AN ANALYSIS OF SUSTAINABLE COMPETITIVE ADVANTAGE AND ENVIRONMENTALLY FRIENDLY MARKETING MODELS IN NATURAL DYES AND BATIK AND ECOPRINTING MSMEs

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ABSTRACT

This research aims to examine the influence of green knowledge management, ecological innovation, and ecological commitment on sustainable competitive advantage and sustainable marketing performance among batik and natural-dyed ecoprint MSMEs in Purworejo Regency. The study addresses the problem of low integration of sustainable business practices and limited use of local natural resources, which challenge MSMEs in responding to global market demands and environmental regulations.

A quantitative explanatory survey was conducted with 100 SMEs selected by purposive sampling. Data were analyzed using Partial Least Squares – Structural Equation Modeling (SEM-PLS). The results show that green knowledge management, ecological innovation, and ecological commitment have significant positive effects on sustainable competitive advantage and green marketing performance. In addition, sustainable competitive advantage mediates the relationship between these factors and green marketing outcomes, providing important implications for MSME development in eco-friendly industries.

Keywords*: green marketing performance, sustainable competitive advantage, green knowledge management, inovvation ecoology, commitment ecology*

INTRODUCTION

Batik and natural-dye ecoprint industry in Indonesia holds highly significant cultural and economic value, particularly among MSMEs, which play a strategic role in promoting sustainable development and strengthening the local economy (Juli et al., 2014:15; Fitri et al., 2025:210). However, in recent years, batik MSMEs have faced challenges from global competition and sustainability pressures, mainly due to the use of synthetic dyes that are increasingly rejected by export markets such as the European Union. (Widhi et al., 2023:22). Only a small fraction of MSMEs in Central Java Province have implemented environmentally friendly principles in their production processes (Muslimah et al., 2024:99). The implementation of green business through ecoprint innovation specifically the use of natural plant materials and fibers has been proven effective in reducing pollution and lowering production costs by up to 25%. Furthermore, it creates new market opportunities for natural-dye batik (Rumefi et al., 2024:1044; Lestari et al., 2023:129). Purworejo Regency itself possesses abundant biological resources, such as turmeric, mangosteen peel, sappan wood, and butterfly pea flowers. However,

the utilization of these dyeing materials remains suboptimal and has yet to be integrated into the local batik business (Aditya et al., 2019:45; Pangesti et al., 2024:73). Previous research reveals that green business practices within batik MSMEs provide a competitive advantage not only in terms of price, quality, and delivery but also in the environmental awareness of the entrepreneurs (Lestari et al., 2023:130). Nevertheless, adaptation to global market demands, technical issues, and management capacity still pose significant constraints; thus, a theoretical model is required to bridge local resource potential with sustainability requirements and green marketing strategies (Rumefi et al., 2024:1053). The research gap lies in the low integration of green knowledge management, ecological innovation, and ecological commitment as a unified strategic framework for building sustainable competitive advantage (Lubis et al., 2023:54; Qosasi et al., 2019:134). Prior studies have extensively discussed aspects of knowledge management and innovation, yet they remain limited to operational efficiency and environmental spending, without addressing the direct and indirect relationships with green marketing performance (Lovely et al., 2021:130; Battour et al., 2021:167).

Concurrently, the success of MSMEs in green business remains significantly influenced by human resource factors, digital marketing strategies, and business process adaptations that support eco-innovation (Wachjuni, 2024:122; Handayani, 2025:51).

Emerging business phenomena emphasize the urgency of adapting marketing models and sustainability-based competitive advantages, particularly to enable batik MSMEs to meet market demands, comply with environmental regulations, and enhance the competitiveness of national products (Wibowo, 2025:607; Fahira et al., 2025:88). Consequently, the objective of this study is to empirically examine the influence of green knowledge management, ecological innovation, and ecological commitment on sustainable competitive advantage, as well as the impact of such competitive advantage on the green marketing performance of batik and ecoprint MSMEs in Purworejo Regency (Lestari et al., 2023:126).

Berikut adalah terjemahan untuk bagian Originalitas Penelitian (Research Novelty) Anda. Saya menggunakan diksi yang menekankan nilai kebaruan riset Anda agar terlihat menonjol bagi pengulas jurnal (reviewer).

The originality of this study lies in its integrative modeling incorporating three strategic variables (green knowledge management, ecological innovation, and ecological commitment) that have not been

comprehensively documented for natural-dye batik MSMEs in Indonesia. While prior research has focused on these variables individually, this study examines both the direct and indirect relationships of the three variables with sustainable competitive advantage and green marketing performance. Furthermore, it introduces a theoretical model grounded in the local context of Purworejo using Structural Equation Modeling (SEM) analysis, an approach that has not been previously undertaken in this field (Lestari et al., 2023:127; Handayani, 2025:52; Rumefi et al., 2024:1054)..

THEORETICAL REVIEW

Sustainable Marketing Performance

Sustainable marketing performance posits that sustainability oriented marketing strategies do not merely emphasize the achievement of commercial goals but also prioritize the balanced creation of long-term economic, social, and environmental value. This approach positions companies as agents of change that actively shape responsible consumption behaviors, promote innovation, and address stakeholder demands for eco-friendly practices (Crittenden et al., 2011; Griffith & Yalcinkaya, 2015). Conversely, the Resource-Based View (RBV) explains that green marketing performance is achieved when a firm is capable of leveraging unique and inimitable resources—such as green innovation practices, green knowledge management, and ecological commitment—to build a sustainable competitive advantage (Barney, 2016; Sun et al., 2014; Jung et al., 2020). Both theoretical frameworks underscore that green marketing performance is rooted in the integration of sustainability values, green innovation, and the management of internal corporate resources to support reputation, consumer retention, and the attainment of long-term competitive advantage.

Sustainable Competitive Advantage

The most robust and prominent theory concerning sustainable competitive advantage is the Resource Based View (RBV), as pioneered by Jay Barney. Barney (1991) posits that sustainable competitive advantage is realized when an organization possesses resources that are valuable, rare, inimitable, and non-substitutable. The RBV maintains that this advantage is secured if an organization holds resources and capabilities characterized by these four attributes. Resources meeting these criteria enable firms to formulate and execute strategies that are challenging for rivals to imitate or replace, thus sustaining a dominant market position over the long term. Furthermore, competitive advantage does not arise merely from external factors such as market or industry conditions; rather, it stems primarily from an organization's internal capacity to creatively and adaptively manage and exploit unique assets, including

technology, knowledge, culture, and business processes (Barney, 2007).

Green Knowledge Management

According to Bolisani and Bratianu (2017), knowledge management is a strategic endeavor to manage knowledge assets as a primary source of organizational value creation. Knowledge management practices adopted by MSME entrepreneurs such as documenting ecoprint processes and engaging in community-based learning enhance organizational adaptability to external changes and facilitate sustainable product innovation.

Ecological Innovation

Hojnik, Ruzzier, and Manolova (2018) define eco-innovation as the development of products, processes, or business models that minimize negative environmental impacts. Ecological innovation within batik and ecoprint MSMEs encompasses the application of natural dyeing technologies and waste management systems, which have been proven to enhance production efficiency and market appeal.

Ecological Commitment

Berikut adalah terjemahan dalam bahasa Inggris akademik untuk bagian Komitmen Ekologi Anda. Saya memastikan pilihan katanya formal, presisi, dan mengikuti kaidah penulisan jurnal internasional.

Terjemahan:

"The theory of ecological commitment highlights the significance of an organization's pro-environmental attitudes and behaviors in conducting business responsibly. Keogh and Polonsky (1998) argue that environmental commitment serves as a fundamental basis for developing environmentally conscious entrepreneurship behavior. In this study, ecological commitment is measured through the internal policies of MSMEs regarding the utilization of local natural resources and compliance with environmental regulations both of which are believed to bolster sustainable competitive advantage and green marketing performance (Keogh & Polonsky, 1998).

Hypothesis

H1: Green knowledge management has a positive effect on sustainable competitive advantage.

H2: Ecological innovation positively influences sustainable competitive advantage.

H3: Ecological commitment has a positive impact on sustainable competitive advantage.

H4: Green knowledge management positively affects green marketing performance.

H5: Ecological innovation has a positive influence on green marketing performance.

H6: Ecological commitment is positively related to green marketing performance.

H7: Sustainable competitive advantage has a positive effect on green marketing performance.

H8: Green knowledge management, ecological innovation, and ecological commitment have an indirect effect on green marketing performance through sustainable competitive advantage.

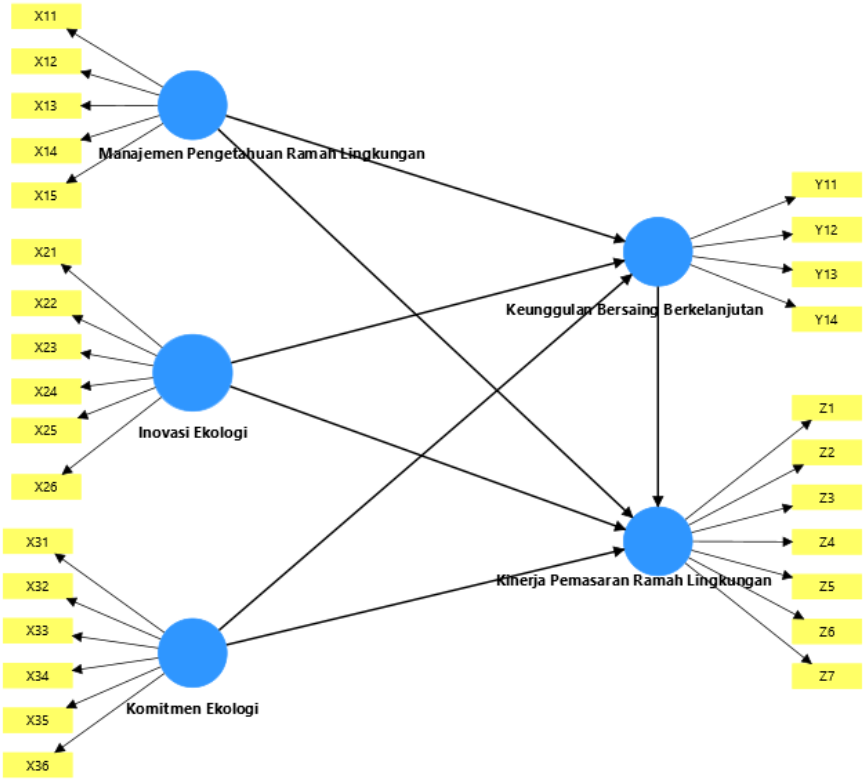


Figure 1. Conceptual Framework and Latent Variable Model

RESEARCH METHOD

This study adopts an explanatory quantitative approach, utilizing primary data derived from a survey of natural-dye batik and ecoprint MSMEs in Purworejo Regency. A sample of 100 MSME entrepreneurs was selected via purposive sampling, based on the criteria of having at least two years of operational activity and possessing an independent brand.

The research instrument consists of a Likert scale questionnaire (1–5), developed from indicators established in theoretical frameworks and prior studies. Instrument validation was ensured through validity and reliability testing during the initial phase.

Data analysis was performed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) version 24 to examine direct and indirect relationships, as well as mediating effects among the variables. SEM-PLS is particularly effective for accommodating non-normally distributed data and managing complex models

commonly found in modern socio-economic research..

Table 1. Targeted Achievement Indicators

Variable	Indikator	Source
Green Knowledge Management (X1)	a. Knowledge Acquisition b. Knowledge Storage c. Knowledge Sharing d. Knowledge Application e. Knowledge Creation	Bolisani & Bratinau (2017)
Ecological Innovation (X2)	a. Ecological Process Innovation b. Ecological Product Innovation c. Ecological Organizational Innovation d. Ecological Marketing Innovation e. Ecological Technological Innovation f. Ecological Social Innovation	Hojnik & Manolova (2018)
Ecological Commitment (X3)	a. Affective Commitment b. Continuance Commitment c. Normative d. Strategic Commitment e. Behavioral Commitment f. Leadership Commitment	Keogh & Polonsky (1998)
Sustainable Competitive Advantage (Y)	a. Valuable b. Rare c. Inimitable d. Non-substitutable	Barney (1991)
Green Marketing Performance (Z)	a. Raw material efficiency b. Waste reduction c. Human resource enhancement d. Sales growth e. Customer growth f. Profitability g. Customer satisfaction h. Customer loyalty	Baron dkk (2006)

RESULTS AND DISCUSSION

This study employs a quantitative approach with a purposive sampling technique, involving 100 natural-dye batik and ecoprint MSMEs in Purworejo Regency. The primary instrument is a questionnaire designed to measure the variables of Green Knowledge Management, Ecological Innovation, Ecological Commitment, Sustainable Competitive Advantage, and Green Marketing Performance. Data analysis was conducted to examine the relationships between variables using Structural Equation Modeling (SEM) via the SmartPLS 4 application. The respondent profiles for this study are presented as follows:

Table 2. Respondent Profiles

Characteristics	Category	Frequency	Percentage (%)
Gender	Male	21	21

Characteristics	Category	Frequency	Percentage (%)
	Female	79	79
Age	25–35 years	21	21
	36–45 years	14	14
	46–55 years	64	64
Business Tenure	>10 years	14	14
	2–5 years	68	68
	6–10 years	18	18

Source: primary data, 2025

Based on the tabulated results presented in Table 2, the respondents comprising natural-dye batik and ecoprint MSME entrepreneurs in Purworejo Regency exhibit distinctive demographic characteristics that bolster local community strength in eco-friendly business development. The majority of respondents are female (79%), indicating that women play a dominant role in Purworejo's batik and ecoprint craft industry. This finding aligns with prior studies suggesting that female entrepreneurs demonstrate a profound concern for sustainability-oriented innovation and cultural preservation, while also tending to be more active in business community networks.

In terms of age distribution, the majority of entrepreneurs fall within the 46–55 age group (64%). This productive demographic suggests that the business owners possess extensive experience and comprehensive knowledge, which are instrumental in propelling innovation and the adoption of eco-friendly technologies in the batik and ecoprint production processes. Furthermore, the dominance of this mature age group serves as significant social capital for building a community capable of transferring sustainable practices to the younger generation.

Regarding business tenure, most MSMEs have been operational for 2–5 years (68%), followed by those in business for 6–10 years (18%) and more than 10 years (14%). This proportion reflects a rapid surge of new entrants in the natural-dye sector, alongside the steadfast presence of veteran entrepreneurs who sustain the local industry. This combination is highly relevant to the development of an MSME innovation ecosystem, as new players tend to be more adaptive to modern updates, while senior entrepreneurs

provide stability and essential experience transfer.

Overall, the respondent characteristics in this study reflect that the batik and ecoprint MSMEs in Purworejo are underpinned by a community of mature women with diverse levels of business experience, ranging from emerging startups to well-established enterprises. These findings provide critical insights into the social structure, capacity, and potential for MSME empowerment to bolster the development of Green Marketing Performance. Furthermore, this demographic landscape is vital for addressing both the challenges and opportunities within the local resource-based craft sector in Purworejo Regency.

Evaluation of the Outer Model

The evaluation of the measurement model (outer model) was conducted using several criteria, including convergent validity, Average Variance Extracted (AVE), and composite reliability. One of the primary indicators of convergent validity is observed through the outer loading values of each indicator. The results are presented in Table 3 below:

Table 3. Results of Outer Loadings for Convergent Validity Test

Items	Green Knowledge Management	Ecological Innovation	Ecological Commitment	Sustainable Competitive Advantage	Green Marketing Performance	Remarks
X11	0.894					Valid
X12	0.894					Valid
X13	0.895					Valid
X14	0.885					Valid
X15	0.857					Valid
X21		0.79				Valid
X22		0.909				Valid
X23		0.884				Valid
X24		0.737				Valid
X25		0.878				Valid
X26		0.815				Valid
X31			0.781			Valid
X32			0.777			Valid
X33			0.782			Valid
X34			0.787			Valid
X35			0.773			Valid
X36			0.717			Valid
Y1				0.852		Valid
Y2				0.885		Valid
Y3				0.852		Valid

Y4	0.839		Valid
Z1		0.778	Valid
Z2		0.765	Valid
Z3		0.811	Valid
Z4		0.839	Valid
Z5		0.819	Valid
Z6		0.898	Valid
Z7		0.84	Valid

Based on the results presented in Table 3, the outer loading values for the convergent validity test in this SEM-PLS analysis indicate that all indicators for each construct have fulfilled the requirements for convergent validity. Each research item measuring Green Knowledge Management, Ecological Innovation, Ecological Commitment, Sustainable Competitive Advantage, and Green Marketing Performance yielded a loading factor exceeding 0.70. These values demonstrate that each indicator effectively and optimally represents its respective latent construct; consequently, all indicators are deemed valid measures for each latent variable in this study.

These results underscore the reliability of the research instruments and the suitability of the measurement model, as no indicators were found with loading factors below the established threshold of 0.70. Consequently, the measurement model can proceed to the next stage of analysis without any indicator deletion. These findings provide a robust foundation, substantiating that the research instruments are appropriate for capturing both empirical and theoretical information related to the research phenomenon.

Tabel 4. Hasil AVE Uji *Convergent Validity*

Variable	Average variance extracted (AVE)	Remarks
Green Knowledge Management	0.784	Valid
Ecological Innovation	0.701	Valid
Ecological Commitment	0.593	Valid
Sustainable Competitive Advantage	0.734	Valid
Green Marketing Performance	0.676	Valid

Based on the convergent validity results presented in Table 4, all Average Variance Extracted (AVE) values for each construct exceed the 0.5 threshold. These high AVE values indicate that the latent constructs explain a substantial proportion of the variance in their respective indicators. Each construct namely Green Knowledge Management, Ecological Innovation, Ecological Commitment, Sustainable

Competitive Advantage, and Green Marketing Performance has successfully met the minimum requirements for convergent validity, as recommended by statistical modeling experts.

This condition serves as evidence that the constructs measured in this study consistently explain the majority of the variance in their indicators. Consequently, the convergent validity of the measurement model has been fully established, strengthening the justification that all constructs are suitable for further analysis, including structural model testing and the exploration of subsequent research implications.

Tabel 5. Result *Cross Loading* Test *Discriminant Validity*

Items	Green Knowledge Management	Ecological Innovation	Ecological Commitment	Sustainable Competitive Advantage	Green Marketing Performance	Remarks
X11	**0.894**	0.628	0.559	0.633	0.628	Valid
X12	**0.894**	0.578	0.506	0.614	0.589	Valid
X13	**0.895**	0.643	0.551	0.619	0.621	Valid
X14	**0.885**	0.608	0.557	0.739	0.698	Valid
X15	**0.857**	0.711	0.653	0.843	0.786	Valid
X21	0.693	**0.790**	0.617	0.596	0.622	Valid
X22	0.576	**0.909**	0.570	0.541	0.559	Valid
X23	0.597	**0.884**	0.531	0.54	0.545	Valid
X24	0.420	**0.737**	0.482	0.494	0.473	Valid
X25	0.557	**0.878**	0.521	0.584	0.594	Valid
X26	0.719	**0.815**	0.769	0.711	0.669	Valid
X31	0.681	0.715	**0.781**	0.626	0.567	Valid
X32	0.472	0.539	**0.777**	0.408	0.366	Valid
X33	0.381	0.479	**0.782**	0.318	0.219	Valid
X34	0.423	0.471	**0.787**	0.367	0.284	Valid
X35	0.489	0.501	**0.773**	0.436	0.436	Valid
X36	0.342	0.397	**0.717**	0.260	0.197	Valid
Y1	0.601	0.525	0.409	**0.852**	0.735	Valid
Y2	0.657	0.591	0.507	**0.885**	0.861	Valid
Y3	0.717	0.627	0.536	**0.852**	0.735	Valid
Y4	0.735	0.649	0.489	**0.839**	0.769	Valid
Z1	0.533	0.502	0.342	0.775	**0.778**	Valid
Z2	0.652	0.532	0.38	0.779	**0.765**	Valid
Z3	0.629	0.548	0.382	0.690	**0.811**	Valid
Z4	0.614	0.590	0.423	0.641	**0.839**	Valid
Z5	0.548	0.598	0.382	0.650	**0.819**	Valid
Z6	0.638	0.645	0.469	0.791	**0.898**	Valid
Z7	0.740	0.598	0.481	0.845	**0.840**	Valid

The cross-loading results presented in Table 5 demonstrate that each indicator achieves its highest loading value on its intended construct relative to other constructs. This finding confirms that each indicator specifically represents its target construct, ensuring no conceptual overlap or mixing of meaning between different constructs. Consequently, the discriminant validity test via cross-loading analysis indicates that the research instrument satisfies the primary criteria for discriminant validity.

All indicators for Green Knowledge Management, Ecological Innovation, Ecological Commitment, Sustainable Competitive Advantage, and Green Marketing Performance exhibit higher correlations with their parent constructs than with any other latent variables. This indicates that each latent variable is accurately measured by its respective indicators; thus, the measurement model structure is established as discriminantly valid and suitable for the subsequent stages of structural analysis.

Tabel 6. Value Cronbach's Alpha

Variabel	Cronbach's alpha	Remarks
Green Knowledge Management	0.931	Reliabel
Ecological Innovation	0.914	Reliabel
Ecological Commitment	0.868	Reliabel
Sustainable Competitive Advantage	0.879	Reliabel
Green Marketing Performance	0.920	Reliabel

Based on Table 6, the Cronbach's Alpha values indicate that all constructs within the research model possess an excellent level of reliability. Each variable—specifically Green Knowledge Management, Ecological Innovation, Ecological Commitment, Sustainable Competitive Advantage, and Green Marketing Performance—exhibits a Cronbach's alpha value exceeding the 0.70 threshold. These findings confirm that all indicators for each construct demonstrate high internal consistency.

Statistically, these high Cronbach's alpha values ensure that the instruments utilized to measure the constructs are capable of producing stable and trustworthy data. Consequently, the research instruments are deemed feasible and reliable, allowing for further analysis with

full confidence in the measurement consistency within the established structural model.

Tabel 7. Result Test Model Fit

Parameter	Rule of Thumb	Estimated model	Remarks
SRMR	Less than 0.10	0.095	Fit
d_ULS	> 0,05	3.675	Fit
d_G	> 0,05	1.925	Fit
Chi-square	χ^2 statistik ≥ χ^2 tabel	900.107 > 40.1133	Fit
NFI	Mendekati nilai 1	0.7	Fit
GOF	**0.1** (GOF kecil), **0.25** (GOF moderate), **0.36** (GOF kuat)	**0,724**	Fit
Q^2 Predictive Relevance	**Q^2 > 0:** Have predictive relevance **Q^2 < 0:** Less Have predictive relevance. **0.02** (Weak) **0.15** (Moderate) **0.35** (Kuat)	Q^2 Sustainable Competitive Advantage0.652 > 0 Q^2 Green Marketing Performance 0.832 > 0	Fit

Table 7. Model Fit Results. The evaluation of the model fit indices indicates that all measured parameters satisfy the established feasibility standards for SEM-PLS analysis. The SRMR (Standardized Root Mean Square Residual) value of 0.095 falls below the maximum threshold of 0.10, signifying that the overall model exhibits a satisfactory fit with the empirical data. Furthermore, the d_{ULS} and d_G parameters exceed the required minimum thresholds, while the Chi-square value surpasses the critical table value, further reinforcing the conclusion that the model is robust and appropriate for the research data.

The Normed Fit Index (NFI) value of 0.70 indicates that the model is approaching an ideal fit, although it has not yet reached a perfect state. Collectively, these measurement results categorize the model as a 'fit' model, allowing the analysis to proceed to the structural relationship testing between constructs with confidence that the model is free from misspecification.

The Goodness of Fit (GoF) value is registered at 0.724, which falls into the strong and high category; thus, the model is highly reliable in explaining the research phenomenon under study. Meanwhile, the Q^2 Predictive Relevance values for each construct are well above zero, specifically 0.652 for Sustainable Competitive Advantage and 0.832 for Green Marketing Performance. These results provide robust empirical evidence that the model is not only fit but also possesses excellent predictive power regarding the tested constructs. This underscores the model's strength in

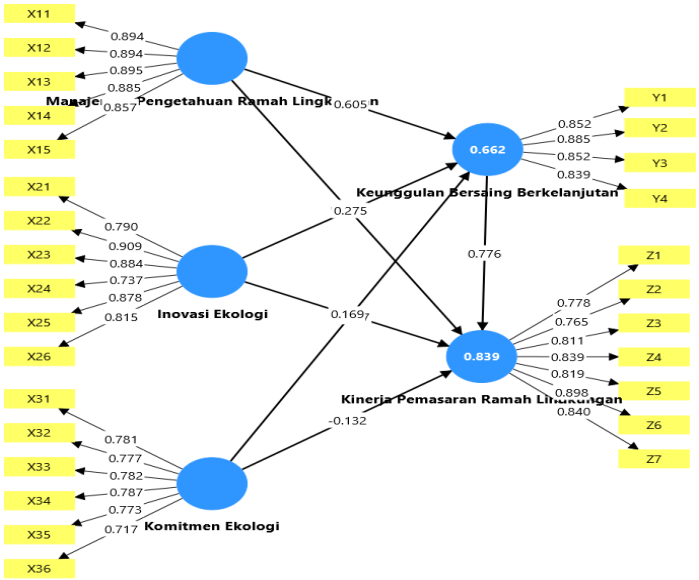
explaining the endogenous variables significantly and consistently.

Tabel 8: Result Test R Square (R^2)

Variabel Dependent	R-square	R-square adjusted
Sustainable Competitive Advantage	0.662	0.652
Green Marketing Performance	0.839	0.832

Table 8. R-squared (R^2) Results. The results of the R^2 test illustrate the model's explanatory power regarding the tested dependent variables. For Sustainable Competitive Advantage, the resulting R^2 value is 0.662. This indicates that approximately 66.2% of the variance in this construct can be explained by the independent variables incorporated into the model, while the remaining 33.8% is attributed to other factors outside the scope of this research model.

For the Green Marketing Performance construct, an R^2 value of 0.839 signifies that the model provides a very high proportion of explanation for this variable, reaching 83.9%. The remaining 16.1% is influenced by external variables not examined within this model. Based on the criteria established by Chin (1998) and Hair et al. (2011), R^2 values exceeding 0.67 are categorized as strong. Consequently, both endogenous constructs in this research model possess excellent predictive power and are highly reliable for analyzing the phenomenon addressed in this study.



Gambar 2. Output model PLS SEM Algorithm

Tabel 9: Result *Cross Loading* Uji *Discriminant Validity*

Path Coefficients	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values	Keterangan
Green Knowledge Management -> Sustainable Competitive Advantage	0.605	0.605	0.079	7.691	0.000	Accepted
Ecological Innovation -> Sustainable Competitive Advantage	0.275	0.276	0.092	2.999	0.003	Accepted
Ecological Commitment -> Sustainable Competitive Advantage	-0.017	-0.013	0.064	0.267	0.789	Rejected
Green Knowledge Management -> Green Marketing Performance	0.109	0.106	0.082	1.327	0.185	Rejected
Ecological Innovation -> Green Marketing Performance	0.169	0.166	0.075	2.252	0.024	Accepted
Ecological Commitment -> Green Marketing Performance	-0.132	-0.132	0.074	1.795	0.073	Rejected
Sustainable Competitive Advantage -> Green Marketing Performance	0.776	0.782	0.057	13.507	0.000	Accepted

The Relationship Between Green Knowledge Management and Sustainable Competitive Advantage

Based on the results in Table 9, the relationship between Green Knowledge Management and Sustainable Competitive Advantage was statistically examined through SEM-PLS path analysis. The analysis yielded a path coefficient of 0.605, with a T-statistic of 7.691 and a p-value of 0.000. The T-statistic significantly exceeds the minimum threshold of 1.96 (at a 5% significance level), and the p-value is well below the 0.05 alpha level, confirming that this relationship is highly significant.

These findings demonstrate that a higher implementation of Green Knowledge Management within SMEs leads to a greater Sustainable Competitive Advantage. Consequently, Hypothesis H1, which posits that **Green Knowledge Management has a positive effect on Sustainable Competitive Advantage,** is empirically supported by the research data. This statistical evidence serves as robust proof that Green Knowledge Management is a determinant factor in achieving sustainable competitive advantage, specifically for natural dye-based batik and ecoprint SMEs..

The Relationship Between Ecological Innovation and Sustainable Competitive Advantage

According to the path analysis results in Table 9, the effect of Ecological Innovation on Sustainable Competitive Advantage was evaluated through several statistical parameters. The path coefficient between these variables was recorded at

0.275, supported by a T-statistic of 2.999 and a p-value of 0.003. Given that the T-statistic exceeds the 1.96 threshold and the p-value is below 0.05, the relationship is determined to be statistically significant.

These findings indicate that ecological innovation contributes positively to the enhancement of Sustainable Competitive Advantage within SMEs. Consequently, Hypothesis H2, which posits **that Ecological Innovation has a positive influence on Sustainable Competitive Advantage, is fully supported by the statistical data**. This finding suggests that innovative ecological efforts act as a catalyst for the longevity and competitive superiority of natural dye-based batik and ecoprint SMEs.

The Relationship Between Ecological Commitment and Sustainable Competitive Advantage

Based on the results in Table 9, the impact of Ecological Commitment on Sustainable Competitive Advantage was statistically examined, yielding a path coefficient of -0.017, a T-statistic of 0.267, and a p-value of 0.789. The T-statistic is substantially below the minimum threshold of 1.96, and the p-value significantly exceeds 0.05, indicating that the relationship between these two variables is statistically non-significant. These findings suggest that ecological commitment within these SMEs has not yet been able to provide a meaningful contribution to enhancing sustainable competitive advantage. Interestingly, the ecological commitment produced a negative coefficient, illustrating a contrary relationship trend, although it remains non-significant. This suggests that without being integrated into a broader business strategy, high commitment alone might be perceived as an operational burden that does not translate into competitive gains. Consequently, Hypothesis H3, which posits that **Ecological Commitment has a positive effect on Sustainable Competitive Advantage, is not supported by the research data**. This indicates a need for SMEs in the natural dye batik and ecoprint sector to re-evaluate or strengthen how their ecological commitment is operationalized so that it can have a tangible impact on long-term competitive positioning..

The Relationship Between Green Knowledge Management and Green Marketing Performance

Based on the results presented in Table 9, the relationship between Green Knowledge Management and Green Marketing Performance was examined, yielding a path coefficient of 0.109, a T-statistic of 1.327, and a p-value of 0.185. Since the T-statistic remains below the 1.96 threshold and the p-value exceeds the 0.05 significance level, the relationship is determined to be statistically non-significant. These findings suggest that the

implementation of green knowledge management has not yet exerted a tangible impact on the green marketing performance of natural dye-based batik and ecoprint SMEs. Consequently, Hypothesis H4, **which posits that Green Knowledge Management has a positive effect on Green Marketing Performance, is not supported by the research data**. This indicates that managing eco-friendly knowledge alone is insufficient to drive marketing success; hence, additional strategies or other moderating factors may be required to bridge the gap between knowledge management and actual marketing outcomes in the eco-friendly sector.

The Relationship Between Ecological Innovation and Green Marketing Performance

Based on Table 9, the relationship between Ecological Innovation and Green Marketing Performance demonstrates statistically significant results. The analysis yielded a path coefficient of 0.169, a T-statistic of 2.252, and a p-value of 0.024, all of which satisfy the required thresholds for a significant positive relationship (T-statistic > 1.96$ and p-value < 0.05$). This indicates that the ecological innovations implemented by batik and ecoprint SMEs contribute positively to enhancing environment-based marketing performance.These findings validate Hypothesis H5 ("**Ecological innovation has a positive effect on green marketing performance"), which is empirically supported by the data analysis in this study**. Consequently, innovation efforts in ecological aspects serve as a key driver in achieving environmentally friendly and sustainable marketing performance within the natural dye-based SME sector.

The Relationship Between Ecological Commitment and Green Marketing Performance

The analysis of the relationship between Ecological Commitment and Green Marketing Performance yielded a path coefficient of -0.132, a T-statistic of 1.795, and a p-value of 0.073. Since the T-statistic remains below the 1.96 threshold and the p-value is above 0.05, the relationship is determined to be statistically non-significant.

These findings indicate that the ecological commitment currently practiced by batik and ecoprint SMEs has not yet exerted a tangible impact on enhancing environment-based marketing performance. Consequently, Hypothesis H6, **which posits that Ecological Commitment has a positive influence on green marketing performance, is not supported by the statistical results**. This finding signals that ecological commitment alone is insufficient to drive improvements in green marketing

outcomes; it suggests that further intervention or strategic refinements may be necessary to optimize the effect of this commitment on marketing performance.

The Relationship Between Sustainable Competitive Advantage and Green Marketing Performance

According to Table 9, the relationship between Sustainable Competitive Advantage and Green Marketing Performance yields a path coefficient of 0.776, a T-statistic of 13.507, and a p-value of 0.000. The exceptionally high T-statistic, coupled with a p-value well below the 0.05 threshold, indicates that the relationship between these two variables is highly significant statistically.

These results demonstrate that Sustainable Competitive Advantage is a decisive factor in enhancing green marketing performance within natural dye-based batik and ecoprint SMEs. Consequently, Hypothesis H7, **which posits that Sustainable Competitive Advantage has a positive effect on Green Marketing Performance, is fully supported by the research data**. This finding suggests that SMEs capable of maintaining a sustainable competitive edge are better positioned to optimize their environment-based marketing performance effectively.

Tabel 10. Hasil *Path Coefficient Bootstrapping Indirect effect*

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Ecological Innovation -> Keunggulan Bersaing Berkelanjutan -> Green Marketing Performance	0.214	0.217	0.077	2.768	0.006
Ecological Commitment -> Sustainable Competitive Advantage -> Green Marketing Performance	-0.013	-0.01	0.05	0.265	0.791
Green Knowledge Management-> Sustainable Competitive Advantage -> Green Marketing Performance	0.47	0.472	0.063	7.505	0

The indirect path analysis results within the SEM-PLS model, as presented in Table 10, illustrate how Green Knowledge Management, Ecological Innovation, and Ecological Commitment influence Green Marketing Performance through the mediation of Sustainable Competitive Advantage:

The indirect influence of green knowledge management on green marketing performance through sustainable competitive advantage is highly significant.

This is demonstrated by a path coefficient of 0.470, a t-statistic of 7.505, and a p-value of 0.000. These findings prove that effective green knowledge management practices within MSMEs can significantly enhance competitive advantage, which subsequently has a positive impact on green marketing performance.

Eco-innovation also exerts a significant indirect influence through sustainable competitive advantage, with a coefficient of 0.214, a t-statistic of 2.768, and a p-value of 0.006. This indicates that intensifying innovation in ecological aspects not only strengthens competitive advantage but also indirectly supports improved marketing results oriented toward environmental sustainability.

In contrast to the previous two variables, ecological commitment does not show a statistically significant indirect influence on green marketing performance through sustainable competitive advantage. The coefficient value of -0.013, t-statistic of 0.265, and p-value of 0.791 signify that this relationship is not significant, indicating that ecological commitment alone is insufficient to link competitive advantage and green marketing outcomes.

Overall, it can be concluded that a significant indirect influence on improving green marketing performance through the mediation of sustainable competitive advantage is only found in green knowledge management and eco-innovation, while ecological commitment has not yet been able to provide a meaningful contribution to this mechanism

Discussion of Research Results

The primary findings indicate that green knowledge management and eco-innovation have significant direct and indirect influences on the sustainable competitive advantage and green marketing performance of MSMEs. This reinforces the Resource-Based View (Barney, 1991) theory, which posits that knowledge and innovation capacities are the fundamental pillars for creating sustainable competitive advantage within an organization. The processes of knowledge modification and transfer, coupled with the promotion of innovation in eco-friendly products and production methods, are proven to strengthen the market position of MSMEs both nationally and globally.

Knowledge management indicators, such as environmental knowledge systems, inter-member knowledge transfer, and continuous training, all exhibit strong factor loadings, meaning they play a crucial role in building the strategic advantage of small and medium enterprises. Eco-innovation indicators, from the adoption of green technology to the diversification of products derived from natural materials, have proven effective in enhancing the value-added and

competitiveness of MSMEs. These results align with previous research by Bolisani & Bratianu (2017) and Hojnik et al. (2018), which emphasize the significance of utilizing green knowledge and innovation for MSME competitive advantage.

Conversely, ecological commitment in this study does not have a significant effect on either competitive advantage or green marketing performance. This phenomenon supports the findings of Lovely et al. (2021) that commitment alone, without the support of strategic resources and innovation, is insufficient to ensure high competitive advantage and marketing performance in green market competition.

This research successfully proves that to create an effective green marketing model, MSMEs cannot rely solely on environmental commitment; they must also be capable of managing environmental knowledge and implementing innovations relevant to green market demands. The mediation path of sustainable competitive advantage proves to be essential. This means that knowledge and innovation do not impact marketing directly without being facilitated by the creation of a strategic advantage first.

Through comparative and causal analysis, it is evident that marketing performance is not only influenced by internal business aspects but is also strengthened by the adoption of green innovation practices and knowledge collaboration among MSME actors. This further confirms that strengthening the capacity of intellectual and innovative resources is the key to accelerating the progress of batik/ecoprint MSMEs toward the global market and responding to the demands of a sustainable economy.

The practical implications of this research are highly relevant for the formulation of strategic policies at the MSME and local government levels. Business actors need to be more proactive in building environmental knowledge management systems and fostering innovation to penetrate environmentally conscious market competition. The novelty of this study lies in the integration of green knowledge management, eco-innovation, and ecological commitment within a single structural green marketing model for the natural dye batik/ecoprint sector a topic that remains rare in both Indonesian literature and international reviews. From the researcher's perspective, these results demonstrate the urgency of the green business paradigm in creating long-term sustainability for MSMEs and serving as a vital bridge toward export market recognition for Indonesian natural dye batik. The integration of green knowledge and innovation rather than just environmental intent or commitment is proven to be the

primary driver of green marketing growth. The entire analysis is grounded in data, primary theories, and cross-research empirical comparisons. These findings are expected to serve as a reference for policies and empowerment strategies for local batik and ecoprint MSMEs, steering them toward eco-friendly industrialization and global competitiveness.

CONCLUSION

This research successfully explains that strengthening environment-based knowledge management and innovation in production and marketing processes is crucial for creating a sustainable competitive advantage for natural dye batik and ecoprint MSMEs in Purworejo Regency. This competitive advantage is proven to be the primary determinant in enhancing the effectiveness of environmentally oriented marketing strategies. Conversely, ecological commitment that is not accompanied by the optimization of knowledge and innovation has not yet contributed significantly to achieving competitive advantage or green marketing results. Overall, the findings reinforce that the collaboration between eco-innovation and environmental knowledge management is more effective in addressing the challenges of natural resource-based creative industries in the green business era.

The researcher recommends that MSME actors be more proactive in utilizing knowledge management systems and implementing sustainable ecology-based innovations. Local governments and stakeholders need to expand technology-based training and strengthen inter-MSME networks to increase the adoption of eco-friendly practices. Future research is encouraged to expand the scope to other regions or involve other external variables, such as policy or social capital, to better understand the drivers of green marketing in MSMEs. Additionally, synergy and collaboration with business communities and research institutions must be strengthened to support the industrialization and export of eco-friendly batik and ecoprint products.

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