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The Influence of Knowledge Management and Green Innovation on the Environmental Performance of MSMEs in Malang City: A Study of the Laundry Sector

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ABSTRACT

Improving business management by incorporating environmental considerations has become a critical aspect of ensuring business continuity. Environmental performance serves as an analytical tool for assessing the characteristics of business operations within a specific ecological context. Paying attention to environmental concerns, such as effective waste management practices and the development of environmentally friendly products, is pivotal for business success, particularly for small and medium-sized enterprises (MSMEs) engaged in chemical-intensive production processes. This study aims to investigate the role of knowledge management in fostering environmental performance and further explore the mediating effect of green innovation on this relationship. Utilizing a quantitative approach, this research collected data from 150 MSMEs in Malang City known to generate chemical waste, during the period of July to September, employing purposive sampling techniques. The findings of this study corroborate previous research indicating that robust knowledge management practices and proactive green innovation efforts significantly contribute to enhancing environmental performance. However, the analysis reveals that green innovation only partially mediates the relationship between knowledge management and environmental performance, suggesting avenues for further exploration in future research endeavors. Moreover, diversification in the selection of industries, expansion of research scopes, consideration of business scale variations, and exploration of additional relevant variables are deemed essential for advancing future research in this domain.

ABSTRAK

Meningkatkan manajemen bisnis dengan memasukkan pertimbangan lingkungan telah menjadi aspek penting dalam memastikan kelangsungan bisnis. Kinerja lingkungan berfungsi sebagai alat analisis untuk menilai karakteristik operasi bisnis dalam konteks ekologis tertentu. Memperhatikan masalah lingkungan, seperti praktik pengelolaan limbah yang efektif dan pengembangan produk ramah lingkungan, sangat penting untuk kesuksesan bisnis, terutama bagi usaha kecil dan menengah (UMKM) yang terlibat dalam proses produksi yang menggunakan bahan kimia. Studi ini bertujuan untuk menyelidiki peran manajemen pengetahuan dalam meningkatkan kinerja lingkungan dan lebih lanjut menjelajahi efek mediasi inovasi hijau terhadap hubungan ini. Dengan menggunakan pendekatan kuantitatif, penelitian ini mengumpulkan data dari 150 UMKM di Kota Malang yang dikenal menghasilkan limbah kimia, selama periode Juli hingga September, dengan menggunakan teknik purposive sampling. Temuan dari penelitian ini mendukung penelitian sebelumnya yang menunjukkan bahwa praktik manajemen pengetahuan yang kuat dan upaya inovasi hijau proaktif secara signifikan berkontribusi pada meningkatkan kinerja lingkungan. Namun, analisis mengungkapkan bahwa inovasi hijau hanya sebagian memediasi

hubungan antara manajemen pengetahuan dan kinerja lingkungan, menyarankan jalur untuk lebih dijelajahi dalam upaya penelitian masa depan. Selain itu, diversifikasi dalam pemilihan industri, perluasan cakupan penelitian, pertimbangan variasi skala bisnis, dan penjelajahan variabel tambahan yang relevan dianggap penting untuk memajukan penelitian masa depan dalam domain ini.

INTRODUCTION

Business stakeholders such as consumers, the community, and the government are increasingly concerned about environmental sustainability. Companies are required to develop environmentally friendly programs or produce green products (Yung et al., 2011; Chiou et al., 2011; Wang et al., 2022). The implementation of business activities using conventional processes generally has adverse effects on environmental sustainability. Combustion gases from production residues, air pollution, the use of hazardous materials, and increased production waste can lead to environmental damage (Saidal Siburian & Mar, 2020).

Environmental damage poses challenges to business sustainability and introduces uncertainties. Indicators of environmental damage include weather changes, extreme temperature increases, and depletion of natural resources. The consequences of environmental damage will impact sustainable business practices. In the Triple Bottom Line theory, environmental aspects are a key component of sustainable business operations (Elkington, 2013). Major corporations such as Mercedes-Benz, FedEx, Analog Devices, and NRG Energy have committed to implementing environmentally friendly business practices as part of their sustainability strategies and to enhance the environment (Analog Devices, 2023; Mercedes-Benz, 2022). Yu et al. (2017) further emphasize that corporate stakeholders pressure companies to minimize production activities that contribute to environmental damage (Yu et al., 2017).

David et al. (2024) revealed that environmental conservation and the implementation of environmentally friendly business processes have become the focus of researchers and business practitioners to build competitive sustainable businesses. Business actors acknowledge that environmental concerns can foster sustainable development (Li et al., 2023). Elkington (2013) asserts that environmental performance can drive the success of business strategies, alongside profit and people. Environmental performance is crucial for achieving business success (Bendig et al., 2023; Esty & Emerson, 2018; Hsu & Zomer, 2014; Zumente & Bistrova, 2021). Environmental performance serves as a mechanism for companies to voluntarily integrate environmental considerations into their operations and interactions with stakeholders, extending beyond the organization's legal responsibilities.

Measurement of environmental performance serves as an analytical tool to assess the impact of business activities on environmental characteristics (Jasch, 2000; Tyteca, 1996). Environmental performance acts as an indicator for companies to prioritize environmental

conservation in all business activities. Indonesia, as a developing country, is also confronted with environmental issues. The awareness of the Indonesian people regarding the importance of the environment is gradually increasing. This awareness serves as a fundamental basis for a control system for companies to mitigate the adverse effects of industrialization.

The Indonesian government regulates environmental preservation concerning business activities through the Republic of Indonesia Law Number 32 of 2009 concerning Environmental Protection and Management (UUPPLH). This policy is aimed at conserving environmental functions and preventing pollution and/or environmental damage, which includes pollution, utilization, control, monitoring, and law enforcement. Business operations in several industrial sectors can trigger environmental damage, one of which is the textile industry.

The textile industry in Indonesia has experienced significant growth, projected to increase by up to 50% between 2021 and 2022 (Handayani, 2022). Alliance Laundry Systems (ALS) regards Indonesia as a primary market with great potential in the laundry business. Behind the growth of the laundry business, the waste generated from laundry activities can pose a threat to environmental sustainability. Pratiwi et al. (1979) demonstrated that untreated laundry waste has an LC50 between 8-10%, indicating a high level of toxicity in the waste. In addition to its toxic effects, excessive production waste from the textile industry can pollute water bodies and cause eutrophication, where water bodies become rich in dissolved nutrients, reducing dissolved oxygen content and the ability of aquatic biota to thrive (Raissa & Tangahu, 2017). Hence, measuring environmental performance becomes crucial in the development of the textile industry in Indonesia.

The formation of environmental performance is driven by green innovation (Chiou et al., 2011; Kraus et al., 2020; Rehman et al., 2021; Seman et al., 2019; Singh et al., 2020). The concept of green innovation refers to the development and utilization of technologies, products, and processes that are more environmentally friendly (Chiou et al., 2011; Rehman et al., 2021; Singh et al., 2020). The implementation of green innovation will spur the development of more energy and resource-efficient technologies, thus reducing pollutants. Moreover, green innovation can also open up new opportunities for companies to introduce environmentally friendly products and services to the market. This can enhance the company's reputation and provide long-term financial benefits. Studies examining the relationship between green innovation and environmental performance are relatively scarce (Seman et al., 2019). Green innovation is derived from the evolutionary model theory developed by Nelson & Winter (1982) (Nelson, 1985). The concept of green innovation links innovation creation with environmental sustainability to achieve organizational success in the long run. Several studies have revealed that the drive for green innovation in environmental performance is influenced by other internal factors.

Moreover, the support for implementing green innovation and awareness of environmental performance are driven by proficient knowledge management. Knowledge management is essential in enhancing the performance of SMEs (Farooq & Vij, 2019).

Knowledge management is crucial for SMEs to adapt to high environmental business uncertainty. Knowledge management is reflected through the attitudes and behaviors of business actors to record organizational memory, share knowledge, acquire knowledge, and absorb knowledge (Hussein et al., 2018; Kmieciak & Michna, 2018; C. L. Wang et al., 2008, 2009). Business actors who have a knowledge-oriented attitude can utilize company knowledge and information to adapt to changes in the business environment (Farooq & Vij, 2019). Knowledge management is highly needed in the process of strategic planning and business innovation creation (Hussein et al., 2018). Business actors implementing knowledge management will leverage all company knowledge as a lever for performance and competitiveness (Du, 2011; Farooq & Vij, 2019; C. L. Wang et al., 2009).

Several studies have revealed that green innovation can effectively mediate the implementation of digitalization in innovation development for environmental performance. However, research linking knowledge management, green innovation, and environmental performance has not been extensively explored. Based on this gap, this study aims to analyze the role of knowledge management and green innovation in influencing environmental performance. Additionally, this research will uncover the role of green innovation in mediating the relationship between knowledge management and environmental performance in the laundry industry in Indonesia.

THEORITICAL FRAMEWORK

The role of Knowledge management in the realization of Green innovation

Knowledge management and green innovation are closely related and interconnected in the business development process. The level of knowledge possessed by individuals or teams within an organization correlates with the organization's capacity to create green innovation. Companies will optimally utilize their resources and reduce their environmental impact. Knowledge management is crucial in the collection, storage, distribution, and utilization of knowledge relevant to environmental aspects and sustainability. It forms the foundation for the innovation process. The dissemination and application of knowledge within the organization will drive the company's resource capabilities to implement green innovation and promote the absorption of environmentally friendly waste. According to Darroch & McNaughton (2002), aspects such as information acquisition, dissemination, and response are key to shaping green innovation. Their research revealed that incremental innovation occurs due to the company's speed in responding to market changes and knowledge of technology. Therefore, the company's ability to gather, disseminate, and respond to information is crucial for creating environmentally friendly innovations. Hence, this study hypothesizes:

H1: Knowledge management has a positive influence on green innovation.

The role of Knowledge management in the realization of Environmental Performance

Knowledge management has an impact on performance improvement (Darroch, 2005). The structured management and utilization of information can serve as a foundation for creating sustainable innovations, resource efficiency, and deep environmental awareness.

Providing access to up-to-date information about technologies, methods, and practices that support environmental sustainability facilitates the process of sustainable innovation, such as innovation in eco-friendly products, eco-friendly processes, and minimizing production waste (Aramyan et al., 2021; Xie et al., 2019). Furthermore, measured knowledge management contributes to cost efficiency and has a negative impact on reducing resource wastage by providing a better understanding of resource consumption and the environmental impact of operational activities. By analyzing and utilizing this knowledge, organizations can identify and reduce resource wastage, improve operational efficiency, and significantly enhance their competitive advantage (Tu & Wu, 2021). The application of the environmental performance concept must be wise to maintain, develop, and eliminate activities that support environmental sustainability (Shou et al., 2020). The environmental performance concept can be driven by the company's resource capabilities to acquire, share, apply, and absorb knowledge related to environmental performance aspects (Shahzad et al., 2020). Environmentally friendly knowledge obtained is only beneficial if applied and shared with relevant stakeholders. Organizations share knowledge through meetings, discussions, and consultations between internal and external environments (Muñoz-Pascual et al., 2019). Such cooperative activities enhance employee and organizational development and facilitate them in achieving sustainability goals (Sahibzada et al., 2023). Sharing knowledge about eco-friendly concepts is linked to its application (Basten & Haamann, 2018) to ensure sustainable performance. Thus, the better a company's ability to manage information and knowledge, the higher the likelihood of achieving its environmental performance. Therefore, the following hypothesis is stated:

H2: Knowledge management has a positive influence on environmental performance.

The role of green innovation in the achievement of environmental performance

Environmental performance, as previously discussed, focuses on developing environmentally friendly technologies to enhance company profits (Rehman et al., 2021). However, when a company's managerial management is inefficient, it has the potential to increase the risk of environmental remediation failure and damage the company's reputation (Li et al., 2023). The success of a company in managing production waste (waste), creating environmentally friendly products, and focusing on sustainable development strategies will drive the creation of competitive advantages for the company (Hart, 1995). Previous research has shown that environmental strategy's influence on environmental performance, in general, contributes to mediating the impact of CSR on the environment (Kraus et al., 2020). The role of green innovation in driving the formation of environmental performance can be strengthened through proactive rather than reactive approaches. Based on this exposition, the researchers hypothesize:

H3A: Green innovation has a positive influence on environmental performance.

H3B: Green innovation can mediate the influence of knowledge management on environmental performance. Referring to the proposed hypothesis, this research model is illustrated through the following figure;

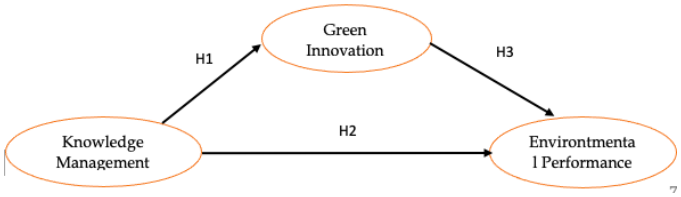

Figure 1 Theoritical Framework

RESEARCH METHODS

This research was conducted in Malang City by surveying 200 laundry entrepreneurs in the area. A total of 150 questionnaires were successfully collected and processed. Data collection took place from July to October 2023. The distribution of laundry services in Malang City is currently quite sporadic and is not yet supported by integrated data sources with the Malang City Government. According to Hair et al. (1998), research with an unknown population size can use minimum assumptions when collecting respondents. Based on the theory proposed by Hair et al. (1998), the sample size can be determined by multiplying the number of indicators by 10, or this study has a minimum sample size of 110 respondents. Data collection was conducted using simple random sampling techniques, with questionnaires distributed directly to the respondents.

The data analysis method used in this study is Structural Equation Modeling (SEM). This research consists of three variables: knowledge management, green innovation, and environmental performance. The measurement of knowledge management orientation is reflected in three dimensions: Information Acquisition, Information or Knowledge Dissemination, and Information or Knowledge Accountability. The measurement of knowledge management orientation is adopted from Darroch & McNaughton (2002). The measurement of green innovation is determined based on environmentally friendly product innovation, waste reduction, and emissions. The measurement of green innovation is adopted from Rehman et al. (2021). Furthermore, the measurement of environmental performance can be revealed through indicators reflecting the company's attention to the environment. Environmental performance is measured using indicators such as environmentally friendly products, environmentally friendly manufacturing processes, environmentally friendly marketing and distribution, and waste disposal with environmentally friendly mechanisms. These indicators are adopted from the research of Rehman et al. (2021), which examines the relationship between green innovation and environmental performance.

RESULTS AND DISCUSSION

This research has gathered information from 150 respondents. The respondents, who are entrepreneurs, are predominantly female, accounting for 71% of the sample, with the majority having a bachelor's degree or higher education level, comprising 64% of the sample. The average monthly profit ranges from 5 to 7 million Indonesian Rupiah. This indicates that the businesses involved operate at a micro-scale. Based on the information obtained, most respondents are aware that their businesses have impacts and risks on the

environment, especially in waste management. The characteristics of the respondents are further described in the following table;

Table 1 ***Respondent Characteristics***

Respondent Identity	Description	Total	Percentage
Gender	Male	107	71%
	Female	43	29%
Education Level	Elementary School	7	4%
	Junior High	7	4%
	High School	20	13%
	Bachelor Degree	96	64%
	Master Degree	22	15%
Profits/Month	<Rp. 10.000.000	127	85%
	Rp. 10.000.000 – 30.000.000	21	14%
	> Rp. 30.000.000	2	1%
Environmental Understanding	Understand and Care	130	86%
	Don't Know	20	14%

Source: processed data (Researcher, 2023)

Model Validity

The research items involved testing the model by examining the values of Convergent Validity and Discriminant Validity to measure factor loadings. Indicators with factor loadings below 0.6 were considered invalid and needed to be removed from the research model. Indicators were deemed valid if their outer loadings exceeded 0.6. All indicators used in this study met the criteria for Convergent Validity and Discriminant Validity. Furthermore, to assess the model's reliability, all research indicators underwent reliability testing, with the results presented in Table 2.

Table 2 ***Construct Reliability and Validity***

	Cronbach's Alpha	Composite Reliability	AVE	Description
Environtmental Performance	0,964	0,967	0,590	Reliable
Green innovation	0,861	0,887	0,531	Reliable
Knowledge management	0,971	0,974	0,718	Reliable

Source: processed data (Researcher, 2023)

Based on the reliability testing results of the latent variables used in the model, the Environmental Performance latent variable has a Cronbach's Alpha value of 0.964 and a Composite Reliability of 0.967. The Green Innovation latent variable has a Cronbach's Alpha value of 0.861 and a Composite Reliability of 0.887. Additionally, the Knowledge Management latent variable has a Cronbach's Alpha value of 0.971 and a Composite Reliability of 0.975. Thus, all variables are deemed reliable as they possess Cronbach's Alpha or Composite Reliability values greater than 0.60, and all variables have Average Variance Extracted (AVE) values exceeding 0.50.

Based on the inner model measurements, the Adjusted R-square for Path 1 is 0.688, indicating that Knowledge Management and Green Innovation together explain 68.4% of Environmental Performance, while 31.6% is explained by other variables beyond the scope of this research. The Adjusted R-square for Path 2 is 0.086, suggesting that Knowledge Management contributes 8.6% to Green Innovation, while 91.4% is influenced by variables not included in this study.

Table 3 ***Path Coefficient***

	Relationship Between Variable	Path Coefficient	T Statistics	P Values	Result	
H1	GI ➔ EP	0,287	4,101	0,000	Significant	Accepted
H2	KM ➔ EP	0,870	18,259	0,000	Significant	Accepted
H3	KM ➔ GI	0,304	2,833	0,005	Significant	Accepted
H4	KM➔GI ➔ EP	0,087	2,663	0,008	Significant	Accepted

Source: processed data (Researcher, 2023)

The research findings demonstrate a significant relationship between Green Innovation and Environmental Performance, with a T-statistic of 4.101 (> 1.96). Hence, hypothesis H1 states that "Green Innovation significantly influences Environmental Performance," is accepted. Similarly, the relationship between Knowledge Management and Environmental Performance is significant, with a T-statistic of 18.259 (> 1.96), confirming hypothesis H2, which posits that "Knowledge Management significantly influences Environmental Performance." The relationship between Knowledge Management and Green Innovation is also significant, with a T-statistic of 2.833 (> 1.96). Thus, hypothesis H3, asserting that "Knowledge Management significantly influences Green Innovation," is accepted.

The indirect effect of Knowledge Management (X) on Environmental Performance (Y) through the mediation of Green Innovation (Z1) is proven to be significant, with a p-value of 0.008 (<0.05). Meanwhile, the direct effect of Knowledge Management (X) on Environmental Performance (Y) is also significant. These results indicate partial mediation in this study. Partial mediation implies that involving a mediator variable, both directly and indirectly, the independent variable affects the dependent variable.

The direct effect of Knowledge Management (X) on Environmental Performance (Y) is 18.259. Meanwhile, the indirect effect of Knowledge Management (X) on Environmental Performance (Y) through the mediation of Green Innovation (Z1) is calculated as 18.259 x 0.087 = 1.588. Thus, the total effect of Knowledge Management (X) on Environmental Performance (Y) through the mediation of Green Innovation (Z1) is 18.259 + 1.588 = 19.847.

Discussion

Business management must focus on profit market expansion and long-term strategies to create a competitive advantage (Dewi et al., 2023). Ensuring business sustainability while considering environmental impacts has become imperative to attain competitive advantage. This research has found results that support previous studies. Firstly, it found that Knowledge Management can foster the formation of green innovation. This finding is consistent with prior research (Chaithanapat et al., 2022; Darroch & McNaughton, 2002;

Naqshbandi & Jasimuddin, 2022). Knowledge management plays a central role in expediting the implementation of green innovation concepts.

Companies that have implemented knowledge management possess the capability to store and provide rapid access to information regarding sustainable practices and the latest green technologies. On a broader scope, knowledge management also supports organizational learning by creating effective processes for sharing knowledge and experiences among team members and departments (Firman, 2023; Wahyuni & Giantari, 2022). The strength of information transfer processes facilitates the creation of green innovation transformations.

By fostering collaboration among departments and engaging stakeholders, knowledge management encourages the generation of ideas and practices related to the environment and the development of sustainable businesses. The adequacy of information possessed by companies with systematic knowledge management enables them to design and implement green innovations proactively, identify market gaps, and lead in adopting solutions that prioritize sustainability. Knowledge management can store a company's historical data, which can be used as a reference to understand and comply with changes in environmental regulations and policies. With a good understanding of evolving legal frameworks, organizations can allocate resources and design green innovations by regulatory demands, thereby reducing legal and reputational risks.

This research also found that knowledge management can enhance environmental performance. As previous studies have revealed, access to the latest information on technologies, methods, and practices supporting environmental sustainability facilitates sustainable innovation processes, such as developing eco-friendly products, improving environmentally friendly production processes, and reducing production waste (Aramyan et al., 2021; Xie et al., 2019). These findings support such assertions by demonstrating that knowledge management significantly impacts environmental performance. Knowledge management is a means to manage and leverage information regarding green practices, the latest technologies, and evolving environmental policies. Implementing knowledge management in MSMEs enables collaboration among departments and individuals within the company, facilitating the exchange of ideas and experiences to create innovative, environmentally friendly solutions. By sharing knowledge, MSMEs can foster an environment conducive to experimentation and continuous learning, thereby promoting the creation of new sustainable products and processes.

Furthermore, the importance of knowledge management in measuring and reporting environmental performance must be considered. The application of knowledge management allows MSMEs to collect, analyze, and report data related to the environmental impact of their operational activities. This information helps MSMEs monitor their performance progress, identify areas for improvement, and serves as a foundation for making strategic decisions that support business sustainability. Knowledge management also aids MSMEs in complying with applicable environmental regulations and policies. By monitoring changes in environmental regulations and policies, MSMEs can adjust their

policies and practices to comply with the latest legal requirements. This not only reduces legal risks but also helps MSMEs meet environmental standards.

At the organizational culture level, the implementation of knowledge management also plays a role in shaping employee awareness and engagement regarding environmental issues. Through approaches such as training and awareness campaigns, a foundation is laid for a culture that prioritizes environmental responsibility. Employee awareness and engagement are crucial to implementing and supporting sustainable practices in MSMEs.

Furthermore, this study also found that green innovation plays a crucial role in shaping and enhancing an organization's environmental performance, shifting business paradigms towards sustainability and environmental responsibility. One significant impact of green innovation is the reduction of carbon footprint and greenhouse gas emissions. By adopting more environmentally friendly technologies and improving energy efficiency in production processes, organizations can substantially mitigate their adverse effects on the atmosphere and global climate. Green innovation also significantly contributes to improving the resource efficiency of SMEs. More efficient production processes in water, energy, and raw material usage help alleviate environmental pressures and enhance supply chain sustainability. By designing sustainable products that consider their lifecycle comprehensively, green innovation paves the way for waste reduction and more effective waste management.

Moreover, green innovation brings significant benefits to waste management and pollution reduction. Optimized production processes result in less waste generation, while innovations in materials and production methods can help reduce the risk of water and soil pollution. Innovative products designed with a sustainable approach can also offer better and safer alternatives for the environment. Green innovation also impacts a company's image and reputation. Competitive advantage can be achieved through providing products and services that support environmental values. Consumer concern for environmental issues is growing. Thus, green innovation creates new opportunities for business growth and development. By creating a demand for sustainable solutions, green innovation not only positively impacts organizational environmental performance but also drives further innovation across various sectors. Therefore, green innovation is not just a sustainability requirement but also an opportunity to shape a more environmentally friendly and sustainable future. These findings are consistent with previous research (Li et al., 2023; Rehman et al., 2021).

Finally, this study aims to elucidate the role of green innovation as a mediator in the relationship between knowledge management. Previous research has concurred that green innovation can play a dominant role in driving the influence of knowledge management on performance. However, the findings of this study reveal that green innovation can only partially mediate the relationship between knowledge management and environmental performance. This possibility arises when the knowledge-sharing process and the application of knowledge have been optimally utilized within SMEs. Upon reviewing the characteristics of the study respondents, it is evident that most of them have a high level of

education and understand the importance of environmental awareness. The background of these SME actors impacts the implementation of knowledge-sharing capabilities in environmental management and encourages the pooling of resources to create environmentally friendly innovations. Mature knowledge management is essential for tracking and reporting environmental-friendly performance and providing a basis for further assessment and development. Thus, green innovation has yet to fully mediate the influence of knowledge management on environmental performance, failing to create synergies that yield holistic organizational sustainability. In a comprehensive sustainability strategy, green innovation and knowledge management together act as catalysts for change that positively impacts the environment and society.

CONCLUSION

This research demonstrates that the interaction between green innovation and knowledge management plays a crucial role in shaping the environmental performance of SMEs. Knowledge management provides a fundamental foundation for acquiring, storing, and disseminating sustainable knowledge that inspires the development of green innovation. Conversely, green innovation leverages this knowledge to design innovative solutions that are business-effective and optimize positive environmental impacts. Green innovation mediates the influence of knowledge management to ensure every decision made aligns with environmental and sustainability issues. Thus, the overall findings of this study indicate that green innovation and knowledge management contribute to shaping sustainable, innovative measures and lay the groundwork for an organizational culture focused on sustainability.

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