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GREEN ECONOMY MODEL DEVELOPMENT IN INDONESIAN BATIK SMES: NATURAL RESOURCE-BASED VIEW APPROACH AND SYSTEMS THINKING METHODOLOGY

Keywords:

Indonesian Batik SMEs; Green
Economy; Natural Resource-
Based View (NRBV);
Interpretive Structural Modeling
(ISM); Sustainable Business;
Waste Management

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Abstract

Indonesian batik SMEs still face various challenges in developing green business processes due to limited understanding of the framework for developing a green economy. This study aims to develop a conceptual hierarchy model that can guide batik SMEs in developing a green economy based on the NRBV. This study used a survey method to collect data. The surveyed companies were six traditional batik producers in Cirebon Regency, West Java Province. The study combined the Delphi, MICMAC, and ISM methods to analyze the data. The results of this study indicate the existence of 14 relevant supporting factors in the development of a green economy based on the NRBV. These factors can be grouped into three: dependency factors (organizational culture, green financing, corporate networks, association support, and consumer development), linkage factors (green supply chains, resource efficiency, waste management, and green product design), and independent factors (innovation capabilities, environmentally friendly production processes, skilled labor, leadership commitment, and supportive policies and regulations). The results of the study provide implications for the importance of waste management, product management, and sustainability in building a sustainable green economy for batik SMEs.

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1. Introduction

The literature generally acknowledges that small and medium enterprises (SMEs) play a crucial role in national economic growth. It argues that SMEs are economic entities that contribute significantly to GDP. They also play a crucial role in job creation, particularly in rural areas. By providing employment, SMEs help reduce unemployment and poverty. Furthermore, SMEs contribute to a competitive economic environment through their ability to innovate, increase efficiency, and introduce new products and services (Erdin & Ozkaya, 2020). Furthermore, the literature also recognizes the crucial role of SMEs in poverty alleviation programs, reducing inequality, and promoting economic resilience. Many experts argue that SMEs have the capacity to increase and distribute income, which in turn can reduce poverty and improve community welfare. By developing economic activities in rural areas, SMEs can help reduce socio-economic disparities. This capability will create a more balanced development between urban and rural areas (Alaghbari, 2022). Furthermore, the literature also suggests that SMEs have greater flexibility than large companies. This capability allows them to adapt and respond more quickly to market changes. In other words, SMEs are resilient economic entities during economic crises (Gherghina et al., 2020).

Furthermore, the literature has proposed several perspectives and approaches to developing sustainable SMEs, including the Green Economy approach (Maesaroh et al., 2024). In the context of SMEs, a green economy approach implies that SMEs need to implement environmentally friendly business practices while maintaining economic growth

and being socially responsible. The green economy approach implies that SMEs need to implement business practices that reduce environmental impacts. SMEs can achieve these practices through more efficient resource use, preventing waste at source, and developing green products and services. These practices enable SMEs to achieve high environmental performance and a sustainable competitive advantage (Zaman et al., 2024).

Furthermore, the literature argues that green economic development will provide several positive benefits for the sustainability of SMEs. First, it increases competitiveness. Environmentally friendly practices enable SMEs to increase their competitiveness and attract more customers, favoring sustainable products and services. Environmental initiatives also encourage a work environment that supports increased innovation capabilities in products, processes, and organizations, which in turn opens up new business opportunities. Further benefits include cost savings and increased responsiveness through resource efficiency and waste reduction. Environmentally friendly business practices also increase SMEs' chances of gaining government support by providing incentives and support needed by SMEs in building a green economy (Sanz-Torro et al., 2024).

Furthermore, the literature has proposed several elements considered core components of the economy. The first element focuses on the efficient use of resources (such as materials, energy, and water) to minimize waste. The second element is the application of cleaner technologies and production processes to reduce greenhouse gas emissions. The next element focuses on the development of sustainable products and services. In other words, SMEs must produce quality products using energy-efficient processes with minimal environmental impact. Furthermore, SMEs must develop environmentally friendly services, including recycling and waste management. The fourth element is a circular economy, prioritizing the use of reusable materials. The final element is the realization of social justice by ensuring that SME business processes are inclusive and beneficial to the community. This can be achieved by collaborating with local economic entities and prioritizing the use of local materials (Pangarso et al., 2022).

While some experts acknowledge the importance of SMEs for a region's economic growth, others believe that SMEs still face complex challenges in achieving sustainability. Among the challenges SMEs face, environmental issues are a frequent issue. Some experts argue that SMEs have a significant environmental impact. While SMEs individually have a relatively small environmental impact, collectively they contribute significantly to industrial pollution, waste, and greenhouse gas emissions (Setyaningsih et al., 2024).

According to Madrid-Guijarro & Duréndez (2024), several factors make it difficult for SMEs to achieve high environmental performance: these include limited resources and finances, a short-term perspective, and limited human resources. In this regard, SMEs often struggle financially to invest in technologies and processes that support sustainability. SMEs also often focus solely on short-term profits. SMEs are often hesitant to invest in initiatives with longer payback periods, even if they offer future cost savings. Furthermore, SMEs often lack personnel with the technical expertise needed to implement environmental initiatives.

The second factor that makes it difficult for SMEs to implement environmental initiatives is the knowledge and information gap. The literature generally cites that SMEs often have a low understanding and awareness of environmental regulations and issues, as well as best practices for environmental management. SMEs also have limited access to data and information on the essential knowledge needed to build SME sustainability. Furthermore, SMEs lack the technical knowledge and skills to adopt environmentally friendly technologies (Clemente-Almendros et al., 2024). The third factor that makes it difficult for SMEs to achieve high environmental performance is management and organizational factors, including a lack of top management support, reluctance to change, and low internal awareness and attitudes. The literature indicates that SME leaders still rarely place environmental performance as a goal to be achieved. SMEs are also often reluctant to abandon long-standing business perspectives and practices, believing that changing environmental perspectives will provide significant benefits (Tyler et al., 2023).

The literature also suggests that external and market pressures, compliance challenges, and varying market demands are other factors that can hinder SMEs from achieving high environmental performance. Lack of support from government, institutions, or the community can lead to a lack of the technical knowledge and skills needed to implement environmental initiatives. Low compliance with environmental regulations can also be a barrier to achieving environmental performance for SMEs. Furthermore, varying market and stakeholder demands can influence SMEs' motivation to act (Thu et al., 2023).

On the other hand, the literature has proposed several views on how a company achieves competitive advantage, including the Natural Resource-Based View (NRBV) theory. In general, the NRBV refers to the theory that a company's competitive advantage stems from its capabilities related to environmental sustainability, including its capabilities in pollution prevention, product management, and sustainable development (Wang et al., 2024). Pollution prevention can generate benefits such as increased productivity and lower costs through waste and emissions prevention from the start, rather than waste treatment at the end of the process. Product stewardship relates to a company's ability to manage the environmental impacts of its products throughout all stages of its green economy. Sustainable development relates to a company's ability to achieve long-term economic, social, and environmental sustainability, which in turn will generate new market opportunities and improve the company's overall sustainability (Munch et al., 2022).

Despite the growing importance of sustainable green economic development, the Indonesian batik industry continues to encounter substantial environmental challenges. This condition suggests that the transition toward sustainable practices within batik SMEs has not yet been fully achieved and therefore requires a more comprehensive conceptual and managerial framework (Kusumastuti, 2023). Previous studies concerning the implementation of green

economy principles have predominantly focused on large-scale manufacturing industries and modern industrial sectors, whereas traditional and cultural industries, including batik SMEs, have received comparatively limited scholarly attention. This imbalance constitutes a significant research gap, considering that batik SMEs operate within distinctive socio-cultural, economic, and environmental contexts that differ considerably from those of large corporations.

In addition, prior research on sustainable batik production has generally emphasized technical and operational solutions, such as the utilization of natural dyes, wastewater treatment technologies, and cleaner production practices. Although these studies provide important practical contributions to environmental management, they tend to overlook the strategic organizational capabilities required to achieve long-term sustainable competitiveness. Existing literature commonly positions environmental practices merely as compliance-oriented activities rather than as strategic resources capable of fostering innovation, organizational resilience, and competitive differentiation. Consequently, the strategic dimensions of environmental capability development in batik SMEs remain insufficiently explored (Sujiwo et al., 2023).

Another important limitation in the existing literature is the lack of integration between sustainability concepts and systems-based analytical approaches. Research on green economy development in SMEs frequently employs linear analytical methods that are unable to adequately capture the complexity and interdependence among economic, environmental, social, institutional, and technological factors. In the absence of a comprehensive understanding of causal relationships and dynamic interactions among these variables, sustainability initiatives are likely to produce fragmented outcomes and may fail to support long-term green transformation. Therefore, there is a strong need for analytical approaches capable of examining sustainability challenges from a systemic perspective (Johnson-Hall and Hall, 2022).

Based on these research gaps, this study proposes a more holistic and interdisciplinary approach to green economy development in Indonesian batik SMEs. Specifically, this research aims to develop a green economy development roadmap model by integrating the Natural Resource-Based View (NRBV) with Systems Thinking Methodology. The integration of these approaches is expected to provide a more comprehensive understanding of how environmental capabilities can contribute to sustainable competitiveness within traditional SME sectors.

From a theoretical perspective, this study contributes to the expansion of the Natural Resource-Based View within the context of traditional and cultural SMEs. Existing NRBV literature has largely concentrated on large and modern organizations, while studies addressing SMEs, particularly those operating in traditional industries, remain relatively limited. By applying the NRBV framework to Indonesian batik SMEs, this research broadens the contextual applicability of the theory and demonstrates that environmental capabilities can function as strategic organizational resources even within resource-constrained enterprises. Methodologically, this study contributes through the development of a green economy model specifically designed for Indonesian batik SMEs. Such contextualization is essential because sustainability strategies that are effective in industrialized countries may not necessarily be directly applicable to traditional industries in developing economies such as Indonesia. Accordingly, this research offers a locally grounded green economy framework that reflects the unique characteristics and operational realities of the Indonesian batik industry.

From a managerial standpoint, this study provides practical insights for SME owners and practitioners regarding environmentally based economic development strategies. The proposed model is expected to assist batik SMEs in identifying key driving factors for sustainability enhancement, including waste minimization, efficient utilization of natural resources, green product innovation, and stakeholder collaboration. By understanding sustainability as both a systemic and strategic process, SME managers may become better equipped to balance economic performance with environmental responsibility and cultural preservation. Finally, the integration of the Natural Resource-Based View and Systems Thinking Methodology proposed in this study offers a novel interdisciplinary framework that may serve as a foundation for future research on sustainable development and green economy transformation within SMEs and traditional industrial sectors.

2. Methods

Following the methodological framework proposed by Sujiwo et al. (2023), this study adopts a mixed-methods approach, integrating quantitative and qualitative techniques within a case study design. This methodological approach is employed to obtain a comprehensive and in-depth understanding of green economy development in the batik industry and to provide an empirical foundation for developing a model that describes the framework and strategic roadmap for advancing a green economy based on the Natural Resource-Based View (NRBV) among batik SMEs. Data were collected through multiple complementary techniques, including systematic literature review, in-depth interviews, questionnaire surveys, and field observations. The literature review and expert interviews were conducted to identify and validate the key factors relevant to the development of an NRBV-based green economy in batik SMEs. Field observations were undertaken to obtain an empirical overview of batik SME operations and to map the principal stages of their business processes. In-depth interviews involved key stakeholders with relevant knowledge and experience in the development of a green economy in the batik sector, including batik industry practitioners, academics, and consumers. Meanwhile, the questionnaire survey was administered to capture respondents' perceptions and preferences concerning various dimensions of batik production and sustainability. The overall data collection process was conducted from July to September 2025.

Table 1. The Companies Surveyed in the Study

No.	Companies	Address
1	Batik Buana Mas	Jl. Kusuma Indah I No. 24
2	EB Batik Tradisional	Jl. Panembahan Utara No. 1
3	IM Batik	Jl. Kinatagama No. 3
4	Batik Dua Putri	Jl. Trusmi No. 136
5	Batik Tulis Munari	Jl. Gamel I No. 54
6	Batik Lismaina	Jl. Indrakila No. 5

Table 2. Key Factors Supporting a Green Economy Based on NRBV

Coding	Main Factors Supporting the Success of Green Economy
FS-1	Innovation capabilities
FS-2	Green production process
FS-3	Organizational culture
FS-4	Green supply chain management
FS-5	Green financing
FS-6	Skilled workforce
FS-7	Leadership commitment
FS-8	Corporate network
FS-9	Resource efficiency
FS-10	Waste management
FS-11	Green product design
FS-12	Supporting policies and regulations
FS-13	Association support
FS-14	Consumer development

Sources: adapted from Alfarizi & Arifian (2024), Clemente-Almendros et al. (2024), Kusumastuti (2023), Kusumawardani et al. (2024), Maesaroh et al. (2024), Pangarso et al. (2022), Rodrigues & Franco (2023), Tyler et al. (2023).

Although Indonesian batik encompasses both traditional and modern forms, this study specifically focuses on traditional batik. In this research, traditional batik refers primarily to batik produced using hand-drawn (canting) and stamping techniques and characterized by symbolic motifs containing philosophical meanings, the use of natural dyes where applicable, and adherence to established cultural and production conventions. Considering the extensive geographical distribution of batik industry clusters across Indonesia and the practical constraints associated with field research, the study concentrates on six traditional batik SMEs located in Cirebon Regency, West Java Province. The selected enterprises represent SMEs engaged in the production of traditional batik using either hand-drawn (canting) or stamping techniques. The characteristics of the surveyed enterprises are presented in **Table 1**.

To address the research objectives, the study employs two complementary structural analysis techniques, namely Interpretive Structural Modeling (ISM) and MICMAC (Cross-Impact Matrix Multiplication Applied to Classification) analysis. ISM is used to identify and organize the interrelationships among the factors influencing green economy development and to transform a complex system into a structured multilevel hierarchical model. Through this process, the method enables the underlying relationships among the identified factors to be systematically interpreted and represented. MICMAC analysis complements the ISM procedure by classifying the identified variables according to their driving power and dependence power, thereby distinguishing relatively autonomous, dependent, linkage, and driving factors within the system. This combined approach facilitates the identification of strategically important factors and provides a more systematic understanding of the structural complexity of green economy development among batik SMEs (Teymourifar & Trindade, 2023; Sumrit, 2025). The research variables comprise factors identified through the literature review and subsequently assessed and validated based on their relevance to the development of a green economy in the batik industry from an NRBV perspective. These variables represent the organizational, technological, environmental, financial, institutional, and market-related conditions considered important for enabling batik SMEs to integrate sustainability principles into their business activities. The final set of validated factors and their respective descriptions are presented in **Table 2**.

3. Results and Discussions

3.1 MICMAC Analysis

The transition toward a green economy among Indonesian batik SMEs requires a systematic understanding of the interdependencies among the strategic factors that shape this transformation. Accordingly, this study employs MICMAC (Matrix of Cross-Impact Multiplications Applied to Classification) analysis as an initial structural analysis to examine the driving and dependence characteristics of the identified variables. The analysis is intended to distinguish variables according to their driving power and dependence power, thereby identifying the factors that exert substantial influence on the system and those whose conditions are predominantly determined by other variables. Based on the

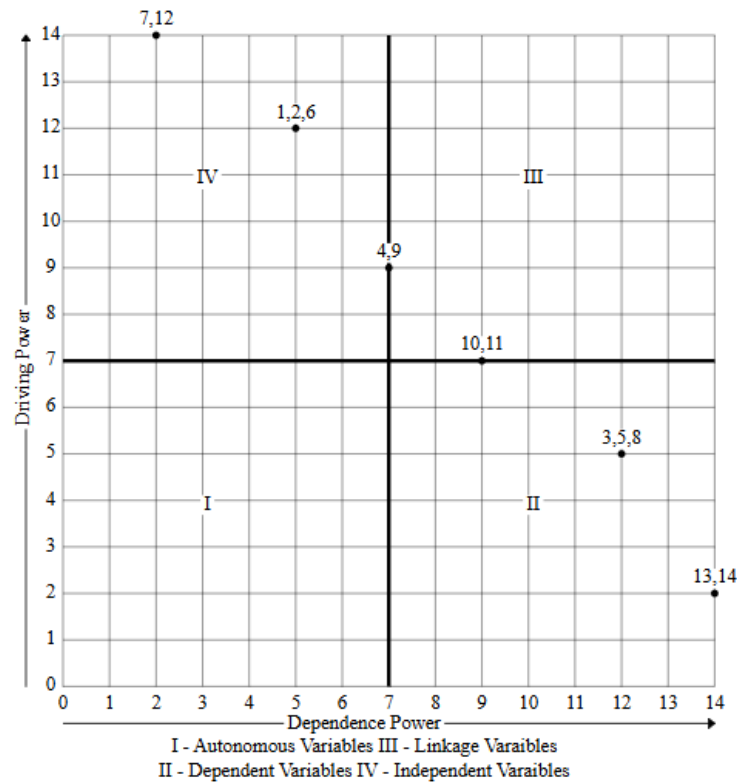


Figure 1. Output of MICMAC Analysis.

MICMAC results, the 14 strategic variables associated with green economy development are categorized into four clusters: autonomous variables (Cluster I), dependent variables (Cluster II), linkage variables (Cluster III), and independent or driving variables (Cluster IV).

As shown in **Figure 1**, none of the 14 variables is positioned in Cluster I (autonomous variables). Autonomous variables are characterized by relatively weak driving and dependence powers and therefore have limited interaction with the other elements of the system. The absence of variables in this cluster indicates that the factors identified in this study are structurally interconnected and cannot be considered peripheral to the green economy transition of Indonesian batik SMEs. Rather, the findings suggest that changes in one component may generate direct or indirect effects on other components of the system. From a systems perspective, this configuration highlights the interdependent nature of green economy development and suggests that isolated interventions may have limited effectiveness when the broader structural relationships among the variables are not simultaneously considered. Cluster II (dependent variables) comprises organizational culture (FS-3), green financing (FS-5), corporate networks (FS-8), association support (FS-13), and consumer development (FS-14). In MICMAC analysis, variables in this cluster are characterized by relatively high dependence power but comparatively limited driving power, indicating that their development is substantially influenced by other elements within the system (Sumrit, 2025). These variables can therefore be interpreted primarily as system outcomes or downstream manifestations of broader organizational, institutional, technological, and market transformations.

Organizational culture (FS-3), for example, is positioned as a dependent variable because the development of environmentally oriented organizational values and practices is likely to be conditioned by more fundamental factors, including leadership commitment, innovation capabilities, regulatory support, and organizational learning. The MICMAC classification therefore indicates that strengthening a green organizational culture may require interventions that address its underlying determinants rather than treating organizational culture as an isolated intervention target. This finding is consistent with a systems perspective in which organizational values and routines evolve in response to changes in the broader institutional and strategic environment. Green financing (FS-5) is similarly classified as a dependent variable. Although access to appropriate financing is critical for enabling SMEs to invest in cleaner technologies, resource-efficient processes, and environmental management systems, its availability may depend on a combination of institutional, regulatory, organizational, and market conditions. SMEs demonstrating credible sustainability strategies, adequate managerial capabilities, innovation potential, and compliance with relevant environmental requirements may be better positioned to access financing instruments designed to support green investment. Thus, within the structural configuration identified by the MICMAC analysis, green financing is not necessarily an isolated antecedent of green transformation but may also emerge as a consequence of improvements in the wider institutional and organizational ecosystem.

The same structural pattern applies to corporate networks (FS-8) and association support (FS-13). The development and effectiveness of interorganizational networks may depend on the existence of an enabling institutional

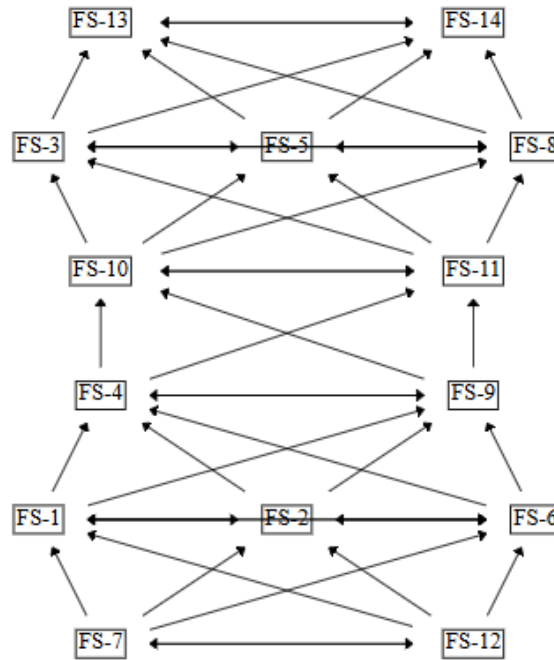


Figure 2. ISM Output

environment, collaborative leadership, technological capabilities, and opportunities for knowledge exchange. Similarly, industry associations may become more influential when SMEs, government agencies, academic institutions, and other stakeholders have established mechanisms for coordination and collective action. These relationships suggest that strengthening collaborative structures requires more than simply establishing formal networks; it also depends on improvements in the organizational and institutional conditions that enable sustained interaction among stakeholders. Consumer development (FS-14) is likewise categorized as a dependent variable because consumer awareness, preferences, and demand for environmentally responsible batik products may be shaped by improvements in product quality, environmental performance, market communication, and sustainability-oriented branding. As SMEs increasingly incorporate green practices into production and communicate their environmental attributes to consumers, market awareness and demand for sustainable products may evolve accordingly. Therefore, consumer development can be understood as an important downstream component of the green economy transition, reflecting the extent to which improvements within the production and institutional system are translated into market-level responses.

Cluster III (linkage variables) consists of green supply chain management (FS-4), resource efficiency (FS-9), waste management (FS-10), and green product design (FS-11). According to the MICMAC framework, linkage variables exhibit both relatively high driving power and high dependence power (Sumrit, 2025). Their dual characteristics make them particularly important within the system because they both influence other variables and are simultaneously influenced by changes elsewhere in the structural configuration. Consequently, linkage variables tend to be structurally sensitive and potentially unstable, meaning that interventions affecting one variable may propagate through multiple interconnected elements of the system. Within the context of green economy development in Indonesian batik SMEs, these linkage variables represent critical interfaces between environmental performance, operational efficiency, innovation, and market-oriented sustainability. Green supply chain management (FS-4), for instance, connects internal production practices with suppliers, distributors, and other external stakeholders, while resource efficiency (FS-9) directly links environmental objectives with operational performance and cost efficiency. Waste management (FS-10) connects production processes with environmental protection and regulatory compliance, whereas green product design (FS-11) links technological and design innovation with resource conservation and changing market expectations. Their simultaneous high driving and dependence characteristics indicate that improvements in these areas may generate broader systemic effects, but their successful implementation also requires supportive changes in other strategic variables. Consequently, these linkage variables constitute important intervention points for coordinating the multiple dimensions of green economy development among Indonesian batik SMEs

3.2 Interpretive Structural Modeling (ISM) Analysis

Previous research has established Interpretive Structural Modeling (ISM) as a systematic approach for analyzing complex systems by identifying interrelationships among variables and organizing them into a hierarchical structure based on their relative driving and dependence characteristics (Teymourifar & Trindade, 2023). In this study, ISM is applied to examine the structural relationships among the strategic variables that influence the implementation of a green economy in Indonesian batik SMEs. Based on the Natural Resource-Based View (NRBV) perspective, 14 variables were identified as relevant determinants of green economy development. The resulting ISM framework, presented in **Figure 2**, organizes these variables into six hierarchical levels, which can be interpreted through three

broad structural layers: the foundational layer, consisting of variables that provide the primary driving forces; the intermediate layer, comprising variables that transmit and operationalize these influences; and the outcome layer, representing variables that emerge from interactions among the factors positioned at the lower levels.

Level 1 comprises leadership commitment (FS-7) and supporting policies and regulations (FS-12). Their position at the lowest level of the ISM hierarchy indicates that these variables possess strong driving characteristics and relatively limited dependence on other variables. They therefore constitute the foundational conditions for the development and institutionalization of green economy practices among batik SMEs. Leadership commitment represents the extent to which SME owners and managers incorporate environmental sustainability into organizational priorities, strategic decisions, and day-to-day business operations. Strong managerial commitment can facilitate the allocation of resources to cleaner technologies, stimulate green innovation, and encourage employees to participate in environmentally responsible practices (Sanz-Torro et al., 2024). From an organizational perspective, leadership commitment therefore provides an essential mechanism for translating sustainability objectives into concrete operational practices and long-term organizational change. Supporting policies and regulations constitute the second foundational variable. Government interventions concerning environmental protection, waste management, sustainable production standards, and incentives for green industry development can establish an institutional environment conducive to the adoption of environmentally responsible practices among SMEs (Pangarso et al., 2022). The ISM structure consequently suggests that leadership commitment and an enabling regulatory environment jointly provide the fundamental conditions from which subsequent organizational, technological, and operational transformations can develop.

Level 2 consists of innovation capability (FS-1), environmentally friendly production processes (FS-2), and skilled labor (FS-6). These variables are structurally influenced by the foundational conditions established at Level 1 while simultaneously exerting influence on variables positioned at subsequent levels. Their intermediate position indicates that they function as important organizational and operational capabilities through which leadership commitment and institutional support are translated into practical green economy initiatives. Innovation capability refers to the capacity of batik SMEs to develop or adopt products, technologies, processes, and production methods that reduce environmental impacts while maintaining product quality and market competitiveness. Strong leadership and supportive public policies can create the organizational and institutional conditions necessary for SMEs to invest in innovation and adopt environmentally sustainable technologies. Environmentally friendly production processes represent the operationalization of green economy principles within the firm's core activities. These processes may involve the use of environmentally preferable materials, efficient utilization of water and energy, waste minimization, and the adoption of cleaner production techniques. The ISM structure indicates that the effectiveness of such practices depends on the availability of competent human resources, managerial support, and an appropriate regulatory environment. Skilled labor (FS-6) represents another critical capability at this level. Employees equipped with appropriate technical knowledge, environmental awareness, and adaptive capabilities are better positioned to implement green innovations and maintain environmentally responsible operating standards. Workforce competence therefore functions as an enabling mechanism that supports both the implementation and continuity of green production practices within batik SMEs.

At Level 3, the ISM model identifies green supply chain management (FS-4) and resource efficiency (FS-9) as intermediary drivers. Their position indicates that these variables translate the organizational capabilities established at Level 2 into broader resource-management and interorganizational practices. Green supply chain management encompasses the integration of environmental considerations across procurement, production, distribution, and logistics activities (Sujiwo et al., 2023). For batik SMEs, this may include selecting environmentally preferable raw materials, establishing relationships with sustainable suppliers, minimizing transportation-related environmental impacts, and adopting environmentally responsible packaging. The ISM structure indicates that the development of green supply chain practices is influenced by innovation capability, environmentally friendly production processes, and workforce competence at Level 2. Once implemented, these practices can contribute simultaneously to improved environmental performance, product value, organizational reputation, and customer confidence. Resource efficiency (FS-9) represents the second variable at this level and concerns the optimization of material, energy, and water consumption throughout the production process. More efficient resource utilization can generate both economic and environmental benefits by reducing production costs, minimizing material losses, and limiting environmental impacts associated with excessive resource consumption and waste generation. In the batik sector, relevant practices may include wastewater recycling, reduction of fabric losses, adoption of renewable energy, and improvement of dyeing efficiency (Iswanti et al., 2000). The ISM structure further indicates that resource efficiency is influenced by innovation capability and workforce competence, demonstrating the importance of technological and human capabilities in translating sustainability objectives into operational improvements.

Level 4 comprises waste management (FS-10) and green product design (FS-11). These variables occupy an intermediate position in the hierarchy and represent more specific mechanisms through which improvements in resource utilization and supply chain practices are translated into environmental and product-level outcomes. Waste management encompasses the collection, treatment, recycling, recovery, and disposal of waste generated throughout batik production activities. Effective waste management is particularly important for SMEs because inadequately managed production residues can contribute to environmental pollution and regulatory non-compliance (Tyler et al., 2023). Within the ISM

structure, waste management is closely connected with resource efficiency and green supply chain management, suggesting that waste reduction should not be treated as an isolated environmental activity but rather as an integral component of a broader resource-management system. The adoption of appropriate treatment technologies and recycling mechanisms can consequently reduce environmental risks while strengthening the environmental performance of batik SMEs. Green product design (FS-11) extends environmental considerations from production processes to the characteristics and lifecycle of the products themselves. It involves incorporating environmental considerations into material selection, manufacturing, packaging, product use, and end-of-life management (Pangarso et al., 2022). In the context of batik SMEs, such practices may include the use of environmentally preferable fabrics and dyes, recyclable packaging, and product designs that emphasize durability and extended use. Beyond its environmental contribution, green product design may support product differentiation and market positioning by responding to the preferences of increasingly environmentally conscious consumers. Thus, this variable provides a direct link between environmental innovation and the market-oriented dimension of green economy development.

The ISM model places organizational culture (FS-3), green financing (FS-5), and corporate networks (FS-8) at Level 5. Their position indicates that these variables are influenced by the accumulation of capabilities and practices developed at the preceding levels. Collectively, they represent organizational, financial, and interorganizational mechanisms that reinforce the transition toward a green economy. Organizational culture (FS-3) encompasses the shared values, norms, attitudes, and behavioral patterns that encourage sustainability-oriented practices within SMEs. A strong sustainability-oriented culture can enhance employee engagement, environmental awareness, innovation, and continuous improvement in green business processes (Thu et al., 2023). Within the ISM hierarchy, organizational culture is positioned downstream from operational and resource-management capabilities, suggesting that organizational values and behaviors may progressively evolve as SMEs institutionalize environmentally responsible production, resource efficiency, and waste-management practices. Green financing (FS-5) provides financial support for investments required to advance the green transformation of batik SMEs. Access to environmentally oriented financial instruments can facilitate investment in cleaner technologies, sustainable waste-treatment systems, resource-efficient equipment, and environmentally responsible product innovation. The ISM structure places this variable at a relatively high level, indicating that financing opportunities may be facilitated by improvements in organizational capability, environmental performance, and operational efficiency. This interpretation is consistent with the argument that stronger environmental and operational performance can improve SMEs' ability to access sustainability-oriented financing (Telukdarie et al., 2024). Corporate networks (FS-8) refer to interorganizational relationships involving SMEs and external stakeholders, including suppliers, academic institutions, government agencies, and non-governmental organizations. Such networks can facilitate knowledge sharing, technology diffusion, access to markets and resources, and collaborative innovation (Kusumastuti, 2023). Their position at Level 5 suggests that interorganizational collaboration is reinforced by the development of internal capabilities and environmentally oriented practices at lower levels of the ISM hierarchy.

At the highest level of the ISM hierarchy, Level 6 comprises association support (FS-13) and consumer development (FS-14). These variables represent external reinforcement mechanisms and market-oriented outcomes emerging from the interaction of the organizational, operational, environmental, financial, and interorganizational factors positioned at the lower levels. Association support (FS-13) reflects the contribution of industry associations, cooperatives, and professional organizations in strengthening the capacity of SMEs to adopt and sustain green economy practices. These institutions can facilitate information dissemination, capacity building, stakeholder coordination, and knowledge exchange among industry participants (Lestari et al., 2024). Their position at the highest level of the hierarchy suggests that association support functions as an external reinforcement mechanism that can consolidate and sustain green transformation once the underlying organizational and operational capabilities have been established. Meanwhile, consumer development (FS-14) concerns efforts to increase consumer awareness of environmental responsibility and stimulate market demand for sustainably produced products. Growing environmental awareness can influence consumer preferences toward products manufactured using environmentally responsible processes (Madrid-Guijarro & Duréndez, 2024). In the ISM framework, this variable represents an important market-level manifestation of the green economy transition, whereby improvements in internal SME capabilities and sustainability practices can increasingly be translated into consumer recognition and market demand. Sustained consumer demand can, in turn, provide an external incentive for SMEs to maintain environmental commitments and pursue continuous green innovation.

3.3 Discussion

The integrated findings of the MICMAC and ISM analyses indicate that green economy development among Indonesian batik SMEs is a systemic process shaped by interconnected organizational, institutional, technological, environmental, financial, and market-related factors. Rather than functioning as independent determinants, the 14 identified variables form a hierarchical structure in which foundational factors influence intermediate capabilities and, ultimately, outcome-oriented variables. This finding reinforces the relevance of a systems perspective in understanding sustainability transitions among SMEs, where internal capabilities interact continuously with external institutional and market conditions. Previous ISM and MICMAC research similarly demonstrates that sustainability-related factors should be interpreted according to their structural interdependencies rather than as isolated variables (Sumrit, 2025). A

particularly important finding is the dominant position of leadership commitment (FS-7) and supporting policies and regulations (FS-12) at the foundation of the ISM hierarchy. Their high driving characteristics in the MICMAC analysis suggest that green transformation is strongly conditioned by both internal managerial orientation and the external institutional environment. This finding is consistent with the NRBV perspective, which emphasizes the development of organizational capabilities for pollution prevention, sustainable resource use, and environmentally oriented innovation as sources of long-term advantage. Research on SMEs has likewise demonstrated that environmental strategies are associated with organizational capabilities such as shared vision, stakeholder management, and strategic proactivity (Alfarizi and Arifian, 2024). More recent research also indicates that environmental regulation and green organizational capabilities can jointly shape green innovation and competitive advantage among SMEs (Sanz-Torro et al., 2024).

The positioning of innovation capability, environmentally friendly production processes, and skilled labor at Level 2 further demonstrates that institutional and leadership drivers must be translated into tangible organizational capabilities. This finding is particularly relevant for batik SMEs, which generally operate with relatively limited resources and therefore need to strategically combine human competencies, technological adaptation, and managerial commitment. Green innovation can function as a strategic resource that enables firms to reconcile environmental objectives with competitiveness, while green innovation capabilities and sustainable human capital contribute to the development of sustainability-oriented organizational capabilities (Clemente-Almendros et al., 2024). Thus, the results suggest that regulatory support alone is insufficient unless it is accompanied by the internal capabilities required to implement green practices. The MICMAC classification of green supply chain management, resource efficiency, waste management, and green product design as linkage variables provides another important theoretical insight. Their high driving and dependence characteristics indicate that these factors operate as critical interfaces between organizational capabilities and sustainability outcomes. Green supply chain management and green product design, in particular, extend environmental considerations beyond internal production processes toward suppliers, products, and markets. This interpretation is consistent with the NRBV literature, which identifies green supply chain management and green product innovation as important themes through which firms transform environmental capabilities into competitive value (Johnson-Hall and Hall, 2022). Evidence from small manufacturing firms also indicates that green product innovation and green suppliers can reinforce differentiation advantage (Madrid-Guijarro and Durendez, 2024).

Conversely, organizational culture, green financing, corporate networks, association support, and consumer development appear at higher levels of the ISM hierarchy and are characterized predominantly by dependence on lower-level factors. This configuration suggests that these variables should not necessarily be treated as initial intervention points. For example, access to green financing may become more feasible when SMEs demonstrate stronger environmental capabilities, credible sustainability practices, and improved operational performance. Similarly, corporate networks and consumer development may strengthen as firms develop more credible green products and practices. Recent research on Indonesian SMEs supports the importance of green intellectual capital, green entrepreneurial orientation, and green innovation capacity in translating internal resources into sustainability performance (Maesaroh et al., 2024). Overall, the combined MICMAC–ISM results contribute to the literature by demonstrating that green economy development in Indonesian batik SMEs should be approached as a sequential and interconnected capability-building process. The structural logic emerging from the model can be summarized as institutional and leadership commitment, organizational capabilities, green operational practices, environmental and product innovation, organizational, financial, and network reinforcement, and market and stakeholder outcomes. This configuration extends the NRBV perspective by showing how natural-resource-oriented capabilities may be progressively embedded within SME operations rather than adopted as isolated environmental initiatives. Accordingly, the findings provide a structural basis for designing a green economy roadmap in which interventions prioritize foundational drivers before attempting to maximize dependent outcomes.

4. Conclusion

This study developed a structural model for green economy development among Indonesian batik SMEs by integrating MICMAC and Interpretive Structural Modeling (ISM) within the Natural Resource-Based View (NRBV) perspective. The integrated analysis demonstrates that green transformation in batik SMEs is characterized by strong interdependencies among organizational, institutional, technological, environmental, financial, and market-related factors. This finding is consistent with previous sustainability research showing that ISM–MICMAC is particularly useful for revealing hierarchical relationships and distinguishing foundational drivers from dependent outcomes in complex SME systems. The ISM results identify leadership commitment (FS-7) and supporting policies and regulations (FS-12) as the foundational drivers at Level 1. These factors provide the institutional and managerial basis for developing innovation capability, environmentally friendly production processes, and skilled labor at Level 2. Subsequently, these capabilities facilitate green supply chain management and resource efficiency at Level 3, which contribute to the implementation of waste management and green product design at Level 4. The higher levels consist of organizational culture, green financing, and corporate networks, followed by association support and consumer development as the highest-level variables. This hierarchical configuration indicates that green economy development should be approached as a progressive capability-building process rather than through isolated interventions. Similar

ISM-based studies emphasize that strengthening foundational drivers can improve the performance of interconnected downstream factors within SME sustainability systems.

The MICMAC analysis further reinforces this interpretation. The absence of autonomous variables indicates that all 14 variables have meaningful structural relationships within the system. Organizational culture, green financing, corporate networks, association support, and consumer development are classified as dependent variables, indicating that their development is substantially influenced by other factors. Meanwhile, green supply chain management, resource efficiency, waste management, and green product design constitute linkage variables because they exhibit both substantial driving and dependence characteristics. Such linkage variables represent strategically sensitive elements because interventions affecting them may generate broader systemic effects. This finding is consistent with recent applications of ISM–MICMAC in sustainability research, which demonstrate the value of identifying high-dependency and high-driving variables when formulating intervention strategies.

From a theoretical perspective, the findings extend the application of NRBV by illustrating how sustainability-oriented capabilities can be structurally developed from foundational managerial and institutional conditions toward operational, organizational, and market outcomes. From a practical perspective, the model provides a basis for developing a green economy roadmap for Indonesian batik SMEs, in which interventions should first strengthen leadership commitment, regulatory support, innovation capability, workforce competence, and environmentally responsible production before emphasizing downstream outcomes such as green financing, market development, and consumer demand. Overall, the study demonstrates that the transition toward a green economy in batik SMEs is a systemic and hierarchical process. The combined MICMAC–ISM framework therefore provides a structured decision-support mechanism for identifying the relationships among strategic variables and establishing an evidence-based foundation for subsequent policy formulation, managerial interventions, and sustainability-oriented development strategies.

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