal articles indexed in Scopus within the defined publication window were considered. Articles were excluded if they focused on non-SME contexts, lacked performance-related content, were not full journal articles (such as conference papers or book chapters), demonstrated insufficient methodological rigor, or diverged from the research question upon deeper review.

The final set of 24 articles represents the most relevant, methodologically sound, and thematically aligned sources available within the defined search parameters. These articles collectively provide a rich foundation for identifying key green performance indicators and organizing them into meaningful dimensions applicable to the sustainable development and management of SMEs. To maintain consistency in the analysis, the study employed a clear coding procedure that integrated both deductive and inductive approaches. During the open-coding stage, sustainability-related concepts were identified, followed by axial coding to categorize similar indicators, and finally selective coding to merge these categories into the core dimensions of green performance.

## **RESULTS AND DISCUSSION**

### **Green Performance Measurement in SME**

The final screening of the 24 selected articles resulted in the identification of six key indicators influencing the implementation of green performance measurement in Small and Medium Industries (SMEs). These indicators are summarized in Table 1. The factor with the highest frequency (50%) is Green Human Resource Management (GHRM). Environmentally conscious organizations require a workforce capable of understanding and actively supporting sustainability-oriented policies (Altassan, 2024). This finding is reinforced by Junejo et al. (2025), who argue that firms leveraging insights derived from their human resources are better positioned to make informed decisions aligned with sustainability objectives, thereby enhancing both economic viability and environmental management performance.

Furthermore, studies conducted by Syarief (2021), Olekanma, Rodrigo, Adu, & Gahir (2024), Guo et al. (2024), Jo and Kwon (2022), Lu et al. (2020), and Sunarya, Nur, Rachmawati, Suwiryo, & Jamaludin (2023) demonstrate that Green Innovation is a critical determinant in assessing green performance. The adoption of green innovation enables firms to develop competitive advantages, improve operational efficiency, and enhance business performance (Syarief, 2021). This suggests that innovation-driven sustainability practices constitute a strategic pathway for SMEs to achieve long-term competitiveness.

Another important indicator in evaluating green performance is Environmental Performance, which reflects the extent to which firms reduce their environmental footprint (Altassan et al., 2023; Syarief, 2021; Dzikriansyah et al., 2023; Olekanma et al., 2024). Environmental performance assessments often emphasize carbon footprint reduction, which plays a pivotal role in supporting the transition toward low-carbon economic activities (Olekanma et al., 2024). Consistent with the findings of Kumar et al.

(2023), Kim, Lee, and Lim (2021), Kosasih, Pujawan, and Karningsih (2023), Yaroson, Chowdhury, Mangla, and Dey (2024), Lu et al. (2020), Sunarya et al. (2020), Vörösmarty and Dobos (2020), and Benjamin et al. (2023), this indicator captures the firm's capacity to produce optimal output while minimizing adverse environmental impacts.

In addition, the implementation of green practices within SMEs requires substantial support from government institutions (Reza-Gharehbagh et al., 2023; Kumar et al., 2023; Mankar et al., 2023; Kosasih et al., 2023; Dzikriansyah et al., 2023; Babaloo et al., 2024). Government intervention may include regulatory frameworks, incentives, capacity-building programs, and access to green technologies. Technology adoption itself emerges as a critical factor in evaluating sustainability performance, as this indicator not only assesses technical effectiveness but also reflects the long-term commitment of SMEs to environmentally responsible and future-oriented business practices (Kumar et al., 2023; Junejo et al., 2025; Faisal, Widiawati, Ramadhani, & Sumantri, 2025; Al Naimat & Davies, 2025).

Overall, the six identified indicators collectively highlight the multidimensional nature of green performance measurement in SMEs, emphasizing internal capabilities, innovation, environmental impact, government support, and technological readiness as key determinants of sustainable supply chain transformation. However, a deeper analysis shows that the six indicators do not represent a homogeneous conceptual category. Instead, they operate across four analytically distinct levels, reflecting the multidimensional character of sustainability measurement.

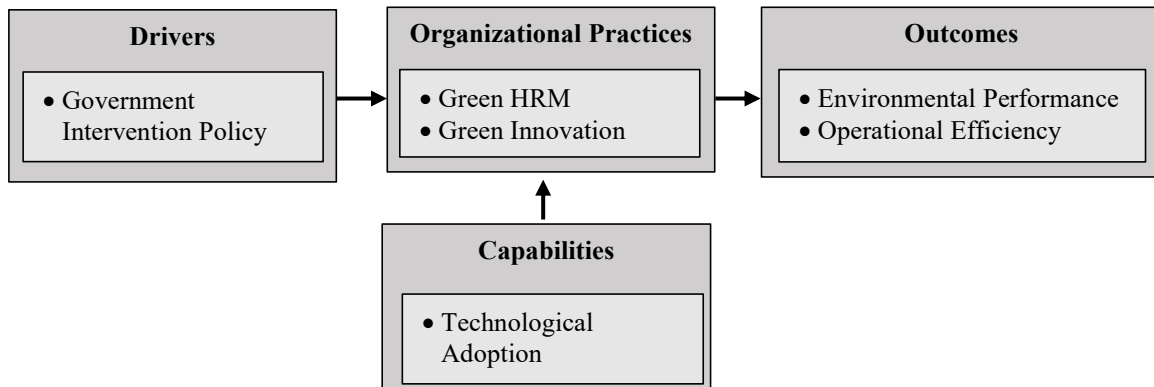
Organizational practices such as Green HRM and Green Innovation emphasize the internal behaviors and strategic initiatives that enable SMEs to embed sustainability into daily operations. Institutional drivers, particularly Government Intervention Policy, shape the external regulatory and support environment that determines the readiness and motivation of SMEs to adopt green practices. Technological Adoption functions as an enabling capability, reflecting a firm's readiness to implement environmentally responsible and future-oriented business processes.

Meanwhile, Environmental Performance and Operational Efficiency represent measurable performance outcomes that capture reductions in environmental footprint and improvements in resource utilization. Treating these heterogeneous constructs as equivalent indicators risks conceptual ambiguity; therefore, distinguishing them into drivers, practices, capabilities, and outcomes offers a clearer theoretical structure. This refined categorization elevates the contribution of the study by moving beyond descriptive aggregation and presenting a coherent causal logic that explains how SMEs transition from institutional pressures to organizational action, capability development, and ultimately, sustainability outcomes.

To support the conceptual clarification discussed above, the relationship among institutional drivers, organizational practices, enabling capabilities, and performance outcomes is illustrated in the diagram below. The visual framework provides a clearer representation of how these constructs operate at different analytical levels and interact within SME sustainability systems (Figure 4.)

**Tabel 1. Green Performance Measurement Indicators in SME**

No	References	Indicators Performance					
		Green HRM	Green Innovation	Environment Performance	Government Intervention Policy	Operational Efficiency	Technological Adoptions
1	Altassan M., 2023	V	V	V			
2	Reza-Gharehbagh R.; Arisian S.; Hafezalkotob A.; Makui A., 2023				V		
3	Kumar R.; Gupta S.; Ur Rehman U., 2023				V	V	V
4	Junejo I.; Sohu J.M.; Alwadi B.M.; Ejaz F.; Nasir A.; Hossain M.B., 2025	V	V				V
5	Kim S.T.; Lee H.-H.; Lim S., 2021	V				V	
6	Mankar V.; Vichoray C.; Somani N.; Deogaonkar A.; Ranade A., 2023	V			V		
7	Syarief E., 2021		V	V			
8	Kosasih W.; Pujawan I.N.; Karningsih P.D.; Shee H., 2023	V			V	V	
9	Dzikriansyah M.A.; Masudin I.; Zulfikarjah F.; Jihadi M.; Jatmiko R.D., 2023	V		V	V		
10	Olekanma O.; Rodrigo L.S.; Adu D.A.; Gahir B., 2024	V	V	V			
11	Babalola, Abdul Rahim, & Omar, 2024			V	V		
12	Muafi; Kusumawati R.A., 2021	V		V			
13	Alhitmi H.K.; Ndambuki D., 2023				V		
14	Guo J.; Jia F.; Yan F.; Chen L., 2024		V				
15	Jo D.; Kwon C., 2022		V	V			
16	Faisol; Widiawati H.S.; Ramadhani R.A.; Sumantri B.A., 2025	V					V
17	Yaroson E.V.; Chowdhury S.; Mangla S.K.; Dey P.K., 2024			V		V	
18	Waqas U.; Umair S.; Mrugalska B.; Al Shamsi I.R.; Bystrov I., 2024	V		V			
19	Lu J.; Ren L.; Zhang C.; Rong D.; Ahmed R.R.; Streimikis J., 2020		V			V	
20	Sunarya E.; Nur T.; Rachmawati I.; Suwiryo D.H.; Jamaludin M., 2023	V	V			V	
21	Naimat A.A.A.; Davies L., 2025						V
22	Vörösmarty G.; Dobos I., 2020				V	V	
23	Joo H.-Y.; Min H., 2023			V	V		
24	Benjamin A.K.; Shee H.K.; de Vass T., 2023	V				V	



**Figure 4. Conceptual Diagram of Green Performance Indicators in SME**

### **Relevance of Green Practice Indicators for SME**

The literature review identifies six key indicators that influence the measurement of green performance in Small and Medium Industrie (SME), each exhibiting strong relevance to sustainability-oriented practices. Green Human Resource Management (GHRM) emerges as the most dominant indicator, underscoring the importance of managing human resources in ways that support environmental policies through training programs, incentive systems, and the development of pro-environment organizational cultures (Altassan, 2024; Junejo et al., 2025). Effective implementation of GHRM enables SMEs to embed sustainability values into decision-making processes, thereby enhancing economic performance while simultaneously reducing environmental impacts.

In addition to human resource management, Green Innovation represents a strategic factor that drives the development of more efficient and environmentally friendly products and processes. This indicator is particularly relevant for SMEs, as the ability to innovate sustainably contributes to the creation of competitive advantages, strengthens market positioning, and aligns firms with the increasing demands of sustainability-oriented consumers (Syarief, 2021; Olekanma et al., 2024; Guo et al., 2024). Green innovation thus serves as a catalyst for improving both operational outcomes and long-term business competitiveness.

Beyond innovation and human resources, Environmental Performance constitutes a crucial dimension for evaluating the success of green practices. This indicator reflects efforts to reduce carbon footprints, improve energy efficiency, and manage waste more effectively—all of which support the broader transition toward a low-carbon economy (Olekanma et al., 2024; Kumar et al., 2023). Environmental performance measurement provides a tangible basis for assessing how well SMEs mitigate ecological impacts while maintaining operational productivity.

Government support also plays a catalytic role in facilitating the adoption of green practices. Regulatory frameworks, financial incentives, and capacity-building programs serve as enablers that encourage SMEs to invest in environmentally friendly technologies and sustainable business practices (Reza-Gharehbagh et al., 2023; Mankar et al., 2023). Such institutional support is essential for overcoming structural barriers commonly faced by SMEs, including limited access to capital, technology, and technical expertise.

Furthermore, the adoption of green technologies emerges as a vital indicator of sustainability performance. Green technology adoption enhances operational efficiency and signifies a firm's long-term commitment to sustainability, while simultaneously

strengthening its competitiveness in increasingly globalized markets (Kumar et al., 2023; Faisal et al., 2025; Al Naimat & Davies, 2025). Technological upgrading thus plays a dual role supporting environmental objectives and enhancing strategic positioning.

Based on these findings, SMEs are encouraged to integrate GHRM through structured employee training, promote green innovation by allocating modest research budgets, conduct regular environmental performance assessments, leverage government incentives, adopt environmentally friendly technologies, and establish collaborations with industry associations and research institutions to accelerate knowledge transfer and green technology adoption.

Beyond their functional relevance within SME operations, the six indicators also carry broader contextual and global significance that strengthens their applicability in diverse economic environments. In the Indonesian SME context, these indicators reflect structural gaps common across developing economies—such as limited technological readiness, fragmented regulatory support, and uneven sustainability awareness. However, when positioned within a global sustainability discourse, the same indicators align with internationally recognized frameworks that emphasize human capital development, innovation capability, and low-carbon transitions as key enablers of green competitiveness.

The presence of indicators such as Green HRM and Green Innovation mirrors global best practices in sustainable supply chain management, while Environmental Performance and Operational Efficiency correspond to internationally monitored sustainability metrics, including carbon reduction and resource optimization. Furthermore, the critical role of Government Intervention Policy and Technological Adoption resonates with global evidence showing that SMEs in both advanced and emerging economies rely heavily on institutional support and capability building to adopt green practices effectively. By situating these indicators within both national realities and global sustainability trajectories, the study not only enhances contextual integration but also positions SME green performance within a broader international narrative of sustainable industrial transformation.

## **CONCLUSION AND SUGGESTION**

This study confirms that green performance measurement in Small and Medium Industries (SMEs) is shaped by six key indicators: Green Human Resource Management (GHRM), Green Innovation, Environmental Performance, Government Intervention Policy, Operational Efficiency, and Technology Adoption. These indicators demonstrate direct relevance to the effectiveness of sustainability practices. GHRM contributes to the development of pro-environmental behavior through structured training and incentive mechanisms, whereas Green Innovation supports the creation of environmentally friendly products and processes that enhance competitive advantage. Environmental Performance reflects efforts to reduce carbon footprints and improve resource efficiency, while government intervention serves as a catalyst through regulatory support and incentive structures. Operational Efficiency ensures optimal resource utilization with minimal environmental impact, and Technology Adoption strengthens long-term sustainability commitments through digitalization and the application of eco-efficient technologies.

The findings offer practical implications for policymakers and SME practitioners. Governments should design targeted incentive schemes, provide technical assistance,

and expand access to green financing to accelerate the adoption of green technologies and sustainability-driven innovation. SMEs are encouraged to integrate GHRM through systematic employee training, conduct regular assessments of environmental performance, and utilize energy-efficient technologies and waste-management systems to enhance operational efficiency. Furthermore, collaboration among SMEs, industry associations, and research institutions should be strengthened to accelerate knowledge transfer and support the co-creation of sustainable, mutually beneficial solutions.

With appropriate implementation, SMEs can improve competitiveness, operational efficiency, and environmental responsibility, thereby contributing meaningfully to the national green economy agenda. As such, the study holds both academic and practical relevance, offering insights that support the advancement of sustainable industrial practices in developing economies.

## REFERENCES

- Afolabi, H., Ram, R., Hussainey, K., Nandy, M., & Lodh, S. (2022). Exploration of small and medium entities' actions on sustainability practices and their implications for a greener economy. *Journal of Applied Accounting Research*, 24(4), 655–681. doi:10.1108/JAAR-09-2022-0252.
- Alexander, H. B. (2024, January 6). 4,19 juta IKM serap 65,52 persen tenaga kerja industri nasional. Retrieved from: <https://lestari.kompas.com/read/2024/01/06/185735186/419-juta-ikm-serap-6552-persen-tenaga-kerja-industri-nasional>.
- Alhitmi, H. & Khalifa Ndambuki, D. (2023). Examining the impact of Russia-Ukraine conflict and China support on the supply chain of German family-owned SMEs in 2022. *Asian Journal of Political Science*, 31(3), 273-286. doi:10.1080/02185377.2023.2285921.
- Al Naimat, A., & Davies, L. (2025). A systematic literature review of supply chain management strategies and SME performance: A retrospective analysis, current trends and future opportunities. *Engineering Economics*, 36(2), 192-211. doi:10.5755/j01.ee.36.2.39372.
- Altassan, M. (2024). The moderating mediating model of green climate and green innovation's effect on environmental performance. *Uncertain Supply Chain Management*, 12(1), 345–358. doi:10.5267/j.uscm.2023.9.016.
- ANTARA News. (2024, March 7). *MSMEs contribute 61 percent to Indonesia's GDP: President Jokowi*. Retrieved from: <https://en.antaranews.com/news/307899/msmes-contribute-61-percent-to-indonesias-gdp-president-jokowi>.
- Babalola, H. B., Abdul Rahim, M. K. I., & Omar, S. (2024). Environmental factors and adoption of green supply chain management among SMEs in Nigeria: Moderating role of environmental uncertainty. *International Journal of Energy Economics and Policy*, 14(1), 640–650. doi:10.32479/ijeep.15456.
- Benjamin, A. K., Shee, H. K., & de Vass, T. (2023). Integrated lean-green practices and supply chain sustainability framework. *Journal of Cleaner Production*, 413, 137611. doi:10.1016/j.jclepro.2023.137611.
- Brilliana, C. W., Baihaqi, I., & Persada, S. F. (2020). Praktik Green Supply Chain Management (GSCM) pada UKM. *Jurnal Teknik ITS*, 9(1), F42-F46. doi:10.12962/j23373539.v9i1.48112.

- Cazeria, G. T., Anholon, R., Ordoñez, R. E. C., & Novaski, O. (2017). Performance measurement of green supply chain management: A literature review and gaps for further research. *Brazilian Journal of Operations & Production Management*, 14(1), 60–72. doi:10.14488/BJOPM.2017.v14.n1.a7.
- Dzikriansyah, M. A., Masudin, I., Zulfikarijah, F., Jihadi, M., & Jatmiko, R. D. (2023). The role of green supply chain management practices on environmental performance: A case of Indonesian small and medium enterprises. *Cleaner Logistics and Supply Chain*, 6(March 2023), 1-10. doi:10.1016/j.clscn.2023.100100.
- Faisol, Widiawati, H. S., Ramadhani, R. A., & Sumantri, B. A. (2025). The role of market uncertainty in fostering innovation and green supply chain management on the performance of tourism SMEs. *Sustainability*, 17(2), 1234–1250. doi:10.3390/su17021234.
- Gawusu, S., Zhang, X., Jamatutu, S. A., Abubakari, A., Amadu, A. A., & Miensah, E. D. (2021). The dynamics of green supply chain management within the framework of renewable energy. *International Journal of Energy Research*, 46(2), 1-83. doi:10.1002/er.7278.
- Gazali, D., & Zainurrafiqi, Z. (2023). The effect of green entrepreneur orientation on network resource acquisition and small and medium enterprises' business performance with knowledge transfer and integration and green technology dynamism as moderator variables. *Indonesian Interdisciplinary Journal of Sharia Economics (IJSE)*, 6, 136–153. doi:10.31538/ijse.v6i1.2722.
- Guo, J., Jia, F., Yan, F., & Chen, L. (2024). E-commerce supply chain finance for SMEs: The role of green innovation. *International Journal of Logistics: Research and Applications*, 27(9), 1596–1615. doi:10.1080/13675567.2023.2167959.
- Handfield, R. B., & Nicholas, E. L., Jr. (2002). *Supply chain redesign: Converting your supply chain into integrated value systems*. USA: FT Press.
- Herrmann, F. F., Barbosa-Povoa, A. P., Butturi, M. A., Marinelli, S., & Sellitto, M. A. (2021). Green supply chain management: Conceptual framework and models for analysis. *Sustainability*, 13(15), 1-20. doi:10.3390/su13158127.
- Ikhtiari, K., Azis, D. E. P., Ramadani, D., & Putri, A. A. U. F. (2024). Green entrepreneurial intention through green economy for developing student entrepreneurial character in Selangor, Malaysia. *Celebes Journal of Community Services*, 3(2), 315–326. Retrieved from: <https://issn.lipi.go.id/terbit/detail/20220208050983240>.
- Institute for Essential Services Reform. (2025, November 20). *Rising emissions overshadow ambition for 8 percent economic growth*. Institute for Essential Services Reform (IESR). Retrieved from: <https://iesr.or.id/en/rising-emissions-overshadow-ambition-for-8-percent-economic-growth/>.
- Jo, D., & Kwon, C. (2022). Structure of green supply chain management for sustainability of small and medium enterprises. *Sustainability*, 14(1), 1-20. doi:10.3390/su14010050.
- Joo, H.-Y., & Min, H. (2023). Assessing the impacts of government environmental policies on the small and medium-sized firm's performances in Korea and China. *Benchmarking: An International Journal*, 30(7), 2275–2302. doi:10.1108/BIJ-04-2021-0200.
- Judijanto, L., Utami, E.Y., Apriliani, D. & Rijal, S. (2024). A holistic review of MSME entrepreneurship in Indonesia: The role of innovation, sustainability, and the

- impact of digital transformation. *International Journal of Business, Law and Education*, 5(1), 119-132.
- Junejo, I., Sohu, J. M., Alwadi, B. M., Ejaz, F., Nasir, A., & Hossain, M. B. (2025). Green supply chain management and SMEs' sustainable performance in developing country: Role of green knowledge sharing, green innovation and big data-driven supply chain. *Discover Sustainability*, 6(342), 1-19. doi:10.1007/s43621-025-01055-6.
- Kalyar, M. N., Shoukat, A., & Shafique, I. (2020). Enhancing firms' environmental performance and financial performance through green supply chain management practices and institutional pressures. *Sustainability Accounting, Management and Policy Journal*, 11(2), 451–476. doi:10.1108/SAMPJ-02-2019-0047.
- Kania, D., & Bukhori, R. F. (2025). Green innovation management in Indonesian SMEs: Drivers, barriers, and performance implications for sustainable business development. *Proceeding of the International Conference on Sustainable Environment and Innovation (ICOSEI)*, 1(1), 1-6. doi:10.1007/s43621-025-01028-9.
- Kumar, A., & Kumar, K. (2023). A multi-objective optimization approach for designing a sustainable supply chain considering carbon emissions. *International Journal of System Assurance Engineering and Management*, 15, 1777-1793. doi:10.1007/s13198-023-02085-x.
- Kim, S. T., Lee, H.-H., & Lim, S. (2021). The effects of green SCM implementation on business performance in SMEs: A longitudinal study in electronics industry. *Sustainability*, 13(21), 1-23. doi:10.3390/su132111874.
- Kosasih, W., Pujawan, I. N., & Karningsih, P. D. (2023). Integrated lean-green practices and supply chain sustainability for manufacturing SMEs: A systematic literature review and research agenda. *Sustainability*, 15(16), 1-28. doi:10.3390/su151612192.
- Kumar, R., Gupta, S., & Ur Rehman, U. (2023). Circular economy a footstep toward net zero manufacturing: Critical success factors analysis with case illustration. *Sustainability*, 15(20), 1-19. doi:10.3390/su152015071.
- Lu, J., Ren, L., Zhang, C., Rong, D., Ahmed, R. R., & Streimikis, J. (2020). Modified Carroll's pyramid of corporate social responsibility to enhance organizational performance of SMEs industry. *Journal of Cleaner Production*, 271(20 October 2020), 122456. doi:10.1016/j.jclepro.2020.122456.
- Maheshwari, S., Jaggi, C. K., & Gautam, P. (2025). A state-of-the-art review of green supply chain management: Observations and business insights. *Annals of Operations Research*, 358, 193-273. doi:10.1007/s10479-025-06619-3.
- Martinez C. E., Flores Valdés JR, Castillo JL, Castillo JV, Blanco Montecino RM, Morin Jimenez JE, Arriaga Escamilla D, & Diarte E. (2023). Ten steps to conduct a systematic review. *Cureus*, 15(12), 1-11. doi: 10.7759/cureus.51422.
- Mankar, V., Vichoray, C., Somani, N., Deogaonkar, A., & Ranade, A. (2023). Identifying the barriers to green supply chain practices for small and medium enterprises with reference to Central India. *Journal of Law and Sustainable Development*, 11(4), 1-12. doi:10.55908/sdgs.v11i4.900.
- Muafi, & Kusumawati, R. A. (2021). A nexus between Green HRM (GHRM), supply chain performance (SCP) and business performance (BP): The mediating role of supply chain organizational learning (SCOL). *Journal of Industrial Engineering and Management*, 14(2), 329–344. doi:10.3926/jiem.3339.

- Musa, H., & Chinniah, M. (2016). Malaysian SMEs development: Future and challenges on going green. *Procedia – Social and Behavioral Sciences*, 224(15 June 2016), 254–262. doi:10.1016/j.sbspro.2016.05.457.
- Nege, T. B., & Abegaz, M. B. (2024). Sustainable supply chain management for business competitiveness: A systematic literature review. *European Business & Management*, 10(4), 53–68. doi:10.11648/j.ebm.20241004.11.
- Olekanma, O., Rodrigo, L. S., Adu, D. A., & Gahir, B. (2024). Small- and medium-sized enterprises' carbon footprint reduction initiatives as a catalyst for green jobs: A systematic review and comprehensive business strategy agenda. *Business Strategy and the Environment*, 33(7), 6911–6939. doi:10.1002/bse.3846.
- Owo. (2024, January 5). Kontribusi IKM sebesar 99,7% dari total unit usaha industri – Tahun 2023. Retrieved from: <https://www.neraca.co.id/article/192167/kontribusi-ikm-sebesar-997-dari-total-unit-usaha-industri-tahun-2023>.
- Reynaldy, B. (2024, September 21). 5 sektor industri mikro dan kecil dengan jumlah usaha terbanyak 2023. Retrieved from: <https://data.goodstats.id/statistic/5-sektor-industri-mikro-dan-kecil-dengan-jumlah-usaha-terbanyak-2023-AEiLN>.
- Reza-Gharehbagh, R., Arisian, S., Hafezalkotob, A., & Makui, A. (2023). Sustainable supply chain finance through digital platforms: A pathway to green entrepreneurship. *Annals of Operations Research*, 331, 285–319. doi:10.1007/s10479-023-05456-4.
- Rupa, R. A., & Saif, A. N. M. (2021). Impact of green supply chain management (GSCM) on business performance and environmental sustainability: Case of a developing country. *Business Perspectives and Research*, 10(1), 140–163. doi:10.1177/2278533720983089.
- Shaheen, N., Shaheen, A., Ramadan, A., Hefnawy, M.T, Ramadan A, Ibrahim IA, Hassanein ME, Ashour ME and Flouty O (2023). Appraising systematic reviews: a comprehensive guide to ensuring validity and reliability. *Front. Res. Metr. Anal.*, 8, 1268045. doi: 10.3389/frma.2023.1268045.
- Sunarya, E., Nur, T., Rachmawati, I., Suwiryo, D. H., & Jamaludin, M. (2023). Antecedents of green supply chain collaborative innovation in tourism SMEs: Moderating the effects of socio-demographic factors. *Uncertain Supply Chain Management*, 11(1), 161–168. doi:10.5267/j.uscm.2022.10.011.
- Syarief, E. (2021). The role of market uncertainty in fostering innovation and green supply chain management on the performance of tourism SMEs. *Uncertain Supply Chain Management*, 9(3), 617–624. doi:10.5267/j.uscm.2021.5.009.
- Tuni, A., Rentizelas, A., & Duffy, A. (2018). Environmental performance measurement for green supply chains: A systematic analysis and review of quantitative methods. *International Journal of Physical Distribution & Logistics Management*, 48(8), 765–793. doi:10.1108/IJPDLM-02-2017-0062.
- Vörösmarty, G., & Dobos, I. (2020). Green purchasing frameworks considering firm size: a multicollinearity analysis using variance inflation factor. *Supply Chain Forum: An International Journal*, 21(4), 290–301. doi:10.1080/16258312.2020.1776090.
- Waqas, U., Umair, S., Mrugalska, B., Al Shamsi, I. R., & Bystrov, I. (2024). Mediating role of green talent management between green strategic orientation and sustainable supply chain performance among SMEs of Oman. *Annals of Operations Research*, 340, 1063–1089. doi:10.1007/s10479-024-06159-2.

- Yarosan, E. V., Chowdhury, S., Mangla, S. K., & Dey, P. K. (2024). Unearthing the interplay between organisational resources, knowledge and Industry 4.0 analytical decision support tools to achieve sustainability and supply chain wellbeing. *Annals of Operations Research*, 342, 1321–1368. doi:10.1007/s10479-024-05845-5.
- Zeng, H., Li, R. Y. M., & Zeng, L. (2022). Evaluating green supply chain performance based on ESG and financial indicators. *Frontiers in Environmental Science*, 10, 982828. doi:10.3389/fenvs.2022.982828.
- Zhan, Z., Chin, T. A., Kaihan, Y., & Qi, Q. (2024). Green supply chain management practices and sustainability performance: A review and future perspectives. *International Journal of Academic Research in Business and Social Sciences*, 14(12), 1220-1232. doi:10.6007/IJARBSS/v14-i12/24075.
- Zhu, Q., & Sarkis, J. (2004). Relationships between operational practices and performance among early adopters of green supply chain management practices in Chinese manufacturing enterprises. *Journal of Operations Management*, 22(3), 265–289. doi:10.1016/j.jom.2004.01.005.
- Zhu, Q., Sarkis, J., & Lai, K. H. (2008). Confirmation of a measurement model for green supply chain management practices implementation. *International Journal of Production Economics*, 111(2), 261–273. doi:10.1016/j.ijpe.2006.11.029.