**ACADEMIA: Jurnal Inovasi Riset Akademik**
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

# ENVIRONMENTAL COLLABORATION AS A MODERATING VARIABLE IN THE RELATIONSHIP BETWEEN GSCM AND SUSTAINABILITY PERFORMANCE

**Punang Amaripuja[1]*, Ade Andrilla[2]**
Department of Management, Universitas Muhammadiyah Yogyakarta, Indonesia[1,2]
e-mail: punang.amaripuja@umy.ac.id

Diterima: *20/07/2026*; Direvisi: *14/09/2026*; Diterbitkan: *30/10/2026*

## ABSTRAK

Penelitian ini bertujuan untuk menganalisis hubungan antara praktik Green Supply Chain Management (GSCM) dan kinerja keberlanjutan serta menguji apakah kolaborasi lingkungan memperkuat hubungan tersebut. Penelitian ini menggunakan perspektif Natural Resource-Based View (NRBV), yang menjelaskan bahwa kapabilitas organisasi yang berorientasi pada lingkungan dapat menjadi sumber daya strategis ketika perusahaan mengembangkan kapabilitas pencegahan polusi, stewardship, dan pembangunan berkelanjutan. Penelitian menggunakan pendekatan kuantitatif dengan survei terhadap 53 pemilik dan manajer UMKM berorientasi manufaktur di Daerah Istimewa Yogyakarta yang dipilih menggunakan purposive sampling. Data dianalisis menggunakan Structural Equation Modeling (SEM) dengan AMOS. Hasil penelitian menunjukkan bahwa praktik GSCM berpengaruh positif dan signifikan terhadap kinerja keberlanjutan (estimate = 0,177; p = 0,039), praktik GSCM berpengaruh positif terhadap kolaborasi lingkungan (estimate = 0,615; p < 0,001), dan kolaborasi lingkungan berpengaruh positif terhadap kinerja keberlanjutan (estimate = 0,769; p < 0,001). Kolaborasi lingkungan juga memoderasi secara signifikan hubungan antara praktik GSCM dan kinerja keberlanjutan (estimate = 0,004; p = 0,019). Temuan ini menunjukkan bahwa penerapan GSCM menjadi lebih efektif ketika UMKM mengembangkan hubungan kolaboratif terkait lingkungan dengan mitra rantai pasok. Penelitian ini memberikan kontribusi dengan menguji kolaborasi lingkungan sebagai kondisi batas dalam hubungan antara GSCM dan kinerja keberlanjutan pada UMKM di Yogyakarta, yang masih relatif kurang terwakili dalam literatur terkini.

**Kata kunci**: *Praktik GSCM; Kinerja Keberlanjutan; Kolaborasi Lingkungan*

## ABSTRACT

This study examines the relationship between Green Supply Chain Management (GSCM) practices and sustainability performance and investigates whether environmental collaboration strengthens this relationship. The study adopts the Natural Resource-Based View (NRBV), which explains that environmentally oriented organizational capabilities can become strategic resources when firms develop pollution prevention, stewardship, and sustainable development capabilities. A quantitative survey was conducted among 53 owners and managers of manufacturing-oriented MSMEs in the Special Region of Yogyakarta, selected through purposive sampling. Data were analyzed using Structural Equation Modeling (SEM) with AMOS. The results show that GSCM practices have a positive and significant effect on sustainability performance (estimate = 0.177; p = 0.039), GSCM practices positively affect environmental collaboration (estimate = 0.615; p < 0.001), and environmental collaboration positively affects sustainability performance (estimate = 0.769; p < 0.001). Environmental collaboration also significantly moderates the relationship between GSCM practices and

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

sustainability performance (estimate = 0.004; p = 0.019). These findings indicate that GSCM implementation becomes more effective when MSMEs develop collaborative environmental relationships with supply-chain partners. The study contributes by examining environmental collaboration as a boundary condition of the GSCM–sustainability performance relationship in MSMEs in Yogyakarta, a context that remains less represented in the recent literature.
**Keywords**: *GSCM Practices; Sustainability Performance; Environmental Collaboration*

## INTRODUCTION

Environmental sustainability has become an increasingly important managerial issue because production and supply-chain activities can generate waste, emissions, resource depletion, and other environmental pressures. For small and medium-sized enterprises (SMEs), this challenge is particularly relevant because resource constraints can make the adoption of environmental practices more difficult, while supply-chain relationships can determine access to knowledge, materials, technology, and market requirements. Previous research has shown that green supply chain management (GSCM) can contribute to environmental, economic, and sustainability-related performance in SMEs across different contexts (Aldaas, 2022; Arifin et al., 2023; Ahmad et al., 2022; Dzikriansyah et al., 2023; Junejo et al., 2025). A systematic review by Nguyen et al. (2022) further indicates that the relationship between GSCM practices and sustainability performance has received substantial research attention, while recent evidence from Indonesian SMEs continues to demonstrate the relevance of green supply-chain practices for sustainability outcomes (Fuad et al., 2025; Masudin et al., 2026).

Green Supply Chain Management (GSCM) integrates environmental considerations into purchasing, production, distribution, product design, and other supply-chain activities. In the SME context, GSCM can improve environmental performance and support broader sustainability outcomes, but implementation is rarely an entirely internal process. Supplier relationships, information sharing, joint environmental activities, and other forms of collaboration can help firms translate green practices into measurable outcomes (Jo & Kwon, 2022; Shin & Cho, 2022; Singh et al., 2025). Strategic alliances and supply-chain relationships can also support the implementation of green practices by enabling firms to coordinate resources and environmental objectives with external partners (Abbas & Tong, 2023). Evidence from Indonesia indicates that GSCM adoption is relevant to SME performance, while recent studies in Yogyakarta and other Indonesian regions continue to report variation in the factors that enable GSCM and its performance consequences (Dewa, 2024; Aziz et al., 2025; Nabilla et al., 2025).

The importance of collaboration can be explained through the Natural Resource-Based View (NRBV). The NRBV argues that environmental capabilities can become strategic organizational resources when firms develop capabilities for pollution prevention, product stewardship, and sustainable development. From this perspective, GSCM practices provide the operational foundation, whereas environmental collaboration represents an inter-organizational capability that enables firms to exchange environmental information, coordinate improvements, solve environmental problems jointly, and align supply-chain activities. Research on Indonesian SMEs has also linked green supply-chain capabilities with sustainability outcomes, supporting the relevance of environmentally oriented capabilities in resource-constrained business contexts (Fuad et al., 2025; Masudin et al., 2026). Recent research further supports the relevance of collaboration and related relational capabilities in

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

strengthening the implementation and outcomes of green supply-chain practices (Sadiq et al., 2024; Singh et al., 2025).

Nevertheless, the empirical relationship between GSCM and sustainability performance is not uniformly strong across settings. Recent studies have reported positive relationships, while others show that the effectiveness of GSCM depends on complementary capabilities, institutional pressures, technology, or collaboration mechanisms (Agyapong et al., 2023; Mousa et al., 2025; Junejo et al., 2025). Research on SMEs has likewise shown that GSCM can be associated with sustainability performance through different organizational and competitive conditions (Nafisah & Ratnamurni, 2025; Sukron & Solovida, 2022). These differences suggest that the performance consequences of GSCM may depend not only on whether green practices are adopted, but also on the organizational and relational conditions surrounding their implementation.

The importance of supply-chain collaboration provides a basis for examining environmental collaboration as a potential boundary condition. Environmental collaboration involves joint environmental activities, information exchange, coordination, and problem solving among supply-chain partners. Evidence from manufacturing SMEs indicates that green supply-chain collaboration can contribute to environmental and health-and-safety performance (Nai et al., 2024), while other research has identified collaboration as an important relational capability within sustainable supply-chain management (Jo & Kwon, 2022; Singh et al., 2025).

Although Rahman et al. (2023) examined environmental collaboration as a moderator in the GSCM–sustainability performance relationship, their study focused on the construction industry. The present study examines manufacturing-oriented MSMEs, where production routines, material use, waste handling, and dependence on supplier inputs create a different operational setting for implementing green practices. The contribution is therefore not based solely on regional location: it lies in testing the same boundary-condition argument in a distinct organizational and sectoral context and in integrating it with the Natural Resource-Based View (NRBV). Specifically, GSCM is treated as an operational environmental capability, while environmental collaboration is conceptualized as an inter-organizational capability that may condition how effectively those practices translate into sustainability performance. The study also examines the direct relationships among GSCM, environmental collaboration, and sustainability performance alongside the interaction effect. This is a contextual and theory-informed extension rather than a claim that the moderating relationship has never been studied. The extent of this contribution should be interpreted in light of the study's regional scope and sample size.

Based on this background, the study aims to examine: (1) whether GSCM practices positively affect sustainability performance; (2) whether GSCM practices positively affect environmental collaboration; (3) whether environmental collaboration positively affects sustainability performance; and (4) whether environmental collaboration strengthens the relationship between GSCM practices and sustainability performance. The study therefore contributes empirical evidence on the role of inter-organizational environmental collaboration as a boundary condition of GSCM effectiveness in MSMEs.

## RESEARCH METHODOLOGY

This study uses a quantitative explanatory design to test the proposed relationships among GSCM practices, environmental collaboration, and sustainability performance.

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

Primary data were collected through a structured questionnaire administered to owners and managers of manufacturing-oriented MSMEs in the Special Region of Yogyakarta. Purposive sampling was used because respondents needed direct knowledge of their businesses' operational and environmental practices. The final dataset comprised 53 usable responses from MSMEs across the five administrative areas of Yogyakarta. The sample reflects the eligible responses obtained for this study; the available study documentation does not indicate that an a priori statistical power analysis or a formal minimum-sample calculation was conducted. Accordingly, the sample size is reported transparently rather than presented as definitively sufficient for every parameter in the model.

The questionnaire contained 28 measurement items: 15 items for GSCM practices, 6 items for environmental collaboration, and 7 items for sustainability performance. The measurement model was assessed using confirmatory factor analysis (CFA). Convergent validity was evaluated using standardized factor loadings, with values above 0.50 considered acceptable in the present study, while construct reliability was assessed using Construct Reliability (CR), with a minimum criterion of 0.70. The 53-response sample is relatively small in relation to the 28 indicators and the moderation model; therefore, the estimates and fit statistics should be interpreted cautiously. The reported loading and reliability results provide information about the measurement model in this dataset, but they do not by themselves establish that the sample is large enough to guarantee stable parameter estimates or broad generalizability.

SEM was estimated using IBM SPSS AMOS 22. The analysis was organized into two stages. First, the measurement model was assessed through factor loadings and construct reliability. Second, the structural model was assessed through the direct paths among GSCM practices, environmental collaboration, and sustainability performance. The moderation hypothesis was evaluated by examining the interaction effect of GSCM practices and environmental collaboration on sustainability performance. Because the research model and available results test moderation rather than an indirect-effect model, environmental collaboration is treated as a moderator in the final interpretation and is not described as a mediating variable. Given the modest sample size, the model-fit results and hypothesis estimates are interpreted as evidence within this sample, not as conclusive estimates for all MSMEs. Future studies should use an a priori power analysis or an appropriate SEM sample-size assessment based on model complexity, anticipated effect sizes, and estimation method, and should seek a larger and more diverse sample.

## RESULT AND DISCUSSION

### Results

### Respondent Characteristics

The respondent characteristics were identified to describe the positions represented in the study. The respondents consisted of individuals who were directly involved in ownership or operational management of the MSMEs under investigation. Their positions are presented in Table 1.

**Table 1.** Position of Respondent

| Position | Total Respondent | Percentage |
|---|---|---|
| Owner | 26 | 49.1% |
| Manager Operational | 27 | 50.9% |
| Total Respondent | 53 | 100% |

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

Table 1 shows that the study involved 53 respondents, consisting of 26 owners (49.1%) and 27 operational managers (50.9%). The distribution is relatively balanced between the two respondent groups, with operational managers representing a slightly larger proportion. This composition provides perspectives from both ownership and operational management levels in the MSMEs included in the study.

**Validity and Reliability**

The measurement model was evaluated to determine whether the indicators adequately represented the constructs included in the study. The assessment focused on the factor loading of each measurement item and the Construct Reliability of each construct. The results of the validity and reliability assessment are presented in Table 2.

**Table 2.** Validity and Reliability Results

| Variabel | Item | Factor Loading | Construct Reliability |
|---|---|---|---|
| GSCM Practices | GSCM1 | 0,874 | 0,978 |
| | GSCM2 | 0,882 | |
| | GSCM3 | 0,844 | |
| | GSCM4 | 0,853 | |
| | GSCM5 | 0,878 | |
| | GSCM6 | 0,868 | |
| | GSCM7 | 0,802 | |
| | GSCM8 | 0,881 | |
| | GSCM9 | 0,852 | |
| | GSCM10 | 0,865 | |
| | GSCM11 | 0,904 | |
| | GSCM12 | 0,859 | |
| | GSCM13 | 0,920 | |
| | GSCM14 | 0,857 | |
| | GSCM15 | 0,820 | |
| Environmental Collaboration | EC1 | 0,828 | 0,904 |
| | EC2 | 0,720 | |
| | EC3 | 0,695 | |
| | EC4 | 0,833 | |
| | EC5 | 0,878 | |
| | EC6 | 0,722 | |
| Sustainability Performance | SP1 | 0,783 | 0,927 |
| | SP2 | 0,853 | |
| | SP3 | 0,778 | |
| | SP4 | 0,778 | |
| | SP5 | 0,778 | |
| | SP6 | 0,851 | |
| | SP7 | 0,800 | |

Table 2 shows that all 28 measurement items have factor loading values above 0.50, with values ranging from 0.695 to 0.920. The Construct Reliability values for GSCM Practices, Environmental Collaboration, and Sustainability Performance are 0.978, 0.904, and

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

0.927, respectively, all exceeding the 0.70 criterion. These results indicate that the measurement items demonstrate adequate indicator validity and that the three constructs have satisfactory internal consistency

**Goodness-of-Fit**

The structural model was assessed using several goodness-of-fit indices to evaluate its overall adequacy before testing the proposed relationships. The assessment included absolute, incremental, and parsimony-oriented fit indices. The results of the model-fit assessment are presented in Table 3.

**Table 3.** Goodness-of-Fit Indices

| Goodness of fit index | Cut-off value | Research Model | Explanation |
|---|---|---|---|
| Significant probability | ≥ 0.05 | 0,000 | Poor Fit |
| Chi-Squares | - | 457,773 (df = 347) | - |
| RMSEA | ≤ 0.08 | 0,078 | Good Fit |
| GFI | ≥ 0.90 | 0,625 | Poor Fit |
| AGFI | ≥ 0.80 | 0,561 | Poor Fit |
| CMIN/DF | ≤ 2.00 | 1,319 | Good Fit |
| TLI | ≥ 0.90 | 0,920 | Good Fit |
| CFI | ≥ 0.90 | 0,926 | Good Fit |

Table 3 indicates mixed evidence regarding the fit of the structural model. RMSEA, CMIN/DF, TLI, and CFI meet the reported criteria, whereas the chi-square significance probability, GFI, and AGFI do not meet their respective criteria. Overall, the model demonstrates acceptable fit on several key indices, although the fit is not uniformly satisfactory across all goodness-of-fit measures.

**Hypothesis Testing**

The hypothesis testing was conducted to examine the proposed relationships among GSCM Practices, Environmental Collaboration, and Sustainability Performance. The analysis consisted of testing the direct relationships between the constructs and the moderating role of Environmental Collaboration. The results of the hypothesis testing are presented separately for the direct effects and moderation effect.

**Direct Effects**

The direct-effect analysis was conducted to examine the proposed relationships between the three main constructs in the structural model. These relationships correspond to H1, H2, and H3, which examine the relationships between GSCM Practices, Environmental Collaboration, and Sustainability Performance. The results of the direct-effect analysis are presented in Table 4.

**Table 4.** Direct Relationships Between Variables

| No | Hypothesis | Estimate | P | Limit | Description |
|---|---|---|---|---|---|
| **1.** | GSCM Practices positively affect Sustainability Performance | 0,177 | 0,039 | 0,05 | **Supported** |

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

| No | Hypothesis | Estimate | P | Limit | Description |
|---|---|---|---|---|---|
| **2.** | GSCM Practices positively affect Environmental Collaboration | 0,615 | 0,000 | 0,05 | **Supported** |
| **3.** | Environmental Collaboration positively affects Sustainability Performance | 0,769 | 0,000 | 0,05 | **Supported** |

Table 4 shows that all three proposed direct relationships are positive and statistically significant at the 5% significance level. GSCM Practices have a positive and significant relationship with Sustainability Performance, while GSCM Practices also have a positive and significant relationship with Environmental Collaboration. Environmental Collaboration likewise has a positive and significant relationship with Sustainability Performance, indicating that H1, H2, and H3 are supported.

**Moderation Effect**

The moderation analysis was conducted to examine whether Environmental Collaboration changes the relationship between GSCM Practices and Sustainability Performance. The analysis focused on the interaction between GSCM Practices and Environmental Collaboration as a predictor of Sustainability Performance. The result of the moderation analysis is presented in Table 5.

**Table 5.** Moderation Effect of Environmental Collaboration

| No | hypothesis | Estimate | P | Limit | Description |
|---|---|---|---|---|---|
| **1.** | Environmental collaboration moderates the relationship between GSCM practice and sustainability performance | 0,004 | 0,019 | 0,05 | **Supported** |

Table 5 shows that the interaction between GSCM Practices and Environmental Collaboration is positive and statistically significant (estimate = 0.004; p = 0.019). The p-value is below the 0.05 significance level, indicating that the interaction effect is statistically significant. Therefore, H4 is supported, indicating that Environmental Collaboration moderates the relationship between GSCM Practices and Sustainability Performance.

**Discussion**

**Effect of GSCM Practices on Sustainability Performance**

The positive and significant relationship between GSCM practices and sustainability performance (estimate = 0.177; p = 0.039) supports H1. This finding indicates that the implementation of environmental considerations in purchasing, production, distribution, and other supply-chain activities is associated with better sustainability performance among the MSMEs examined in this study. The finding is consistent with previous studies showing that GSCM practices contribute to environmental and sustainability-related performance across SME contexts (Ahmad et al., 2022; Dzikriansyah et al., 2023; Junejo et al., 2025).

The result is also supported by evidence from Indonesian SMEs. Nafisah and Ratnamurni (2025) found a positive relationship between GSCM and sustainability performance among SMEs in Bandung, while Sukron and Solovida (2022) reported that

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

sustainable supply-chain management practices were associated with SME performance in the batik industry. These findings indicate that environmentally oriented supply-chain practices can contribute to sustainability outcomes across different SME settings, although the strength of the relationship may vary according to industry and organizational conditions.

From the Natural Resource-Based View (NRBV), GSCM practices can be understood as environmental capabilities that enable firms to reduce waste, improve resource efficiency, and manage environmental impacts. For MSMEs, these capabilities are particularly relevant because improvements in material use, waste management, purchasing, and production processes can address environmental pressures while also supporting operational and economic aspects of sustainability. The finding therefore provides empirical support for the relevance of environmentally oriented capabilities in explaining sustainability performance among resource-constrained firms.

**Effect of GSCM Practices on Environmental Collaboration**

GSCM practices have a positive and significant effect on environmental collaboration (estimate = 0.615; $p < 0.001$), supporting H2. This finding suggests that the implementation of environmentally oriented supply-chain practices encourages firms to communicate, coordinate, and work jointly with supply-chain partners on environmental issues. Green purchasing requirements, environmentally oriented production practices, and waste-management activities can create a need for greater information exchange and coordination with suppliers, customers, and other relevant partners.

This result is consistent with research emphasizing the relational dimension of GSCM. Jo and Kwon (2022) identify collaboration as an important component of GSCM implementation for SMEs, while Shin and Cho (2022) show that supplier involvement can support the environmental development of SMEs. Abbas and Tong (2023) likewise highlight the importance of strategic alliances and external relationships in coordinating green supply-chain practices. These findings suggest that GSCM extends beyond internal operational changes and requires interaction with external supply-chain actors.

The finding is particularly relevant to MSMEs because their internal resources, technological capabilities, and environmental expertise may be limited. Collaboration with suppliers and other partners can provide access to environmental knowledge, information, and resources that may not be available internally. This interpretation is consistent with studies on Indonesian SMEs that emphasize the importance of organizational capabilities and external resources in supporting the implementation and outcomes of green supply-chain practices (Dewa, 2024; Fuad et al., 2025).

**Effect of Environmental Collaboration on Sustainability Performance**

Environmental collaboration has a positive and significant effect on sustainability performance (estimate = 0.769; $p < 0.001$), supporting H3. This finding indicates that collaboration among supply-chain partners is associated with better sustainability outcomes and suggests that environmental collaboration represents an important relational capability for coordinating environmental activities. Information sharing, joint environmental problem solving, supplier engagement, and coordinated implementation can help MSMEs translate environmental objectives into more consistent supply-chain practices.

The finding is consistent with previous research emphasizing the contribution of collaboration to sustainability-related outcomes. Jo and Kwon (2022) identify collaboration as

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

an important component of sustainable GSCM among SMEs, while Sadiq et al. (2024) demonstrate the relevance of green supply-chain practices and related organizational capabilities to environmental performance. Singh et al. (2025) further emphasize environmental collaboration as an important relational dimension of sustainable supply-chain management.

Evidence from manufacturing SMEs also provides support for this relationship. Nai et al. (2024) found that green supply-chain collaboration was associated with health, safety, and environmental performance among manufacturing SMEs. Although their study examined a more specific performance dimension than the sustainability performance measure used in the present study, the findings reinforce the argument that collaborative environmental activities can contribute to measurable organizational performance.

From the NRBV perspective, environmental collaboration can be viewed as an inter-organizational capability that complements internal environmental capabilities. Through collaboration, MSMEs can combine internal resources with knowledge and capabilities obtained from external partners, allowing environmental practices to be implemented more effectively across organizational boundaries. This perspective helps explain why environmental collaboration demonstrates a strong direct relationship with sustainability performance in the present study.

**Moderating Role of Environmental Collaboration**

The interaction between GSCM practices and environmental collaboration is positive and statistically significant (estimate = 0.004; p = 0.019), supporting H4. This finding indicates that environmental collaboration significantly strengthens the relationship between GSCM practices and sustainability performance. Thus, the sustainability outcomes associated with GSCM practices are influenced not only by the extent to which green practices are implemented but also by the degree to which firms collaborate with their supply-chain partners on environmental activities.

The finding is consistent with Rahman et al. (2023), who specifically examined the moderating role of environmental collaboration in the relationship between GSCM practices and sustainability performance. It also complements studies emphasizing the importance of collaboration in facilitating information exchange, joint problem solving, and coordination of environmental objectives across supply-chain partners (Jo & Kwon, 2022; Nai et al., 2024; Singh et al., 2025). These findings reinforce the view that the effectiveness of GSCM cannot be considered solely in terms of internal practices because supply-chain relationships can shape how environmental practices are implemented and translated into performance outcomes.

The moderating role of environmental collaboration is particularly relevant for MSMEs because they may face limitations in financial resources, environmental expertise, technology, and organizational capacity. Collaboration can help firms overcome some of these limitations by providing access to external knowledge, shared resources, and joint problem-solving mechanisms. In the context of Indonesian MSMEs, this collaborative dimension may be especially important because sustainability-oriented practices often depend on interactions with suppliers, customers, and other external stakeholders (Dewa, 2024; Aziz et al., 2025; Nabilla et al., 2025).

The result therefore positions environmental collaboration as a boundary condition of the GSCM–sustainability performance relationship rather than as a mediating mechanism.

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

This distinction is important because the present study examines whether the strength of the relationship between GSCM practices and sustainability performance changes according to the level of environmental collaboration. The findings indicate that environmental collaboration provides a complementary relational capability through which the sustainability benefits of GSCM practices can be strengthened.

**Research Contribution and Practical Implication**

This study contributes to the GSCM literature by examining environmental collaboration as a moderator of the relationship between GSCM practices and sustainability performance among manufacturing-oriented MSMEs. Rahman et al. (2023) previously examined a similar moderation relationship in the construction industry; consequently, the present study does not claim that the moderation concept itself is novel. Instead, it extends the discussion to a different operational setting and frames environmental collaboration through the NRBV as an inter-organizational capability that may condition the performance value of internal green supply-chain practices. By testing the direct paths and the interaction effect together, the study provides context-specific evidence on how these constructs relate within the surveyed MSMEs. This contribution remains bounded by the study's regional scope and the relatively small sample.

The findings also have practical implications for MSME managers. The implementation of green purchasing, production, distribution, and waste-management practices should be accompanied by active environmental collaboration with supply-chain partners. Practical initiatives may include sharing environmental requirements with suppliers, exchanging information on environmental practices, jointly identifying opportunities for waste reduction, coordinating environmentally friendly material choices, and conducting joint environmental improvement activities. Such collaboration can enable MSMEs to complement their internal capabilities with knowledge and resources from external partners and thereby strengthen the sustainability outcomes of GSCM implementation. Given the sample size and regional focus, these implications should be treated as relevant recommendations for similar settings rather than assumed to apply uniformly to all MSMEs.

## CONCLUSION

The findings show that GSCM practices are positively and significantly associated with sustainability performance, while GSCM practices also strengthen environmental collaboration. Environmental collaboration has a positive and significant direct relationship with sustainability performance and significantly moderates the GSCM–sustainability performance relationship. These findings are consistent with the NRBV perspective by indicating that environmental practices become more effective when they are complemented by inter-organizational collaboration. The study therefore concludes that environmental collaboration functions as an important boundary condition for translating GSCM practices into sustainability outcomes among MSMEs in Yogyakarta.

This study has several limitations. First, it involved 53 MSMEs in Yogyakarta, so the findings should be interpreted within this regional and organizational context. Second, the sample is modest relative to the 28 measurement indicators and the model that includes an interaction effect. Because an a priori power analysis or formal minimum-sample calculation is not documented, the study cannot claim that the sample guarantees stable estimates for all model parameters. Future research should determine sample size before data collection using

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

ACADEMIA: Jurnal Inovasi Riset Akademik
Vol. 6, No. 4, September-November 2026
e-ISSN: 2807-1808 | p-ISSN: 2807-2294
Online Journal System: https://jurnalp4i.com/index.php/academia

a suitable power analysis or SEM-specific assessment and recruit a larger sample across regions and industries. Third, purposive sampling limits statistical generalization beyond businesses that share the characteristics of the respondents. Future studies may also examine other contextual factors, including technological readiness, organizational capabilities, environmental knowledge, and government support.

## REFERENCES

Abbas, H., & Tong, S. (2023). Green supply chain management practices of firms with competitive strategic alliances—A study of the automobile industry. *Sustainability, 15*(3), 2156. https://doi.org/10.3390/su15032156

Ahmad, A., Ikram, A., Rehan, M. F., & Ahmad, A. (2022). Going green: Impact of green supply chain management practices on sustainability performance. *Frontiers in Psychology, 13*, 973676. https://doi.org/10.3389/fpsyg.2022.973676

Agyapong, A., Aidoo, S. O., Acquaah, M., & Akomea, S. (2023). Environmental orientation and sustainability performance: The mediated moderation effects of green supply chain management practices and institutional pressure. *Journal of Cleaner Production, 430*, 139592. https://doi.org/10.1016/j.jclepro.2023.139592

Aldaas, R. (2022). Green supply chain management and SMEs environmental performance: Green HRM practices as antecedent from service sector of emerging economy. *International Journal of Emergency Services, 11*(3), 422–444. https://doi.org/10.1108/IJES-12-2021-0085

Arifin, Y., Putra, W., Maslikhah, Tongli, B., & Sholeh, M. (2023). The impact of green supply chain management on the economic performance of SMEs, considering environmental conditions. *Economic Annals-XXI, 205*(9–10), 34–38. https://doi.org/10.21003/ea.V205-03

Aziz, A. A., Kusmantini, T., & Nilmawati. (2025). Enablers of green supply chain management and sustainability performance. *Trikonomika, 24*(1). https://doi.org/10.23969/trikonomika.v24i1.18293

Dewa, P. K. (2024). Critical factors of green supply chain management on SMEs business performance Indonesia. *OPSI, 17*(1). https://doi.org/10.31315/opsi.v17i1.11931

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*, 100100. https://doi.org/10.1016/j.clscn.2023.100100

Fuad, E. N., Edward, M. Y., Aminnudin, M., & Rhomadhon, M. S. (2025). Enhancing sustainability in Indonesian SMEs through green HRM and supply chains. *Problems and Perspectives in Management, 23*(2), 384–397. https://doi.org/10.21511/ppm.23(2).2025.27

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:

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

Role of green knowledge sharing, green innovation and big data-driven supply chain. *Discover Sustainability, 6*, 342. https://doi.org/10.1007/s43621-025-01055-6

Jo, D., & Kwon, C. (2022). Structure of green supply chain management for sustainability of small and medium enterprises. *Sustainability, 14*(1), 50. https://doi.org/10.3390/su14010050

Masudin, I., Pangestuti, R. E., Zulfikarijah, F., Restuputri, D. P., & Widayat, W. (2026). Unpacking sustainability performance through IoT, reverse logistics and green supply chain management in Indonesian poultry SMEs. *Management & Sustainability: An Arab Review*, 1-28. https://doi.org/10.1108/MSAR-10-2025-0429

Mousa, H., Khalifa, W., & Alzubi, A. (2025). Green supply chain practices and environmental performance: A moderated role of adaptive green culture and mediated role of competitive pressure. *Sustainability, 17*(1), 12. https://doi.org/10.3390/su17010012

Nabilla, A., Widiyanesti, S., & Anggadwita, G. (2025). The role of green supply chain management and environmental management practices in enhancing enviropreneurship performance based on evidence from Indonesian tourism SMEs. *Discover Sustainability, 6*, 737. https://doi.org/10.1007/s43621-025-01629-4

Nafisah, K. H., & Ratnamurni, E. D. (2025). Green supply chain management and sustainability performance: The mediating role of competitive advantage in Bandung SMEs. *Asian Journal of Economics, Business and Accounting, 25*(2), 131–144. https://doi.org/10.9734/ajeba/2025/v25i21669

Nai, H., Mei, Q., Liu, S., & Zhang, J. (2024). Effect of green supply chain collaboration on the HSE performance of manufacturing SMEs. *Finance Research Letters, 68*, 106013. https://doi.org/10.1016/j.frl.2024.106013

Nguyen, X. H., Nguyen, Q. S., Le, M. H., Nguyen, P. D., Do, T. H., & Vu, V. H. (2022). Effects of green supply chain management practices on sustainability performance: A systematic literature review and directions for future research. *Journal of Economics and Sustainable Development, 13*(10). https://doi.org/10.7176/JESD/13-10-01

Rahman, A., Ali, S. M., & Jehangir, M. (2023). The moderating effect of environmental collaboration on the green supply chain management practices and sustainability performance in construction industries. *Research Journal of Social Sciences and Economics Review, 4*(2), 161–173. https://doi.org/10.36902/rjsser-vol4-iss2-2023(161-173)

Sadiq, M., Nawaz, M. A., Sharif, A., & Hanif, S. (2024). Bridging green supply chain practices and environmental performance in Chinese semiconductor sector: With the role of energy efficiency and green HRM. *International Journal of Production Economics, 277*, 109381. https://doi.org/10.1016/j.ijpe.2024.109381

Shin, S., & Cho, M. (2022). Green supply chain management implemented by suppliers as drivers for SMEs environmental growth with a focus on the restaurant industry. *Sustainability, 14*(6), 3515. https://doi.org/10.3390/su14063515

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229

Singh, R. K., Mishra, R., & He, Q. (2025). Sustainable supply chain and environmental collaboration in the supply chain management: Agenda for future research and implications. *Business Strategy and the Environment*, *34*(5), 5487-5513. https://doi.org/10.1002/bse.4136

Sukron, H. A., & Solovida, G. T. (2022). Sustainable supply chain management practices in batik small and medium scale enterprises performance. *Jurnal Penelitian Ekonomi dan Bisnis, 7*(2), 71-80. https://doi.org/10.33633/jpeb.v7i2.4714

Copyright (c) 2026 ACADEMIA: Jurnal Inovasi Riset Akademik
https://doi.org/10.51878/academia.v6i4.14229