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Shaping sustainability performance in culinary MSMES: Unveiling the impact of environmental regulation, customer pressure, and green dynamic capability

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Abstract The sustainability of small and medium-sized enterprises (SMEs) in the culinary sector is increasingly important in the modern business world. However, many culinary SMEs struggle to achieve economic, environmental, and social sustainability goals, leading to issues like high waste generation, resource inefficiency, and financial vulnerability. This study examines how environmental regulation, customer pressure, and green dynamic capability contribute to enhancing the sustainability performance of culinary businesses in alignment with the SDGs. A quantitative approach was used, collecting data from 295 culinary SMEs in East Java using non-probability sampling. Structural Equation Modeling (SEM) with SmartPLS was applied to analyze the relationships among the variables. The results show that consumer influence significantly enhances sustainability outcomes, meaning that the higher the pressure from customers, the greater its contribution to improving the sustainability performance of culinary businesses. Additionally, environmental policies significantly impact sustainability outcomes, indicating that stricter environmental regulations enhance sustainability performance. Green dynamic capability plays a role in improving sustainability outcomes, though its moderating effect varies. Specifically, green dynamic capability does not strengthen the relationship between consumer influence and sustainability outcomes, but weakens the relationship between environmental policies and sustainability outcomes. This study contributes to the understanding of both internal and external factors influencing sustainability in culinary businesses and provides practical implications for policymakers and business owners to design strategies that support sustainable practices and contribute to achieving the SDGs.

Keywords: sustainability outcomes, environmental policies, consumer influence, green dynamic capability

1. Introduction

Sustainability has become a key element in the strategy of Small and Medium Enterprises (SMEs) worldwide, significantly impacting their operational success and contributions to the global economy (Onyinye & Angela, 2024; Prasanna et al., 2019). In the face of challenges and opportunities within industries, SMEs are required to integrate sustainability practices, not only to enhance their competitive advantage but also to align with broader environmental and social goals (Lin & Chen, 2017; Setyaningrum et al., 2023). Therefore, a strategic approach emphasizing sustainability can become a determining factor in long-term competitiveness.

SMEs need to be prioritized in national policies, as they contribute approximately 40% to GDP in developing countries and provide more than 50% of employment opportunities (Bhanage, 2025). This sector also plays a strategic role in the economic sustainability of nations, especially in job creation (Das et al., 2020) especially in job creation (Ayandibu & Houghton, 2017), and in implementing sustainability practices that can reduce costs, enhance brand reputation, and ensure compliance with environmental regulations (Handaru & Safariningsih, 2025).

Despite efforts to adopt sustainable business practices, SMEs are often hindered by limited financial and human resources (Chong & Kaliappen, 2025; Gomes, 2025), low awareness and competency related to sustainability (Álvarez Jaramillo et al., 2019; Ngoda & Thomas, 2024) and a lack of leadership and organizational culture support (Abdullahi et al., 2018; Burawat, 2019). On the external level, public policies can serve as a major driver if they provide financial and non-financial support (Alkahtani et al., 2020; Lamoureux et al., 2019). However, complex regulations and weak institutional support often

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act as barriers, making it difficult for SMEs to comply with environmental standards and derive benefits from sustainability initiatives (Kurtanović & Kadušić, 2024; Petrakova & Karacsony, 2024).

Sustainability performance has become a central focus of this study, as the culinary SME sector not only contributes significantly to the national economic value but also generates high levels of organic waste and carbon footprint (Kumar et al., 2023). Environmentally friendly practices, such as kitchen waste management, the use of local raw materials, and energy efficiency, can enhance brand reputation, consumer loyalty, and long-term profitability for SMEs (Costa et al., 2022). In Indonesia, government policies mandating environmental footprint reporting for small food businesses accelerate improvement efforts (Rajapakse et al., 2022). Given that over 60% of SMEs in the country operate within the culinary sector (BPS, 2022), identifying both internal and external factors affecting sustainability performance provides guidance for effective policies and interventions (Nuraini et al., 2024). As noted by Elkington, (1998), businesses that embrace sustainability through the triple bottom line—economic, social, and environmental—are positioned for long-term success. Rogers et al. (2011) further emphasize the importance of transformative practices in achieving sustainability, while Cardoni et al., (2020) highlight the role of knowledge management and performance measurement systems in SMEs' economic sustainability. Therefore, the sustainability performance construct becomes a central focus to assess the extent to which culinary businesses can integrate these three objectives into their operations. Therefore, the sustainability performance construct becomes a central focus to assess the extent to which culinary businesses can integrate economic, social, and environmental objectives into their operations.

Stakeholder involvement—governments, NGOs, consumers, and competitors—is a key factor in setting environmental regulations (ER) and driving environmental innovation for small businesses (Ahmadov et al., 2024; Sanka, 2024). Within a circular economy framework, cross-stakeholder collaboration aligns diverse interests, enhances resource efficiency, and drives more sustainable product design and waste management (Onukwulu et al., 2025). Effective stakeholder involvement requires integrating diverse perspectives and resolving conflicts to balance interests without compromising efficiency (Sanka, 2024). SMEs face challenges such as the "paradox of engagement control," which can hinder strategies if not properly managed (Pietilä et al., 2024). Additional barriers include lack of political will, resistance, and resource constraints (Gunawan et al., 2022; Lamoureux et al., 2019). Therefore, SMEs must adjust their engagement strategies to address these challenges and leverage stakeholder insights.

Government regulations and international standards are significant external pressures that compel SMEs to adopt sustainability practices. These regulations often mandate compliance with environmental standards, which drive businesses to innovate and enhance their sustainability performance (Alayón et al., 2022; Balda & Singh, 2022). As (Mu et al., 2022) explain, environmental protection regulations can significantly improve corporate performance by pushing companies to comply with stricter environmental standards, aligning with the Porter Hypothesis. Similarly, institutional pressures, such as governance and stakeholder expectations, increasingly push businesses toward sustainability practices, potentially leading to green innovation and improved environmental performance (Alyahya et al., 2022; Han et al., 2023). Xiumei et al., (2023) highlight how environmental regulations and digitalization act as catalysts for sustainable innovation in SMEs, while (Lima et al., 2021) further emphasize the role of green innovation in driving companies to adopt innovative practices that improve their environmental outcomes.

In addition to ER, customer pressure (CP), including competition and changing consumer preferences, significantly influences SMEs to adopt sustainability practices. This pressure manifests through customer expectations, regulatory requirements, and competitive dynamics, encouraging entrepreneurs to integrate sustainability into their operations. Current trends show that customers are increasingly demanding eco-friendly products and services, prompting SMEs to adopt sustainable practices to maintain customer (Mady et al., 2024; Sujanska & Nadanyiova, 2023). Competitive pressure is also critical, as SMEs seek to differentiate themselves and gain a competitive advantage by incorporating sustainability into their business models (Ali et al., 2021; Chu et al., 2019). In Croatia, FSC certification is vital for the competitiveness of the wood industry, aligning with European sustainability regulations and customer demand (Klarić et al., 2024). The adoption of sustainable practices not only helps entrepreneurs meet external demands but also enhances competitive advantage, brand image, and long-term business sustainability.

Green Dynamic Capability (GDC) represents an adaptive and innovative capability that enables SMEs to effectively respond to environmental challenges. Rooted in dynamic capability frameworks, GDC emphasizes the importance of creating, restructuring, and integrating internal and external competencies to adapt to rapidly changing environments. Adaptive capabilities are crucial for SMEs to navigate dynamic environments, sustain performance, and enhance competitiveness (de Noronha et al., 2023; Indarwati et al., 2024). In technologically turbulent environments, adaptive capability mediates the relationship between business ties and company performance, highlighting the need for SMEs to enhance their relational networks (Emmanuel et al., 2022). Eco-dynamic capabilities (EDC) significantly influence SMEs' sustainability performance, impacting economic, social, and environmental dimensions (Asumah et al., 2024) as well as innovation performance (Ullah et al., 2025). Overall, GDC plays a key role in driving sustainable performance improvements in SMEs (Antwi-Boateng et al., 2023; Borah et al., 2024).

To strengthen the argument regarding the moderating role of GDC in the relationship between CP, ER, and SP, the findings align with previous studies that explore the role of internal capabilities like GDC in moderating external pressures. For example, Badriyah, (2024) emphasize the importance of GDC in mediating external pressures, which supports the finding that GDC weakens the relationship between ER and SP in this study. Additionally, Borah et al., (2024), suggest that dynamic capabilities (DC), while enhancing responses to changes, can act as a double-edged sword. This finding aligns with the study's observation that GDC encourages SMEs to prioritize internal innovation over responding to external regulatory pressures. Furthermore, Asiedu et al., (2025) highlight the complex interaction between internal capabilities and external pressures, suggesting that GDC can produce varying outcomes when addressing environmental regulations. This paradox is consistent with Chen & Chang, (2013), who stress the importance of internal capabilities in balancing external pressures, and Teece et al., (1997), whose DC theory underscores the role of internal resources in adapting to external challenges. Additionally, Emmanuel et al., (2022) discuss how DC enable strategic adaptation, while Peng & Pan, (2023) call for more nuanced approaches in understanding the interaction between internal capabilities like GDC and external pressures in driving sustainability. These insights contribute to a deeper understanding of how internal capabilities influence external pressures in sustainability practices.

This study introduces a new approach by integrating Environmental Regulation (ER) and Customer Pressure (CP), with Green Dynamic Capability (GDC) serving as a moderator to enhance the Sustainability Performance (SP) of Small and Medium-sized Enterprises (SMEs) in the culinary sector in Indonesia. Building on previous research that examined these factors independently, the study bridges the gap by investigating the interaction between ER, CP, and GDC, and the role of GDC in improving SP. The framework highlights the relationships among the variables and the proposed hypotheses. The Environmental Regulation (ER) and Customer Pressure (CP) are expected to have a direct impact on SME Sustainability Performance (SP). Green Dynamic Capability (GDC) is hypothesized to play a moderating role, strengthening or potentially mitigating the effect of ER and CP on SP. The relationships between these variables and the associated hypotheses are illustrated in Figure 1 as follows:

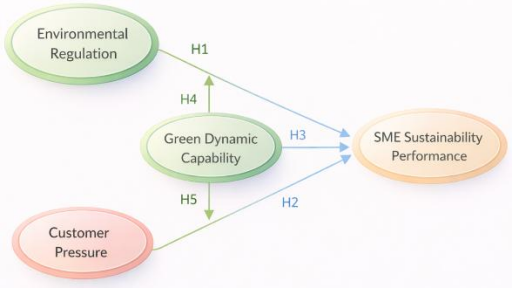

Figure 1 Research framework.

2. Materials and Methods

The study focuses on exploring the relationships between environmental regulation, customer pressure, green dynamic capability, and sustainability performance. The study targets owners and managers of SMEs in East Java's culinary industry, a region noted for its substantial contribution to national GDP and its vibrant startup landscape. Of the 303 individuals who completed the survey, 295 questionnaires met the eligibility criteria for analysis, yielding an effective response rate of 97%. The respondents were chosen using the non-probability sampling technique and the purposive sampling method. The final sample size is deemed adequate to fulfill the minimum criteria required for analysis. According to Faul et al., (2009), using G*Power with a maximum of five predictors for a single construct, the minimum required sample size is 138. Consequently, the 295 valid responses are considered sufficient for conducting variance-based analysis through Structural Equation Modeling with Partial Least Squares (SEM/PLS), as recommended by Hair et al., (2019).

The measurement items used in this study were derived from pertinent sources and subsequently enhanced through expert consultations and academic focus group discussions. Specifically, the items for the sustainability performance construct were adapted from Oduro (2024), the environmental regulation construct (Chan et al., 2023; Zhu et al., 2013), customer pressure (Huang et al., 2016) and green dynamic capability (Y. S. Chen & Chang, 2013; Yousaf, 2021). The respondents' perceptions were assessed using a five-point Likert scale, with 1 representing "strongly disagree" and 5 indicating "strongly agree.

This quantitative research utilized Partial Least Squares (PLS) analysis, which involved three key stages: assessing the outer model for reliability and validity through convergent validity, discriminant validity, and unidimensionality tests; evaluating the inner model; and testing the hypotheses to evaluate the strength of the proposed structural model (Hair et al., 2019). The inner model evaluation involved measuring the strength of the structural model using the coefficient of determination (R^2), effect size (f^2), Standardized Root Mean Square Residual (SRMR), and PLS Predict. The final step was hypothesis testing using an alpha level of 5% ($\alpha = 0.05$) (Hair et al., 2019). To address potential common method bias, this study

employed a full collinearity assessment as recommended by Kock & Lynn, (2012), using the variance inflation factor (VIF). A VIF value below 3.3 indicates that the common bias method is not a critical concern. However, if there is an interaction between variables, such as moderation, the VIF threshold may be disregarded (Darlington & Hayes, 2017). The overall research flow, including the stages of data collection, measurement, and analysis, is illustrated in Figure 2.

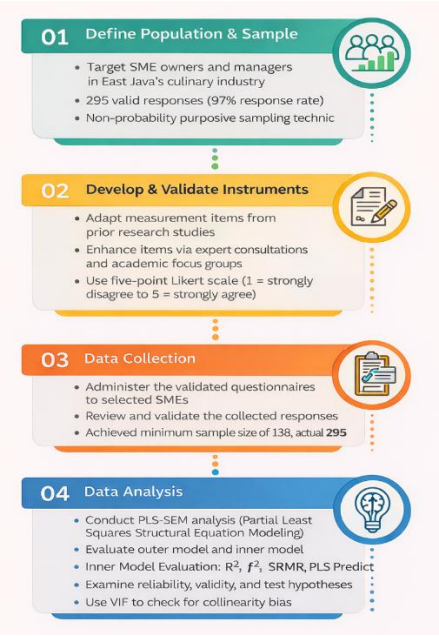

Figure 2 Research procedural flow.

3. Results

3.1. Respondent characteristics

The respondents of this study are owners or managers of small and medium-sized enterprises in the culinary sector in East Java Province, Indonesia. The characteristics of the respondents in this study generally encompass variations in educational level, length of business operation, number of employees, and monthly revenue. The respondents' educational background shows a predominance of high school and undergraduate graduates. A total of 39.66% of respondents have completed senior high school, while 41.69% hold an undergraduate degree. A smaller proportion of respondents have attained higher education levels, with 8.47% holding a master's degree and 4.41% having a doctorate. Only 5.76% of respondents have completed junior high school, indicating that a significant portion of the sample has at least a high school education.

Table 1 Demographics of the Respondents.

Variable		Frequency	Percentage
Respondent's education	Undergraduate	123	41.69
	Senior high school	117	39.66
	Master	25	8.47
	Junior high school	17	5.76
	Doctor	13	4.41
Length of business (year)	1 - 3	101	34.24
	4 - 7	97	32.88
	8 - 10	40	13.56
	Less than 1 year	35	11.86
	More than10 years	22	7.46
Number of employees	1 – 5	170	57.63
	6 – 10	67	22.71
	11 - 15	45	15.25
	16 - 20	8	2.71
	More than 20	5	1.69
Revenue per month	Less than 10 million	139	47.12
	10 to 50 million	100	33.90
	50 to 100 million	45	15.25
	100 to 300 million	7	2.37
	More than 300 million	4	1.36

The majority of respondents' businesses have been operating for 1 to 3 years, representing 34.24% of the sample. The second-largest group is businesses that have been running for 4 to 7 years (32.88%). Fewer businesses have been in operation for 8 to 10 years (13.56%), with 11.86% of businesses being relatively new, having operated for less than a year. The smallest group is businesses that have been operating for over 10 years, accounting for only 7.46% of the respondents.

Regarding the number of employees, the majority of respondents (57.63%) run businesses with between 1 and 5 employees, indicating a prevalence of small-scale operations. A smaller proportion of businesses employ 6 to 10 people (22.71%), and 15.25% have between 11 and 15 employees. A very small percentage of businesses (2.71%) have between 16 and 20 employees, and only 1.69% of businesses employ more than 20 individuals.

In terms of monthly revenue, the majority of respondents (47.12%) report earnings of less than 10 million IDR per month, indicating that most businesses are operating on a smaller scale. Another significant group (33.90%) earns between 10 to 50 million IDR per month. Fewer respondents have higher monthly revenues, with 15.25% earning between 50 to 100 million IDR and only 2.37% earning between 100 to 300 million IDR. A very small percentage of businesses (1.36%) report earnings of more than 300 million IDR per month.

3.2. Outer Model Evaluation

This part presents the validity results, including convergent and discriminant validity, and item unidimensionality assessment, with convergent validity determined by examining outer loading values (Hair et al., 2019), which should ideally exceed 0.7. Additionally, the Average Variance Extracted (AVE) must be greater than 0.5. In this study, one item from the sustainability performance (SP) construct, namely SP5, had an outer loading of only 0.46. As a result, this item was excluded, and the model was re-estimated. Furthermore, two items within the green dynamic capability construct, GDC2 (0.688) and GDC4 (0.665), exhibited outer loading values below 0.7 (Hair et al., 2019) (Figure 2). As shown in Figure 3, the modified-PLS path model visualizes these outer loadings and the exclusion of SP5 from the SP construct. Following the second estimation, the outer loading values ranged from 0.665 to 0.913, while the AVE values spanned from 0.554 to 0.769 (Table 2).

Table 2 Convergent Validity and Internal Consistency Reliability.

Const	Item Code	Outer Load	Cronbach's alpha	Rho_A	Rho_C	AVE
CP	CP1	0.889	0.855	0.862	0.901	0.696
	CP2	0.789				
	CP3	0.809				
	CP4	0.846				
ER	ER1	0.913	0.899	0.903	0.930	0.769
	ER2	0.809				
	ER3	0.886				
	ER4	0.894				
GDC	GDC1	0.807	0.870	0.892	0.896	0.554
	GDC2	0.688				
	GDC3	0.769				
	GDC4	0.665				
	GDC5	0.781				
	GDC6	0.733				
	GDC7	0.757				
SP	SP1	0.825	0.972	0.974	0.975	0.736
	SP10	0.898				
	SP11	0.906				
	SP12	0.891				
	SP13	0.888				
	SP14	0.871				
	SP15	0.876				
	SP2	0.791				
	SP3	0.836				
	SP4	0.826				
	SP6	0.883				
	SP7	0.858				
	SP8	0.835				
	SP9	0.820				

The reliability of the research instrument was evaluated using Cronbach's alpha, composite reliability (Rho_A), and Rho_C. The Cronbach's alpha values demonstrated reliability, with all values exceeding 0.6, ranging from 0.855 to 0.972.

Similarly, the composite reliability values (Rho_A and Rho_C) affirmed the internal consistency of the instrument, with all values surpassing the 0.7 threshold.

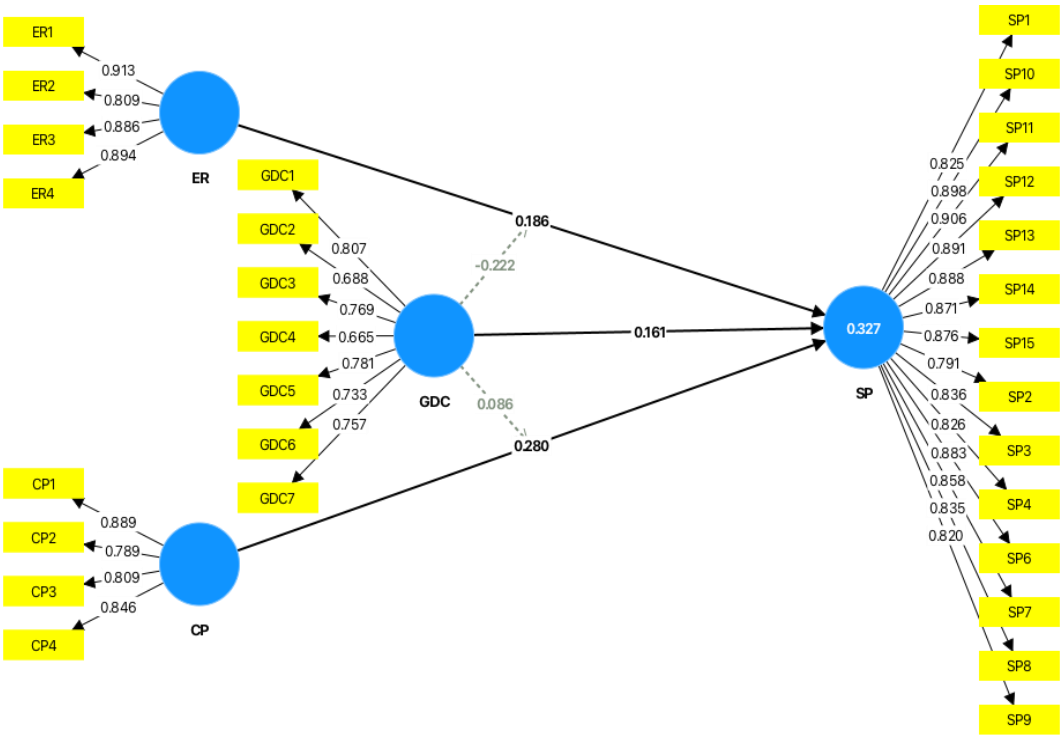

Figure 3 Modified-PLS Path Model.

For assessing discriminant validity, Hair et al. (2019) suggest using the Heterotrait-Monotrait Ratio of Correlations (HTMT), which is regarded as a more precise measure. The recommended threshold for HTMT is below 0.90, and the results confirm that this criterion was satisfied (Table 3).

Table 3 Discriminant Validity: Heterotrait-Monotrait Ratio Statistics.

	CP	ER	GDC	SP	GDCxCP	GDCxER
CP						
ER	0.811					
GDC	0.460	0.327				
SP	0.557	0.463	0.338			
GDC x CP	0.438	0.320	0.153	0.316		
GDC x ER	0.340	0.134	0.120	0.304	0.850	

Discriminant validity was further assessed using the Fornell-Larcker criterion (Fornell & Larcker, 1981), which stipulates that the square root of the Average Variance Extracted (AVE) for each construct must exceed its correlations with other constructs. The customer pressure (CP) construct has a square root AVE of 0.834, surpassing its correlations with the environmental regulation (ER) at 0.707, green dynamic capability (GDC) at 0.401, and sustainability performance (SP) at 0.517. Similarly, the square root AVE values for the other constructs exceed their respective inter-construct correlations, as shown in Table 4. These findings confirm that the discriminant validity of all constructs is well-established.

Table 4 Discriminant Validity: Fornell-Larcker Criterion.

	CP	ER	GDC	SP
CP	0.834			
ER	0.707	0.877		
GDC	0.401	0.297	0.744	
SP	0.517	0.433	0.339	0.858

Note: Diagonal values (bolded) are square-root of AVE, off-diagonals are coefficients of correlation.

3.3. Inner Model Evaluation (Inner VIF Table)

Before testing the hypotheses in the structural model, multicollinearity among the variables was assessed by examining the inner Variance Inflation Factor (VIF) statistics (Table 5). The direct results indicate that all inner VIF values were below 3, which suggests a low level of multicollinearity between the variables. This finding supports the robustness of the parameter

estimates in SEM-PLS, where VIF values below 3 are considered an indication of a model that is not biased (Kock & Lynn, 2012). Although two VIF values were greater than 3, they are still tolerated due to the presence of a moderating relationship (Darlington & Hayes, 2017).

Table 5 Collinearity Statistics (VIF-Variance Inflation Factor).

	VIF
CP -> SP	2.416
ER -> SP	2.200
GDC -> SP	1.193
GDC x ER -> SP	4.192
GDC x CP -> SP	3.973

3.4. Hypotheses Testing

This section presents the results of hypothesis testing regarding the relationships between variables, encompassing five hypotheses. The study tests five hypotheses, three of which examine direct effects and two involving moderating variables.

The results of the hypothesis analysis using SmartPLS 4, as shown in the table, reveal significant paths as well as several non-significant paths. As illustrated in Figure 4, the hypothesized PLS-Path Model displays the relationships between ER, CP, and GDC in influencing SP. The figure visually presents both direct and moderating effects, consistent with the statistical results reported in Table 6. The following section provides interpretation of each tested path.

Table 6 Summary of Hypotheses.

Hypotheses	Path	Std. Beta	Std. Error	t-value	p-value	Bias	Confidence Interv.		R^2 Adjust	f^2
							2.50%	97.50%		
H1	CP -> SP	0.280	3.411	3.411	0.001	-0.002	0.110	0.434	0.315	0.048
H2	ER -> SP	0.186	2.698	2.698	0.007	0.001	0.066	0.253		0.023
H3	GDC -> SP	0.161	3.369	3.369	0.001	0.004	0.049	0.323		0.032
H4	GDC x CP -> SP	0.086	1.049	1.049	0.294	-0.003	-0.062	0.260		0.004
H5	GDC x ER -> SP	-0.222	2.965	2.965	0.003	0.002	-0.384	-0.087		0.026

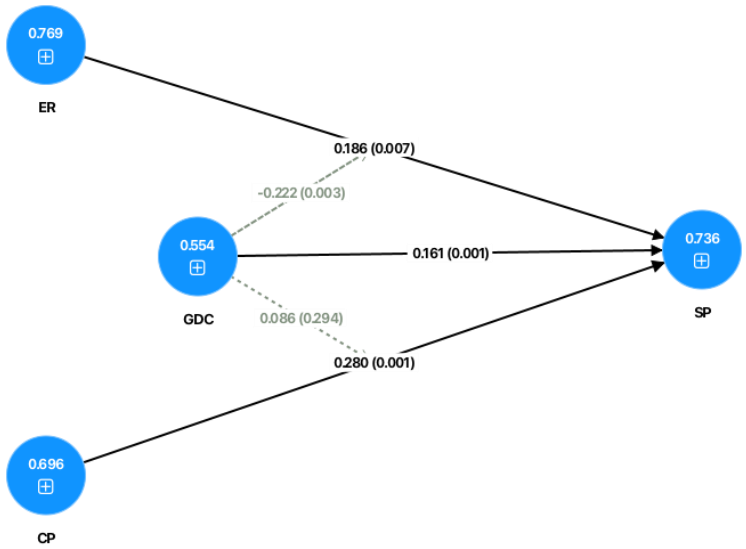

Figure 4 Hypothesized PLS-Path Model.

The first hypothesis, which posits that CP significantly affects the SP of culinary SMEs, is supported with a path coefficient of 0.280 and a p-value (0.001 < 0.05). This indicates that each increase in CP will significantly enhance the sustainability performance (SP) of SMEs. At a 97.5% confidence level, the effect of CP on SP ranges from 0.110 to 0.434. The f^2 value of 0.048 indicates a small-to-medium effect of CP on sustainability performance. An f^2 value of 0.048 suggests that CP has a meaningful but not overwhelming impact on SP, demonstrating that while CP contributes to sustainability outcomes, it is influenced by other factors as well. Therefore, it can be concluded that more intense CP will contribute to improved sustainability performance in culinary SMEs.

The second hypothesis, stating that ER significantly affects the SP of culinary businesses, is accepted with a path coefficient of 0.186 and a p-value (0.007 < 0.05). This means that each change in ER significantly improves the SP of culinary SMEs. The 97.5% confidence interval ranges from 0.066 to 0.253, reinforcing the stability of the estimated results. The f^2 value of 0.023 suggests a small effect of ER on SP. This finding is consistent with the literature, which suggests that stricter

environmental regulations drive firms to adopt more sustainable practices, thereby improving their overall performance (Alayón et al., 2022; Balda & Singh, 2022). Thus, stricter environmental regulations (ER) will enhance the SP of culinary MSMEs.

The third hypothesis, which posits that GDC significantly affects the SP of culinary SMEs, is accepted with a path coefficient of 0.161 and a p-value (0.001 < 0.05). The 97.5% confidence interval between 0.049 and 0.323 strengthens the significance of the results. The f^2 value of 0.032 indicates a small-to-medium effect of GDC on SP. This suggests that GDC enables SMEs to better integrate sustainability practices into their operations, driving improvements in both environmental and economic performance. Therefore, it can be concluded that the stronger the sustainability-based dynamic capability of SMEs, the greater the sustainability performance they are able to achieve.

The fourth hypothesis, which posits that GDC moderates the effect of CP on the SP of culinary businesses, is rejected with a path coefficient of 0.086 and a p-value (0.294 > 0.05). This indicates that the presence of GDC neither strengthens nor weakens the effect of CP on performance. The 97.5% confidence interval ranges from –0.062 to 0.260, crossing zero, indicating an insignificant relationship. The f^2 value of 0.004 reinforces the very small moderating effect. Therefore, GDC does not prove to act as a moderating variable in the relationship between CP and SP. The rejection of H4 indicates that GDC does not strengthen the relationship between CP and SP as expected. This may be due to the imbalance between the internal capacity of SMEs and the external pressure exerted by consumers. GDC as an internal dynamic capability allows SMEs to respond to changes in a more independent way, thus not significantly altering the CP-SP relationship

The fifth hypothesis, which states that GDC moderates the effect of ER on the sustainability performance (SP) of culinary SMEs, is accepted with a path coefficient of –0.222 and a p-value (0.003 < 0.05). However, the negative direction of the relationship suggests that higher GDC weakens the positive effect of ER on sustainability performance. The 97.5% confidence interval ranges from –0.384 to –0.087, all negative, confirming the consistent direction of the relationship. The f^2 value of 0.026 indicates a small effect. The weakening of the relationship between ER and SP with GDC as a moderator suggests that GDC encourages SMEs to rely on their internal strategies and innovations. This study reveals that while external regulations can push for behavior change, in some cases, SMEs with high GDC prefer to adjust their innovations without depending too much on external regulations, which results in a negative effect on the ER-SP relationship. Thus, although significant, GDC has a negative moderating effect on the relationship between ER and sustainability performance in SMEs.

The adjusted R^2 value for sustainability performance (SP) in culinary SMEs is 0.315, meaning that the variables CP, ER, GDC, and their interactions explain 31.5% of the variation in SME performance. According to Chin, (1998), this value is categorized as moderate. This suggests that although these factors have an influence, other variables outside the model also affect the sustainability performance of culinary SMEs.

To ensure the accuracy of the model, this study used the Standardized Root Mean Square Residual (SRMR) measure (Yamin, 2023). If the SRMR value is below 0.08, the proposed model is considered to be fit (Hair et al., 2019). However, SRMR values between 0.08 and 0.10 indicate an acceptable fit (Schermelleh-Engel, 2003). The model estimation result in this study is 0.066 (<0.08), indicating that the model has an acceptable fit as shown in the following Table 7:

Table 7 SRMR.

	Estimated model
SRMR	0.066

Additionally, this study also utilizes PLS Predict to evaluate the predictive capabilities of the proposed PLS model. Based on the analysis of PLS RMSE (PLS root mean square error) and LM RMSE (linear benchmark) values, it can be concluded that the PLS RMSE values are generally smaller than the LM RMSE values. This indicates that the proposed PLS model has better predictive capability, as most of the PLS values are lower than the LM model, as shown in Table 8.

Table 8 Assesment of PLS-Predict.

Item	Q^2predict	PLS-SEM_RMSE	LM_RMSE
SP1	0.286	0.767	0.760
SP10	0.255	0.788	0.806
SP11	0.187	0.935	0.951
SP12	0.266	0.825	0.851
SP13	0.241	0.835	0.851
SP14	0.223	0.774	0.789
SP15	0.195	0.891	0.901
SP2	0.144	0.980	0.978
SP3	0.267	0.751	0.763
SP4	0.183	0.903	0.897
SP6	0.160	0.911	0.930
SP7	0.239	0.774	0.796
SP8	0.174	0.837	0.865
SP9	0.204	0.872	0.867

4. Discussion

This study aims to investigate the relationship between environmental regulation, customer pressure, and green dynamic capability in contributing to the sustainability performance of culinary SMEs in East Java, Indonesia. The results show that customer pressure (CP) significantly affects sustainability performance (SP). This indicates that consumers play a key role as one of the main drivers in encouraging green practices in the culinary business. Consumers demanding healthier, eco-friendly products and ethical production processes force businesses to adapt. Consistent with several previous studies, customer pressure encourages producers to provide products aligned with sustainability issues (Alyahya et al., 2022; Huang et al., 2016; Klarić et al., 2024; Sujanska & Nadanyiova, 2023). However, the relatively small-to-medium effect of CP ($f^2 = 0.048$) suggests that while important, CP alone is not sufficient; it needs to be supported by internal factors such as innovation capability and resource management to create a more significant impact (Omri et al., 2024; Wei et al., 2020).

ER was found to significantly affect SP, although with a relatively small effect. Previous studies have shown that well-designed environmental regulations can encourage SMEs to adopt environmentally friendly practices, thereby improving sustainability performance (Su, 2025). In the context of culinary SMEs, regulations drive the implementation of waste management practices, the use of eco-friendly materials, and food safety standards (S. Chen et al., 2023; Khan et al., 2016; Wang & Sun, 2022; Zhu et al., 2013). However, the small effect of regulation suggests possible implementation challenges in the field, such as high compliance costs, weak socialization, and limited adaptive capacity of small SMEs. This indicates the need for a policy mix that includes incentives, training, and mentoring so that regulations are not perceived as a burden but as an opportunity to innovate.

Similarly, Green Dynamic Capability (GDC) directly and positively affects SP in culinary businesses. This finding aligns with the dynamic capabilities theory (Teece, 2014; Teece et al., 1997) and previous studies that emphasize that companies capable of sensing, seizing, and reconfiguring green resources are better prepared to face environmental changes in the business landscape (Amaranti et al., 2022; Karman & Savanevičienė, 2021). SMEs with strong GDC can adapt more quickly, create eco-friendly products, and access new market opportunities. Additionally, GDC encourages the integration of green practices and green value co-creation, which strengthens the organization's ability to generate sustainable green innovations (Y. S. Chen & Chang, 2013; Yousaf, 2021). While its effect is not yet highly significant, the contribution of GDC is important as it serves as an internal mechanism that determines the success of responding to both consumer pressure and existing regulations, as well as playing a role in strengthening the competitiveness of SMEs through green product differentiation in the market.

Regarding the moderating role, the analysis results indicate that GDC does not moderate the effect of CP on SP in culinary SMEs. This finding suggests that, although GDC plays an important role as an internal mechanism to enhance adaptability and green performance within an organization, it is insufficient to strengthen or alter the influence of customer pressure on sustainability performance. This may occur because CP is an external factor directly felt by SMEs (Leonidou et al., 2017), and thus consumer demands for eco-friendly products already drive sustainability practices without requiring the involvement of GDC. Furthermore, the context of culinary SMEs, which typically have limited resources, innovation capacity, and managerial experience, may constrain the ability of GDC to serve as a significant moderator. In other words, customer pressure may already be sufficient to influence operational decisions related to sustainability directly, so variations in GDC do not result in significant differences in the strength of the effect of CP on SP. This finding is consistent with the literature, which indicates that the moderating effects of internal capabilities often depend on the maturity level of the organization and the available adaptive capacity, particularly in small- and medium-sized enterprises (Bresciani et al., 2022; Mata et al., 2024).

The next finding reveals that GDC moderates the effect of ER on the SP of culinary SMEs, but with a negative direction. This phenomenon can be explained as ER functions as an external pressure that encourages SMEs to adopt sustainability practices, such as waste management, the use of eco-friendly materials, and compliance with food safety standards (Alayón et al., 2022; Balda & Singh, 2022). Meanwhile, GDC reflects the internal capacity of SMEs to strategically sense, seize, and reconfigure green resources. When GDC is high, SMEs tend to rely more on internal mechanisms and their own green innovation strategies, so the response to external regulations may become more selective or indirect, weakening the effect of ER on SP. This emphasizes that internal capabilities, while supporting adaptability and innovation, do not always enhance the influence of external regulations and may act as a double-edged sword in the context of SMEs with resource limitations (Gerlich et al., 2025; Peng & Pan, 2023). In other words, the moderating effect of internal capabilities depends on the organization’s ability to balance external factors and internal strategies.

4.1. Theoretical and Practical Implications

This study highlights the importance of both external and internal factors in driving SP in culinary MSMEs in East Java, Indonesia. CP, ER, and GDC play key roles, with CP acting as a significant external driver for green business practices. The research contributes to dynamic capability theory by emphasizing the importance of a firm's ability to respond, leverage, and reconfigure resources in the face of environmental changes. Additionally, the absence of a significant moderating effect of GDC on CP suggests that external factors, such as consumer demand for eco-friendly products, can independently drive

sustainability practices without requiring internal capabilities. This finding expands the understanding of how businesses respond to pressures and regulations and the complex relationship between external pressure and internal capabilities in sustainability research.

For practitioners, this research emphasizes the need for MSMEs in the culinary sector to recognize the growing role of consumer demand for sustainable products. The study suggests that businesses should align their practices with consumer preferences for eco-friendly and ethical products. Policymakers should also consider the practical limitations faced by MSMEs in implementing environmental regulations and explore supporting measures such as incentives, training, and mentoring to facilitate compliance. Furthermore, businesses with strong green dynamic capabilities are better equipped to innovate and adapt to market changes, but they must balance internal capabilities with external regulatory pressures. This research underscores the need for a strategic approach that integrates internal innovation and external market demand to drive sustainability performance.

5. Conclusions

This study demonstrates that CP, ER, and GDC significantly contribute to the sustainability performance (SP) of culinary SMEs in East Java, Indonesia. Customer pressure is found to be a primary external driver in promoting the adoption of eco-friendly practices, while environmental regulation influences businesses through the implementation of safety standards and waste management. Although GDC has a positive effect on SP, the results suggest that this internal capability is insufficient to moderate the effect of customer pressure on sustainability. These findings reveal that while regulations and consumer pressure play vital roles, SMEs also require strong internal capabilities to innovate and adapt to market changes. Therefore, this research provides important insights into the complex relationship between external and internal factors in achieving optimal sustainability performance in the culinary SME sector. The practical implication for SMEs is the importance of aligning with consumer demand for eco-friendly products while also developing internal capabilities for sustainable innovation.

This study has several limitations. First, its geographical scope is limited to culinary SMEs in East Java, so the results may not be generalizable to other regions or countries. Second, the study does not account for other external variables, such as climate change or access to eco-friendly technologies. Third, the limited data on the implementation of environmental regulations may constrain the understanding of the challenges SMEs face in complying with these regulations. Further data collection and a broader scope are needed for a more comprehensive understanding.

Future research could expand the geographical scope and include other SME sectors to determine whether the same findings hold outside of the culinary industry. Additionally, future studies could delve deeper into the interaction between green dynamic capabilities and other external factors, such as climate change or government policies. Research focusing more specifically on the impact of compliance costs related to environmental regulations could provide a deeper understanding of the challenges SMEs face in adapting to these regulations. A longitudinal approach to monitor long-term changes would be useful to observe the sustained impact of sustainability practices on SMEs.

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6. Declarations

6.1. Ethical considerations

This study involved human participants and was conducted in accordance with institutional, national, and international research ethics guidelines. All participants were fully informed about the study's purpose, the voluntary nature of participation, their right to withdraw at any time without consequence, and the procedures for obtaining informed consent before data collection. No personally identifiable information was collected during the study, and the anonymity and confidentiality of the participants were fully protected. Ethical approval for this research was granted by the Research and Innovation Ethics Committee of Universitas Brawijaya, Indonesia, following a thorough ethical review process. All collected data were used solely for academic purposes and analyzed in an aggregated form, ensuring that no individual participant could be identified.

6.2. Use of artificial intelligence (AI)

The authors declare that the generative artificial intelligence (AI) tool Grammarly was used exclusively for language editing and/or grammatical improvement. The use of AI did not influence the scientific content, study design, data analysis, data interpretation, results, or conclusions of the manuscript. Full responsibility for the content remains with the authors.

Additionally, the AI tool ChatGPT was used to create images, such as the research framework and research procedural flow diagrams, included in the manuscript. The use of ChatGPT was limited to visual content creation and did not affect the scientific integrity of the research or its findings.

6.3. Conflict of Interest

The authors declare no conflicts of interest.

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