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Green strategic orientation, innovation, and government support: drivers of sustainable performance in the Indian food processing sector

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With regard to mounting global environmental challenges and urgent demand for sustainable practices, there exists a struggle for food processing firms to adopt green innovation, given the sectors' substantial contribution towards food waste and institutional challenges. Addressing this gap, the current study aims to examine the influence of green strategic orientation (GSO), green innovation (GI), and government support (GS) on the sustainable performance (SP) of the food processing sector in India, drawing on NRBV and Stakeholder theory. The present study considers the collective influence of green entrepreneurial orientation and green market orientation as key dimensions of green strategic orientation. Using stratified random sampling, the study collected data from 541 respondents during the period of March to June 2025 through a survey method. To enhance methodological rigor, the study employed structural equation modelling using SMART PLS along with discriminant analysis. The findings from discriminant analysis identifies effectiveness of each government support factor to distinguish varying levels of green innovation in the food processing sector. As per PLS-SEM observations, both dimensions exhibit significant influence on GI (R^2 = 72.5%), while government support emerges as a strong predictor for SP, explaining 85.8% of its variance. These outcomes highlight the strategic importance of GEO, GMO, GI, and government support in transforming intangible resources into tangible sustainability outcomes, by offering actionable thoughts for policymakers and industry leaders to strengthen environmental resilience and long-term sustainability in the food sector.

KEYWORDS

green entrepreneurial orientation, green market orientation, green innovation, sustainable performance, government support, food processing

1 Introduction

The food sector plays an indispensable role in determining a sustainable future globally due to its crucial involvement in the production, distribution, and consumption of food (Prasanna et al., 2025). The food industries occupy an integral part in the world's ecological balance, social system, and financial landscape. The food industry has a global impact because of its influence on the livelihoods, landscapes, health, value addition to farm produce, and food security (Tomich et al., 2019). In India, the food processing sector has seen a remarkable growth over the past few years, with a strong farm base, growing demand, and supportive government policies (World Food India, 2025). India is positioned as worlds' second largest

producer of fruits and vegetables, due to its strong agricultural base (World Food India, 2025). This sector has become vital in the economy with its contribution of 13% towards GDP, 7.93% towards GVA (Gross Value Added), generating employment to more than 7 million people, and 23% exports marked out of agriculture and processed foods touching USD 49.4 billion in 2024–2025 (World Food India, 2025). India's organic food market is expected to project a surge with a CAGR of 20.13% to $10.8 billion by 2033 (World Food India, 2025).

However, conventional practices have led to numerous ecological matters such as greenhouse gas emission, excessive water usage, shifting climate patterns, etc., which poses a serious threat to balance the stability of natural resources, biodiversity, productivity, water availability and food security (Mperejekumana et al., 2024), placing a significant pressure on ecosystems around the world (Halbusi et al., 2024). Moreover, rising global financial status, growing urbanisation, and consumers' environmental awareness have spurred the demand for safe, sustainable, and responsibly produced food globally (Alonso et al., 2020). According to the UN, the world population will reach 9.8 billion by 2050, which intensifies heavy pressure on food systems (ASSOCHAM report, 2025). Moreover, food waste and food loss have a significant impact on the economy, environment, and society, drawing global attention to food security and climate change links (Alonso et al., 2020).

A study by OECD (2024) estimates the food processing sector to contribute 60–70% of industrial pollution globally. According to the FAO (Food and Agriculture Organisation), the food sector alone emits 30% of GHG (GFG - Green House Gas), mainly due to methane, nitrous oxide, and carbon dioxide emitted during various agricultural processes (Weber et al., 2025) and is expected to increase upto 80% by 2050 (World Food India, 2025). The sector consumes 70% of water usage, raising a global issue of environmental conservation (Prasanna et al., 2025).

In response to this, sustainability has evolved as a core strategic priority for food sector firms to adopt sustainable practices and reduce the adverse impact of climate change on natural resources (Opoku-Mensah et al., 2024), balance economic efficiency, ecological integrity, and social justice throughout food systems (Prasanna et al., 2025). For instance, converting byproducts such as molasses, eggshells, or citrus peels to high-value goods can be a perfect example for a viable, economical, and ecologically sound food chain (Abouzeid et al., 2022).

Thus, sustainability has emerged as a key subject of focus in environmental legislation of the government, academics, and industrialists (Sreenivasan and Suresh, 2023). In response to these global challenges, the United Nations established the SDGs (Sustainable Development Goals) in the year 2015 as a universal framework to achieve inclusive, sustainable, and resilient development by 2030 (Chan et al., 2025). Along with SDG frameworks, some of the other notable institutional initiatives at the global level were the Paris Agreement, Food and Agriculture Organisations (FAO), Global Initiative on Food Loss and Waste Reduction, 2030 Water Resources Group 2030 (WRG), Global Agriculture and Food Security Program (GAFSP), Climate-Smart Agriculture (CSA), World Food Programmes Zero Hunger Challenge, and European Green Deal (Bhutta et al., 2022; Prasanna et al., 2025; Weber et al., 2025).

To entitle incentives from various government initiatives, food processing firms are required to adopt and implement green innovation (Najib et al., 2022). Green innovation (GI) arises as a conscious process of advocating ESG (Environmental, Social, and Governance) governance (Ranjini and Rajeswari, 2024) by encouraging a cleaner and greener environment (Tuncer and Korchagina, 2024). GI has the capability to enhance sustainable performance in the form of social, economic, and environmental ways. Looking at the economic viewpoint, employing sustainable strategies can upgrade firms' market share, minimise government taxes, and augment customer trustworthiness, leading to better financial performance (Ishaq et al., 2023). From a social standpoint, GI plays an incredible role in identifying, retaining, and enticing employees, communicating and enhancing brand equity (Muangmee et al., 2021). From an environmental standpoint, GI can minimise carbon dioxide emissions, waste generation, and eliminate toxic substances, thereby improving financial performance (Fernando et al., 2019).

For the successful implementation of GI, it is essential that firms have a strong core internal orientation strategy. Strategic orientation refers to an all-encompassing method that firms use to develop and carry out business strategy to achieve their goals (Xiao et al., 2023). With increased public consciousness about ecological issues, firms nowadays are intensifying usage of strategic orientation by involving green practices and principles into their business operations, thus giving rise to a new term called green strategic orientation (GSO) (Borah et al., 2023). Green strategic orientation has different components such as green entrepreneurial orientation (GEO), green market orientation (GMO), green learning orientation (GLO), and green innovation orientation (GIO). The current study has chosen green entrepreneurial orientation and green market orientation, as it has high influential capacity on the firms to adopt eco-friendly practices and contribute to sustainable performance. GEO reflects a firm's proactive, innovative, and risk-taking approach to introducing eco-friendly products and services for better economic and ecological outcomes (Jiang et al., 2018; Muangmee et al., 2021; Ali et al., 2024). Similarly, green market orientation focuses on adopting environmentally friendly marketing strategies (Du and Wang, 2022; Papadas et al., 2017).

The relevance of green strategic orientation and green innovation can be observed across multiple geographies. The European Green Deal strategy adopted in 2020 is seen as one of the most innovative environmental policy frameworks, which has been introduced in Europe, especially for the food processing sector to achieve climate neutrality by 2050 (Weber et al., 2025). The introduction of the Farm to Fork strategy in Europe exhibits a perfect example for food processing firms in the EU to compulsorily adopt sustainable processing, minimise food wastage, involve green packaging, and green supply chain management across all emerging economies such as Asia, Africa, and Latin America. These trends illustrate that food processing industries are entering into a new era wherein environmental strategy, innovation, and competitiveness are closely linked (Rossato et al., 2024; Weber et al., 2025).

This global transformation manifests profoundly in the Indian context. In addition to internal strategic orientation, the food processing firms need external institutional support to drive sustainable practices. A proper institutional channel may provide financial help, technical advice, and rules that encourage the majority of the firms, irrespective of size and age of the firm, to go green (Porter and Linde, 1995; del Río González, 2005). After recognising the food processing sector's importance, the Indian Government has launched several initiatives to strengthen the sector, such as Pradhan Mantri

Kisan Sampada Yojana (PMKSY), National Mission on Food Processing, ZED certification, Pradhan Mantri Formalisation of Micro Enterprises (PMFME), Production Linked Incentive Scheme for Food Processing Industry (PLISFPI), One District One Product (ODOP) Scheme, Operations Green, Make in India, and Millet mission (Ministry of Food Processing Industries, 2021).

Although India is considered as one of the fastest growing economies, the country still faces a dual challenge of expanding its industrial base along with meeting environmental sustainability targets. In response to growing sustainability challenges and meeting SDG requirements, the Government of India targets to achieve net-zero GHG emissions by 2070, in line with the Paris Agreement Goal (Ministry of Environment, Forest and Climate Change (MoEFCC), 2022). Despite these interventions, there remain disparities in adopting sustainable-oriented strategies in the Indian context. Although strategic orientation has been examined extensively in various domains, the specific dimension of green strategic orientation remains underexplored in the literature. Sustainability necessitates the involvement of green practices, which mandates the study of green strategic behaviours of the entrepreneurs (Asif and Bakar, 2025). Therefore, the study recognises the significance of GSO in the context of emerging economies and resource-pact sectors such as food processing (Asif and Bakar, 2025). Existing literature has focused intensively more on general manufacturing sectors, rather than individual sectors, and moreover, sectors considered for study were automotive, textile, electronics, etc. Although innovation is widely studied as a driver of sustainability, very few studies have explored how GSO specifically promotes green innovation practices in an emerging economy such as India, where technological adoption remains inaccessible (Muangmee et al., 2021). Furthermore, the role of government support has not been thoroughly incorporated into sustainability strategy to explain how green innovation can be translated to sustainable outcomes, with the intervention of a strong institutional support, in the previous literature of green strategic orientation and innovation (Asif and Bakar, 2025). Hence, the researcher identifies a lack of empirical frameworks that examine the combined influence of green strategic orientation, green innovation, and government support on sustainable performance in the context of the Indian food processing sector. Hence, these gaps signal the urgency of conducting a thorough investigation into how green strategic practices and supportive policy instruments shape the sector's long-term sustainable transformation. This study's findings will provide insights to food processing owners, policy makers, and academicians on providing strategic recommendations to integrate green entrepreneurship and innovation for long-term sustainability and environmental conservation. The following are the objectives of the study:

1) To examine how green strategic orientation influence green innovation aimed at improving environmental, economic, and social performance in the food processing sector.
2) To analyze the effect of green innovation on sustainable performance and the mediating role of government support in this relationship in the food processing sector.

In accordance with these objectives, the present study aims to make three contributions towards literature of green entrepreneurship, innovation, and sustainability. First, the study introduces a combined impact of two key dimensions of green strategic orientation, i.e., green entrepreneurial orientation and green market orientation, on green innovation, to validate their collective influence on sustainable outcomes through GI, and with a strong institutional support in the context of micro and small-scale food processing entrepreneurs. Second, from a theoretical perspective, we extend to the Natural Resource Based View theory (NRBV) and Stakeholder theory by empirically testing government support in the mediation framework, which acts as an internal mechanism that helps in converting firm-level green strategies to sustainable outcomes in a sector characterised by high resource intensity, substantial food waste and loss, regulatory pressure, etc. Third, the execution of discriminant analysis among green innovation and government support variables provides practical guidance for policy makers in the sector to specifically focus on financial subsidies and increase incentive initiatives to attract more green practices, such as tax rebates and GST concessions, and performance-based incentives, such as cash rewards for eco-friendly business practices, etc.

2 Theoretical background and hypothesis development

The study is based upon the natural resource-based view theory, developed by Hart (1995), which marks an extension of resource-based view theory (Barney, 1991; Al-Swidi et al., 2023). RBV theory emphasises the importance of firms' internal abilities and resources and defines them as valuable, rare, irreplaceable, and non-substitutable (also known as VRIN). As per the RBV framework, firms aim at competitive advantage to bring added value to the organisations (Wang et al., 2024). Compared to RBV theory, natural resource-based view theory highlights the role of the natural environment dimension as a core pillar to sustainability (Al-Swidi et al., 2023). NRBV theory is recognised as the theoretical foundation of strategic management (Barney, 1991). One of the major contribution of NRBV theory is to fill the theoretical gap of RBV theory that entrepreneurs should enhance the interaction between firm and natural environment with its three key strategic and distinctive capabilities such as product stewardship (i.e., exclusive access to resources), pollution prevention (i.e., to prevent from waste and emission), and sustainable development (long-term sustainability in the form of social, economic, and environmental development) (Wang et al., 2024). The conceptual aspect of GEO blends with the NRBV framework as it insists to employ environmental sustainability as a strategic asset to lead long-term competitive advantage (Kura and Lukman, 2025). Moreover, it can be accomplished by optimising the impact of GEO on green innovation links and leveraging GI to achieve sustainable performance. Accordingly, the NRBV offers an appropriate theoretical foundation to explore the role of resources and capabilities on GI and sustainable performance.

This study also adopts stakeholder theory along with NRBV frameworks. Stakeholder theory, proposed by Freeman and Phillips (2002), is a framework in business ethics and management that suggests that a firm's success lies in satisfying the needs and demands of multiple stakeholders who can affect or are affected by the organisation, rather than focussing on maximising shareholder value (Dmytriyev et al., 2021; Kura and Lukman, 2025). Based on the stakeholder theory framework, it is anticipated that firms with social responsibility consciousness should address the interests of various stakeholders, such as regulators,

customers, communalities, and investors, that collectively shape the firm's sustainability efforts (Kura and Lukman, 2025). The perspective of green market orientation aligns with stakeholder theory as it highlights the role of multiple actors within a firm's operational landscape, and also as it effectively blends with sustainability-driven innovations as per expectations of customers and other stakeholders for the business.

2.1 Green entrepreneurial orientation and green innovation

The green entrepreneurial orientation (GEO) concept is based on green entrepreneurial theory and entrepreneurship orientation theory (Guo and Wang, 2022). According to Ameer and Khan (2023), GEO is a strategic orientation wherein an entrepreneur or business places environmental sustainability on high priority, along with business objectives. The principles of the triple bottom line are applied to the concept of GEO to develop enterprises (Huang et al., 2024). The main goal of GEO remains to understand the needs and requirements of various environmental stakeholders such as customers, society, government, and other stakeholders who are concerned about the environment and economic health (Ishaq et al., 2023). Hence, firms implementing GEO tend to capture the right market opportunity (Fares et al., 2021), support the deployment of innovative technologies, and be proactive to seize unique opportunities (Bhatti et al., 2023). Nowadays, firms find it difficult to deal with unpredictability and complexity in introducing new products that have less environmental intervention. This situation prompts firms to undertake green innovation (Ameer and Khan, 2023). In light of existing reviews, this study assumes GEO to act as an independent system that represents businesses' proactive steps to spur green innovation and lead sustainable performance (Gholian-Jouybari et al., 2024; Ranjini et al., 2025). Based on the above arguments, the following hypothesis is proposed:

> *H1*: Green Entrepreneurial orientation has a significant and positive impact on Green Innovation

2.2 Green market orientation and green innovation

The novel concept of green market orientation can be defined as the extent to which a firm initiates an internal tendency to develop such products and services which has least environmental effect (Papadas et al., 2017). Hence, GMOs can be an excellent method for firms to capture environmentally conscious consumers and satisfy their growing demands (Shaukat and Ming, 2022; Vilkaitė-Vaitonė and Skačkauskienė, 2019). It is not just the green consumers, but the rise of green competitors in the market also pressurises a business to adopt green practices into its operations (Martins, 2021). This situation mandates a firm to undergo critical thinking and entrepreneurial innovation to achieve economic as well as environmental benefits (Du and Wang, 2022). Consequently, green innovation is used as a strategic resort to eliminate negative effects and improve the environmental sustainability of business processes (Guo and Wang, 2022; Asif and Bakar, 2025). Additionally, GMO incorporates the modification of products, processes, packaging, and marketing of their firm (Tjahjadi et al., 2023). It becomes pivotal for firms to develop a distinctive strategy to face environmental ambiguity and competitive constraints (Shaukat and Ming, 2022). Hence, it would be right to say that the more a firm gives importance to GMO, the more it can achieve sustainable performance through green innovative products and services. Based on the above justification, the second hypothesis is proposed:

> *H2*: Green Market orientation has a significant and positive impact on Green Innovation

2.3 Green innovation, sustainable performance, and mediation link

Green innovation refers to the creation of new products, processes, and services that help to mitigate negative environmental effects and improve ecological sustainability (Sanni and Verdolini, 2022). This concept develops creative solutions to reduce not only greenhouse gas emissions, waste, and pollution but also to promote efficient usage of energy and resources, thus encouraging responsible consumption and production (Rena et al., 2021; Dewiyani et al., 2025). According to a recent study by Aftab, Abid et al. (2022), firms that adopted green practices resulted in reduced waste and environmental contamination. Existing literatures define sustainable performance as the one to reduce resource depletion, waste generation, and CO2 emissions while maintaining societal wellbeing (Riaz et al., 2023). In the opinion of Fernando et al. (2019), GI has a great impact on long-term sustainable business performance. It recommends businesses to design strategies and policies to ensure technological advancements balance with environmental requirements, the company's procedural consistency, and market expectations over time (Tjahjadi et al., 2023; Du and Wang, 2022; Shahzad et al., 2022). In light of the above discussion, the following hypothesis is framed for further examination.

> *H3*: Green innovation has a significant and positive impact on Sustainable performance

The literature demonstrate how a firm's economic and non-economic performance boosts GI and behaviour within the workplace (Ishaq et al., 2023). Although numerous studies support green innovation over sustainable performance, very few studies examined the influence of GEO as an intangible asset on GI that indirectly impact on sustainable outcomes, especially in micro settings (Aftab et al., 2022; Isichei et al., 2020). We try to fill this gap through the study. We believe that GEO plays a crucial role in creating an urge in entrepreneurs to behave in a green manner and focus on developing innovative products and services. This urge helps entrepreneurs shape their abilities, skills, and readiness to develop and try various innovative green ideas. And when these ideas are applied in a creative and novel way to business, it is believed that the business could reap substantial economic returns and competitive advantages. Furthermore, it is noted that entrepreneurs with a higher level of GEO seem to use available resources in a more effective way, reducing their negative impact on the environment and also ensuring societal wellbeing, which eventually result in sustainable performance. Based on previous reviews, the present study believes that GEO can create green innovation, which ultimately facilitates sustainable outcomes.

Thus, it examines the mediating effect of GI in the GEO and sustainable performance nexus:

> *H4*: Green Innovation mediates the relationship between Green Entrepreneurial Orientation and Sustainable Performance

Over the years, consumers have become more environmentally cautious and have made healthier picks (Tuncer and Korchagina, 2024). Moreover, the stringent environmental regulations by the government have changed the pattern of production and consumption in the market (Al-Swidi et al., 2023). To fulfil the ethical and environmental commitment, firms are increasingly resorting to eco-friendly marketplaces (Halbusi et al., 2024). Firms are forced to embrace GI in the form of product and process to satisfy the dual needs of green consumers and minimise environmental waste (Sulaiman, 2025). These initiatives help to curb pressures from customers, competitors, and regulators (Ranjini et al., 2025). Moreover, the adoption of GMO and GI is linked to higher sales in the long run, establishing a strong position in the sustainable marketplace (Sulaiman, 2025). The empirical evidence demonstrate how green innovation adoption has impacted sustainability in the manufacturing sector (Figiel and Badar, 2025). Consequently, the role of green market orientation grows crucial in green innovation deals, attaining sustainable accomplishments. Hence, we access the following hypothesis:

> *H5*: Green Innovation mediates the relationship between Green Market Orientation and Sustainable Performance

2.4 Green innovation and government support

Government support is considered a key determinant in green innovation adoption (Kura and Lukman, 2025). Previous literature works demonstrate a close link between green innovation adoption and government support, at the firm-level operations (Bhutta et al., 2022). The support from the government in the form of technical, financial, license, and informational assistance proves crucial for micro and small-scale firms to adopt green innovation into their business settings (Opoku-Mensah et al., 2024; Wang et al., 2024). Hence, research from emerging economies highlight the role of government actions in advancing green innovation through subsidies, tax credits, environmental regulations, etc., which in turn suggests that firms that receive substantial benefits from the government for green initiatives are more likely to exhibit sustainable performance (Sanni and Verdolini, 2022). According to Dewiyani et al. (2025), governing bodies are expected to motivate green initiatives of firms by allocating adequate resources and knowledge with sufficient backup of funds, as part of the primary regulator of environmental sustainability in the manufacturing field. Furthermore, green innovation mandates firms to be legitimate and align their strategic decisions with national environmental policies, leading to sustainability oriented programmes (Wang et al., 2024). However, prior studies report inconsistent findings regarding the strength of this relationship, which indicates a need for further investigation, especially in Indian MSMEs. Hence, the study frames the following hypothesis:

> *H6*: Green innovation has a significant and positive impact on Government Support

2.5 Government support, sustainable performance, and mediation role

Government support aid as a key component for business executives at the MSME level to adopt sustainable practices (Hasan and Du, 2023). According to the famous Porter hypothesis (Porter and Linde, 1995), the government that supports environment-conscious projects tends to gain twin benefits in terms of minimising environmental pollution and enhancing economic benefits. This support from the government, which comes through financial and non-financial means, is considered a key factor in stimulating sustainable practices, especially in the case of MSMEs in the manufacturing sector. The government serves as a prominent authority while setting sustainability standards (Alkahtani et al., 2020), regulating environmental policies (Ali et al., 2024), and safeguarding the social wellbeing of both residents and corporate employees (Bamgbade et al., 2017). The literature from previous studies unfolds that the possibility of MSMEs shift towards a sustainable economy largely depends upon the level of support received from the government from their respective countries (Riaz, Ali et al., 2024). The support can be in the form of subsidies, tax incentives, grants, regulatory frameworks, environmental policies, campaigns, training programs, digitalisation, etc. Thus, the government becomes an important stakeholder in facilitating green innovation adaptation among Indian MSMEs and also enhances sustainable performance. Therefore, the hypotheses for the following discussion are as follows:

> *H7*: Government Support has a significant and positive impact on sustainable performance.

Existing studies highlight the role of government intervention in bridging the gap between GI and sustainable outcomes (Alkahtani et al., 2020). Government support, such as financial subsidies, tax benefits, and research funding, not only encourages firms to adopt green innovative technologies and frameworks but also helps translate innovations into measurable outcomes (Riaz, Ali et al., 2024). In contrast, when firms face high government pressure but lack sufficient support to adopt green innovation, then it may limit their entrepreneurial growth in terms of resource exploitation and inability to enhance their business performance (Wang et al., 2024). These findings highlight the necessity to consider government support mechanisms as an intervening variable to strengthen this relationship (Kura and Lukman, 2025). Thus, the current study undertakes to examine the mediating effect of government support between GI and SP links, to enable firms to overcome resource and regulatory constraints over sustainability. Based on the above arguments, the following hypothesis is framed:

> *H8*: Government Support mediates the relationship between Green Innovation and Sustainable performance

Figure 1 shows the progressions of the relationship wherein green entrepreneurial orientation and green market orientation have a direct effect on green innovation, with a mediation effect of government support on sustainable performance.

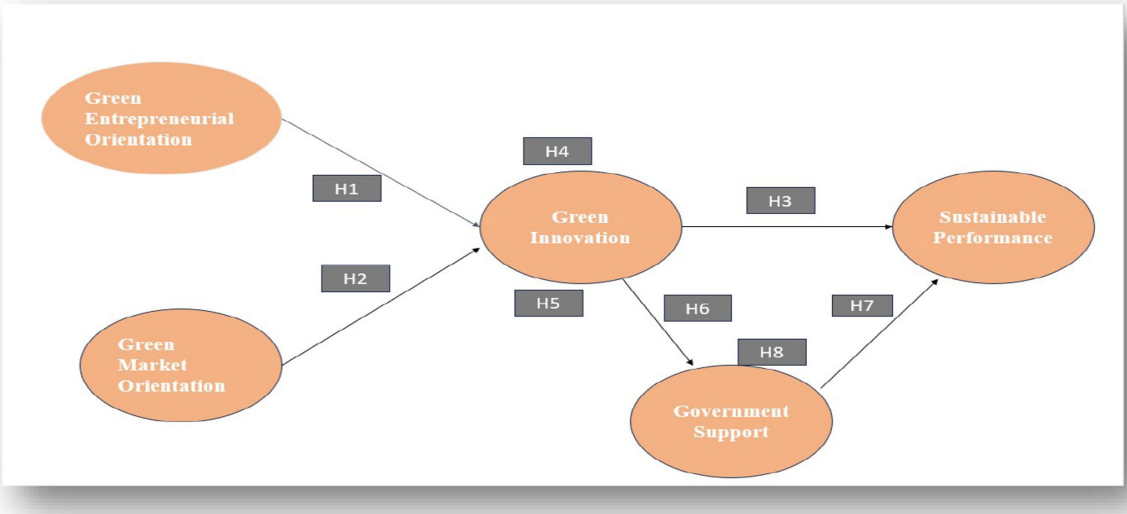

FIGURE 1
Conceptual framework.

3 Methodology

3.1 Research setting and data collection

A quantitative research design grounded in a positivistic research philosophy was employed in this study to objectively examine the determinants of sustainability performance in the food processing sector. The study adopted a deductive approach with a focus on evaluating the influence of green entrepreneurial orientation, green market orientation, green innovation practices, and the role of government support in enhancing sustainability outcomes. A cross-sectional survey method was adopted to collect from a large number of respondents at a single point in time, to ensure efficiency and comparability of responses.

Before data collection, the researcher performed face validity with the help of four academicians, and content validity tests were undertaken with 75 participants to ensure the reliability and validity of the scale measured.

A structured and closed-ended questionnaire served the purpose of primary data collection, incorporating standardised scales adapted from prior validated studies to ensure reliability and validity. The study also collected secondary information from government reports, magazines, and scholarly articles of interest. The questionnaire was designed in English and the local language for respondents' convenience. The target population included managers and owners of food processing firms from various sub-sectors such as agro-processing units, spice powder manufacturing units, oil mills, processed fish, and ready to eat food product units located in the southern region of India.

3.2 Sample population, sample size, and sampling technique

This study collected primary data from entrepreneurs and managers of micro and small-scale food processing industries located in Kerala, India, during the period of March to June 2025, to empirically test the proposed conceptual framework. The food processing sector holds strategic importance in the Indian economy, ranking among the top five industries and contributing approximately 7.7% to the national Gross Value Added. It is also a major source of employment, providing jobs to approximately 71 lakh workers, while accounting for approximately 11% of the country's total exports (Riaz et al., 2023; Economic Review, 2024). Kerala, in particular, is recognised as one of the leading states in this sector due to its substantial role in food production, processing, and export activities. The state's strong agricultural base, coupled with established processing infrastructure, makes it a relevant context for examining sustainability-oriented business practices (Economic Review, 2024).

The data for the research were collected through a combination of direct field visits and distribution of structured questionnaires. Of the total responses, 223 responses were obtained through field visits and 326 responses through online surveys. From 326 responses, only 318 could be considered suitable for analysis based on complete information. Thus, clubbing both primary and online surveys, a total of 541 responses are finalised. The researcher estimated the minimum sample size with the help of G*Power as suggested by Hair and Alamer (2022). Based on the parameters $f^2 = 0.02$(effect size), error probability = 0.05, number of predictors = 2, and power = 0.80, the tool calculated to be 395 as minimum sample size. However, this study collected data from 541 firms to avoid issues of small sample size. Moreover, the study also satisfies the basic condition of "10 times rule" as per Partial Least Square-structural equation modelling (Hair and Alamer, 2022).

To ensure analytical robustness, stratified random sampling was employed, dividing Kerala into three strata, north, central, and south, with one district selected based on the highest number of food processing firm registrations. Within each selected district, food processing units were chosen based on key socio-demographic factors, such as gender, age, education, business experience, business age, business size, and place in the food processing sector, ensuring diverse perspectives on green innovation adoption.

3.3 Measures

The survey instrument used in this study consisted of five key constructs measured through previously validated scales to ensure reliability and content validity. All items were assessed using a 5-point Likert scale ranging from strongly disagree to strongly agree. Green entrepreneurial orientation was measured using five items adapted from Jiang et al. (2018) and Muangmee et al. (2021), while four items for green market orientation were sourced from Najib et al. (2022). Green innovation was evaluated using five items adapted from Muangmee et al. (2021). Government support was captured using 10 items derived from Ha et al. (2024). Sustainable performance was assessed through its three dimensions: environmental performance (five items), economic performance (four items), and social performance (four items), based on scales from Muangmee et al. (2021) and Ishaq et al. (2023) (Table 1).

3.4 Statistical tool

The study has enforced a set of statistical tools to validate the accuracy and credibility of the study. Discriminant analysis was conducted to classify a set of observations into predefined classes. Partial Least Squares Structural Equation Modelling (PLS-SEM) was used to analyse the data. PLS-SEM was chosen over CB-SEM due to its suitability in analysing complex models with multiple constructs, especially when the sample size is small and data are not normally distributed (Hair and Alamer, 2022). The present study employed PLS-SEM version 4 to analyse the conceptual framework and relationships among constructs (Hair and Alamer, 2022). The structural model was assessed using a bootstrapping method of 5,000 resampling technique (Hair and Alamer, 2022).

4 Results

4.1 Demographic analysis

The demographic characteristics of entrepreneurs in the food processing sector are presented in Table 2. Approximately 54% of respondents were men, but there was a balanced representation of women too, with 45%. The age distribution reveals that 36% of respondents belong to the 31–40 years age group, followed by 41–50 years. Approximately 37% were graduates, with 46% of respondents having experience for about 11–15 years in the food processing sector. Approximately 38% of firms operate for around 20 years in the field, with 69% of firms employing less than nine employees in Kerala.

4.2 Discriminant analysis

Discriminant analysis is applied to evaluate group differences using multivariate tests. Furthermore, it is used to determine the minimum number of dimensions required to explain these differences. The purpose of this analysis is to see whether different levels of green innovation adoption can be discriminated based on government support, in the food processing sector in Kerala. The analysis focuses on Box M tests, eigenvalues, Wilks' Lambda, and Standardised Canonical Discriminant Function Coefficients tables.

The purpose of Box's M tests is to test the null hypothesis that the covariance matrices of predictor variables are equal across groups. The results show that Box's M-test was not significant ($M = 3.153$, $F = 1.047$, $p = 0.371$), indicating that the assumption of equal covariances across the groups was met. This supports the robustness of discriminant analysis tests (Table 3).

Higher eigenvalues indicate a more significant function in terms of explaining the variance between the groups. The results show that the first discriminant function has the highest eigenvalue of 1.182, which accounts for 88.5% of variance with a canonical correlation of 0.736, indicating that the first discriminant function is effective at classifying cases in correct groups. The second function explains only 8% of the variance, which contributes the minimum for group separation (Table 4).

Wilks' Lambda measures the effectiveness of the discriminant function in distinguishing between groups, and lower values indicate stronger separation. Here, the Wilks' Lambda test results indicate that the first discriminant function significantly differentiates between groups. The low values of 0.395 combined with a highly significant Chi-square statistic (493.358) and p-value of 0.000 mean that the discriminant function is highly effective in classifying cases into respective groups. The second test also shows significant ($p = 0.000$), whereas the third and fourth tests show insignificant results, thus indicating weak separation between groups (Table 5).

The standardised canonical discriminant function coefficients reflect the relative importance of each variable in discriminating between groups. Variables with positive coefficients increase the score on the discriminant function, whereas negative coefficients decrease the score on the function. Thus, GS1, GS2, GS4, GS5, GS6, GS7, and GS9 indicate that these are the strong predictors that contribute to separating low innovation firms from highly innovative ones. Whereas, GS10 and GS8 variables indicate that their lower absolute values have low influence on the discriminant function.

Thus, the canonical discriminant function equation is:

$Z = -4.419 + 0.466$ (financial, subsidies support by the Government) + 0.308 (technical support from Government) + 0.025 (to train green skills for employees) + 0.278 (organises seminars) + 0.362 (guides the process of implementing environmental protection) + 0.160 (policy reforms create favourable condition for green innovation) + 0.233 (promote environmental strategy) + 0.087 (forecasts the trends of environmental problems) - 0.051 (initiatives launched to attract GI) – 0.020 (incentives on tax rates).

The canonical discriminant function shows how the government support mechanism differentiates food processing firms based on their level of green innovation (Table 6). Financial subsidies score as the strongest discriminant factor among all, placing importance on operational assistance. In contrary, incentives on tax rates and initiatives to attract GI score negative coefficients, marking their ineffectiveness in the food processing sector.

Thus, discriminant analysis was used to determine which type of government support best differentiates firms across different green innovation levels in the Indian food processing industry.

4.3 Measurement model

The guidelines of Hair and Alamer (2022) were used to assess the measurement model, focusing on construct validity and reliability. To ensure internal consistency, factor loadings, composite reliability, and Average Variance Extracted (AVE) were examined, while discriminant

TABLE 1 Constructs and items taken for the study.

Latent variables	Items	Item description
Green Entrepreneurial Orientation		
	GEO1	Our firm uses less or non-polluting materials.
	GEO2	Our firm has a strong tendency for green product development.
	GEO3	Our firm has a strong emphasis on green R&D, technological leadership, and innovation.
	GEO4	Our firm has a tendency to initiate green actions.
	GEO5	Our firm has a tendency to be a market leader in introducing green products, services, or technologies in the market.
Green Market Orientation		
	GMO1	We discuss the environmental aspect of our organisation with stakeholders.
	GMO2	To identify green needs, we implement market research
	GMO3	We target environmentally-conscious consumers.
	GMO4	We prefer digital promotion to promote products, because it is more eco- friendly.
Green Innovation		
	GI1	Materials that consume less energy and emit the least number of pollutants are used in the production process.
	GI2	Our firm improves environmentally friendly packaging for existing and new products.
	GI3	Our firm recovers end-of-life products and recycles.
	GI4	Our firm uses eco-labelling.
	GI5	The use of e-commerce and digital tools is encouraged by our firm because it is more eco-friendly.
Government Support		
	GS1	Businesses are financially supported by the government, such as subsidies, grants, etc. for the application of green innovation.
	GS2	Businesses receive technical support from the Government when applying green innovation.
	GS3	The government supports businesses in training green skills for employees.
	GS4	The government regularly organises seminars on environmental regulations for businesses.
	GS5	The Government guides the process of implementing environmental protection for businesses.
	GS6	Government policy reform creates favourable conditions for green innovation activities of businesses.
	GS7	The Government promote environmental strategy to create favourable conditions for businesses to implement green innovation.
	GS8	The government forecasts the trend of environmental problems for businesses to implement green innovation.
	GS9	Many initiatives have been launched by the Government to increase the attractiveness of green innovation for businesses.
	GS10	Government incentives on tax rates for businesses that protect the environment well.
Sustainable Performance		
	ENT1	The resource consumption in our organisation, e.g., water, electricity, and gas, has decreased over the years.
	ENT2	Reduction of air emissions.
	ENT3	Reduction of waste (water and/or solid)
	ENT4	Reduction of consumption of hazardous/harmful/toxic materials.
	ENT5	Reduction in the frequency of environmental accidents, such as waste leakage, poisoning, or radiation emissions.
	ECO1	Reduction in the cost of materials purchased.
	ECO2	Reduction in the cost of energy consumption.
	ECO3	Reduction in the fee for waste discharge or treatment.
	ECO4	Our firm has improved its capacity utilisation.
	SOC1	Improvement in customer satisfaction.
	SOC2	Our firm serves more beneficiaries (disadvantaged people) or solves certain environmental issues.
	SOC3	Improvement in occupational health and safety of employees.
	SOC4	Reduction in the environmental impact of firms' waste on the community.

TABLE 2 Demographic analysis.

Attributes	Sub-groups	Frequency	Percentage (%)
Gender	Male	295	54.5
	Female	246	45.4
	Total	541	100.0
Respondents age	20–30 years	96	17.7
	31–40 years	199	36.7
	41–50 years	182	33.6
	Above 51 years	64	11.8
	Total	541	100.0
Education	Secondary school	59	10.9
	Higher secondary	130	24.1
	Graduation	204	37.7
	Post graduation	109	20.1
	Diploma or others	39	7.20
	Total	541	100
Experience in years	Less than 4 years	28	5.2
	5–10 years	126	23.3
	11–15 years	251	46.5
	16–20 years	107	19.6
	More than 21 years	29	5.4
	Total	541	100.0
Business age	Less than 5 years	17	3.1
	6–10 years	71	13.1
	11–20 years	203	37.6
	21–30 years	136	25
	Above 31 years	114	21.1
	Total	541	100.0
Business size	Less than 9 employees	375	69.4
	10–49 employees	153	28.1
	50–99 employees	13	2.4
	Total	541	100
Region			
	Central	192	35.5
	North	176	32.5
	South	173	32

Source: Authors work.

validity was assessed to ensure each construct measured distinct concepts.

4.3.1 Common method Bias

To eliminate common method bias issues, the researcher applied multicollinearity tests using the Variance Inflation Factor (VIF) in accordance with recommendations of Kock (2015). The term VIF is used to outline similar or overlapping constructs. These overlapping variables may mislead the findings. According to Kock (2015), acceptable VIF values should fall within the range of 1–5; values exceeding this threshold may indicate problematic collinearity, as also highlighted by Halbusi et al. (2024). The present study conforms to fit within the threshold limits, thus validating the findings of the study to be free from bias and regarded as reliable (Table 7).

4.3.2 Reliability and convergent validity

Reliability refers to the construct's internal consistency. In this step, the tests are conducted to validate the consistency of the constructs with the basic assumption of covariance. As per Hair and Alamer (2022), the threshold limit for reliability as per Cronbach's alpha, Composite Reliability (rho c), and Average Variance Extracted (AVE) are 0.7, 0.7, and 0.5, respectively. CR is considered an advanced level for predicting internal consistency. Compared to rho a, rho c is considered to be more robust in assessing the internal consistency of

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TABLE 3 Eigen values.

Eigen values				
Function	Eigen values	% of Variance	Cumulative %	Canonical correlation
1	1.182[a]	88.5	88.5	0.736
2	0.109[a]	8.2	96.6	0.314
3	0.037[a]	2.7	99.4	0.188
4	0.008[a]	0.6	100.0	0.090

[a]First 4 canonical discriminant functions were used in the analysis.

TABLE 4 Wilks' lambda.

Wilks lambda				
Test of function (s)	Wilks lambda	Chi-square	df	Sig.
1 through 4	0.395	493.358	40	0.000
2 through 4	0.862	78.645	27	0.000
3 through 4	0.957	23.469	16	0.102
4	0.992	4.353	7	0.738

Source: Authors work.

TABLE 5 Standardised canonical discriminant function coefficients.

Standardised canonical discriminant function coefficients	
	Function
	1
GS1	0.472
GS2	0.311
GS3	0.027
GS4	0.379
GS5	0.350
GS6	0.151
GS7	0.247
GS8	−0.090
GS9	0.256
GS10	−0.019

Source: Author's work.

TABLE 6 Canonical discriminant function coefficients.

Canonical discriminant function coefficients	
Function	
	1
GS1	0.466
GS2	0.308
GS3	0.025
GS4	0.278
GS5	0.362
GS6	0.160
GS7	0.233
GS8	0.087
GS9	−0.051
GS10	−0.020
(Constant)	−4.419

Source: Author's work.

TABLE 7 Common method bias.

Variables	VIF
GEO → GI	4.161
GI → GS	1.000
GI → SP	2.066
GMO → GI	4.116
GS → SP	2.063

Source: Author's work.

the constructs. To measure convergent validity, the two tests applied are convergent validity and discriminant validity. Convergent validity measures the degree of correlation among multiple items in the same construct, and Average Variance Extracted (AVE) values are used to analyse the same (Hair and Alamer, 2022). On the other hand, discriminant validity checks if all constructs are distinct from each other and uses tests of HTMT and Fornell–Larcker Criterion values (Hair and Alamer, 2022). The findings provided in Table 8 show that α, CR, and AVE values exceed the threshold limit, suggesting that the outcomes are significant and acceptable for the study.

4.3.3 Discriminant validity

Discriminant validity refers to the degree of variation from one variable to another (Asif and Bakar, 2025). According to Hair and Alamer (2022), Fornell–Larcker is used to assess discriminant validity. This criterion confirms discriminant validity by using the square root of AVE variables. To ensure further, discriminant validity has been analysed using the Heterotrait–Monotrait (HTMT) ratio of correlations. The HTMT criterion demonstrates a threshold limit of not more than 0.90 because previous researchers have noted that when HTMT values are closer to 1, it signals a lack of discriminant validity. Thus, Tables 9 and 10 showcase the results by applying HTMT and Fornell–Larcker criterion.

4.4 Structural model

Once the measurement model is assessed, the next step is to evaluate the structural model to determine its path coefficient and statistical significance.

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TABLE 8 Item loading, reliability, and validity.

Construct	Items	Loadings	Cronbach's alpha (α)	Composite reliability (rho c)	AVE
Green Entrepreneurial Orientation					
	GEO1	0.874	0.907	0.931	0.730
	GEO2	0.871			
	GEO3	0.850			
	GEO4	0.854			
	GEO5	0.821			
Green Market Orientation					
	GMO1	0.865	0.867	0.910	0.716
	GMO2	0.805			
	GMO3	0.884			
	GMO4	0.827			
Green Innovation					
	GI1	0.854	0.902	0.827	0.718
	GI2	0.859			
	GI3	0.843			
	GI4	0.843			
	GI5	0.839			
Government Support					
	GS1	0.811	0.851	0.758	0.694
	GS2	0.836			
	GS3	0.812			
	GS4	0.859			
	GS5	0.862			
	GS6	0.857			
	GS7	0.786			
	GS8	0.813			
	GS9	0.820			
	GS10	0.872			
Sustainable Performance					
	ENT1	0.831	0.856	0.860	0.651
	ENT2	0.800			
	ENT3	0.816			
	ENT4	0.846			
	ENT5	0.788			
	ECO1	0.796			
	ECO2	0.796			
	ECO3	0.819			
	ECO4	0.768			
	SOC1	0.812			
	SOC2	0.815			
	SOC3	0.803			
	SCO4	0.800			

Source: Author's work.

Structural equation modelling (SEM) was employed to evaluate and validate the proposed research model. The analysis was conducted using the Smart PLS software platform, as shown in Figure 2.

4.4.1 Hypothesis testing

Table 11 represents the path coefficient of the structural model. According to the bootstrapping procedure, a two-tailed test approach is used to obtain the path coefficient for the study. The threshold for the significance level of 5% ($\alpha = 0.05$) is 1.96. The significance of the relationships was assessed using path coefficients and *t*-values obtained through bootstrapping.

In the proposed structural model, five hypotheses examined direct relationships and three hypotheses assessed mediation effects. As shown in Table 11, all structural paths are positive and statistically significant, satisfying the conventional thresholds of $t > 1.96$ and $p < 0.05$.

Following the recommendations of Muangmee et al. (2021) and Hair and Alamer (2022), *t*-statistics and *p*-values were used to evaluate whether to accept or reject any hypothesis. Altogether, eight hypotheses were tested in this study, and the results are summarised in Table 11.

H1, which posited that green entrepreneurial orientation significantly influences green innovation, was supported ($\beta = 0.518$, $t = 9.119$, $p < 0.001$). H2, proposing that green market orientation has a significant effect on green innovation, was also accepted ($\beta = 0.361$, $t = 6.109$, $p < 0.001$). H3 confirms a positive yet subtle effect between green innovation and sustainable performance ($\beta = 0.161$, $t = 6.165$, $p < 0.001$). Regarding H4 and H5, the findings suggest a mediation effect of green innovation to be positive in both cases, but it seems robust in GEO and sustainable performance link with ($\beta = 0.381$, $t = 2.967$, $p < 0.003$), whereas the subtle effect in GMO and sustainable performance link with ($\beta = 0.163$, $t = 2.260$, $p < 0.024$).

For the remaining hypotheses, H6 asserted that green innovation significantly influences government support, which was strongly supported ($\beta = 0.718$, $t = 30.388$, $p < 0.001$). H7 is accepted as the findings suggest government support to have significant impact on sustainable performance ($\beta = 0.804$, $t = 38.161$, $p < 0.001$). Finally, H8 confirms a strong mediation effect of government support between GI and SP link with values ($\beta = 0.578$, $t = 26.452$, $p < 0.001$).

Thus, all eight hypotheses were supported and are presented in Table 12 in detail.

TABLE 9 Discriminant validity by HTMT.

	1	2	3	4
GEO				
GMO	0.884			
GI	0.733	0.788		
GS	0.695	0.765	0.783	
SP	0.707	0.793	0.714	0.850

Source: Author's work.

4.4.2 Model fit summary

The model fit summary shows that the estimated model provides a close approximation to the saturated model. The Standardised Root Mean Square Residual (SRMR) values for both saturated (0.066) and estimated model (0.069) fall below the threshold value of 0.08, indicating a good fit. The d_ULS (Unweighted Least Squares) and d_G (Geodesic Distance) indices show minimal differences between saturated and estimated models, which suggests structural stability and fewer model discrepancies. The Chi-square values for saturated (1668.924) and estimated (1620.476) are closely aligned, suggesting consistency in the model structure. The Normed Fit Index (NFI) values for both the saturated and estimated model stands to be 0.680 and 0.678, indicating a satisfactory fit. Thus, the results indicate that the proposed model exhibits an acceptable global fit suitable for predictive PLS SEM analysis (Table 13).

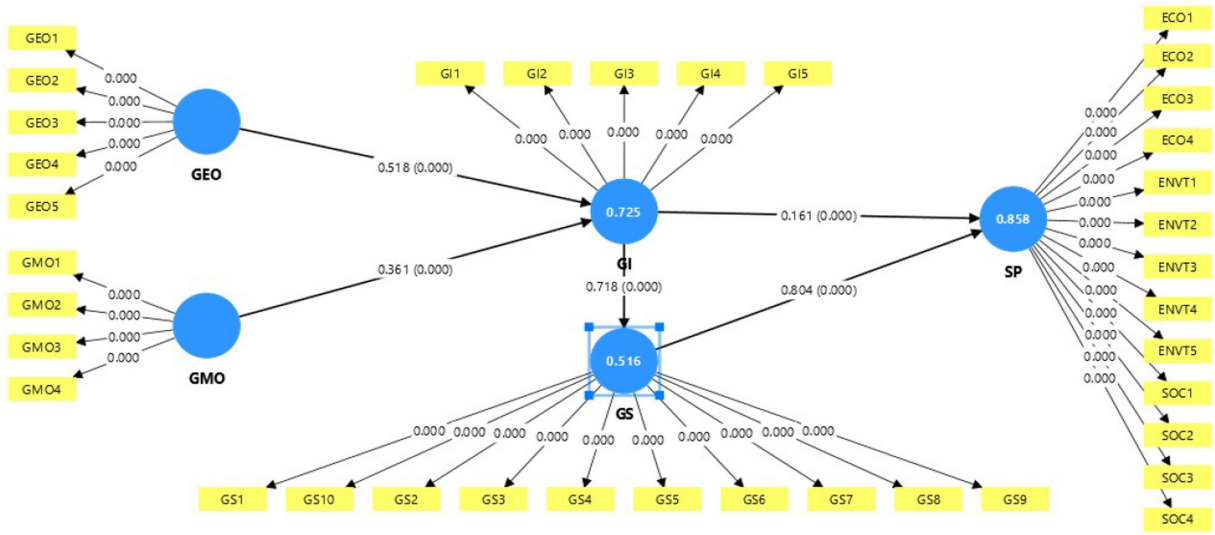

FIGURE 2
Structural model.

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TABLE 10 Discriminant validity by Fornell–Larcker criterion.

	GEO	GI	GMO	GS	SP
GEO	0.854				
GI	0.833	0.848			
GMO	0.842	0.812	0.846		
GS	0.646	0.718	0.621	0.833	
SP	0.660	0.738	0.651	0.720	0.807

Source: Author's work.

TABLE 11 Path coefficients.

Construct relationship	Path coefficients	*t*-statistics	*p*-values
Direct effect			
GEO → GI	0.518	9.119	0.000
GI → GS	0.718	30.388	0.000
GI → SP	0.161	6.165	0.000
GMO → GI	0.361	6.109	0.000
GS → SP	0.804	38.161	0.000
Indirect effect			
GEO → GI → SP	0.083	5.076	0.000
GMO → GI → SP	0.259	4.233	0.000
GI → GS → SP	0.578	26.452	0.000

TABLE 12 Summarised results of the hypothesis.

Paths	Hypothesis	Decision
H1	*Green Entrepreneurial orientation has a significant and positive effect on green innovation*	Accepted
H2	*Green Market orientation has a significant and positive effect on green innovation*	Accepted
H3	*Green innovation has a significant and positive effect on sustainable performance*	Accepted
H4	*Green Innovation mediates the relationship between Green Entrepreneurial Orientation and Sustainable Performance*	Accepted
H5	*Green Innovation mediates the relationship between Green Market Orientation and Sustainable Performance*	Accepted
H6	*Green Innovation has a significant and positive effect on Government support*	Accepted
H7	*Government support has a significant and positive effect on sustainable performance*	Accepted
H8	*Government Support mediates the relationship between Green Innovation and Sustainable Performance.*	Accepted

Source: Authors' work.

4.4.3 R^2 values

The predictive power of the model is assessed through various means. *R*-square values indicate coefficient of determination, also known as the Global Fit Index (Hair and Alamer, 2022). One of the key measures is R^2, which represents the proportion of variance in the dependent variable explained by the independent variable (Table 14). A higher R^2 value indicates that the model explains a significant amount of variation in sustainable performance (Hair and Alamer, 2022). When the R^2 value exceeds 0.5, the model is considered to exhibit a strong model performance to the original data (Hair and Alamer, 2022). In this investigation, the value of R^2 for green innovation is 72%, government support is 51%, and sustainable performance is 85%, which indicates that the model is strong.

TABLE 13 Model fit summary.

Model ft indices	Saturated model	Estimated model
SRMR	0.066	0.069
d_ULS	3.105	3.314
d_G	3.321	3.324
Chi-square	1668.924	1620.476
NFI	0.680	0.678

Source: Authors' work.

TABLE 14 *R*-square values.

Variables	*R*-square	*R*-square adjusted
GI	0.725	0.724
GS	0.516	0.515
SP	0.858	0.857

Source: Authors' work.

5 Discussion and implications

The present study investigated the impact of the collective influence of green entrepreneurial orientation (GEO) and green market orientation (GMO) strategies on green innovation (GI) with a mediation effect of government support (GS) to attain sustainable performance (SP) in the form of economic, environmental, and social performance in the food processing sector. Based on the NRBV theory and Stakeholder theory, the study frames a hypothesis to check whether there is a significance of GEO and GMO towards GI with the intervention of GS as mediation to achieve SP.

The first hypothesis examines the association between GEO and GI, and the results confirm that GEO has a significant impact on GI with values ($\beta = 0.518$, $p < 0.001$). The findings highlight the distinguished features of proactiveness, innovativeness, and risk-taking to promote green practices. The outcome of this investigation aligns with prior research by Muangmee et al. (2021). In the context of Kerala's food processing sector, entrepreneurial traits such as experimenting with energy efficiency technologies, eco-friendly packaging, and involving in the waste reduction process appear to overcome resource constraints and position themselves in a better position. The strength of this relationship clearly states that GEO is a strong entrepreneurial drive that plays a critical role of antecedent to green innovation capability. As per Mondal et al. (2024), firms that embrace GEO into their strategies adhere to green innovation to attain long-term competitiveness.

The second hypothesis investigated the association between GMO and GI, and the outcome communicates that there is a considerable impact with a path coefficient of $\beta = 0.361$ and p-value of 0.000. The results align with a prior study by Du and Wang (2022), Papadas et al. (2017), and Cheng et al. (2022). These results indicate the significance and magnitude of integrating GMOs to recognise the shift in purchasing trend of consumers towards eco-friendly products and boost capacity for innovation (Tjahjadi et al., 2023).

The study's third hypothesis examines the association between green innovation and sustainable performance, which reports a modest positive effect with a path coefficient of $\beta = 0.161$ and p-value of 0.001. The findings suggest that innovation alone cannot guarantee sustainability but also needs strong institutional backing, especially in the micro and small-scale enterprise context. The observations are partially aligned with earlier investigations by Ishaq et al. (2023).The fourth and fifth hypotheses investigate the possibility of green innovation to act as a mediator between green strategic orientation and sustainable performance. Both the hypothesis reports a positive and significant relationship with values GEO ($\beta = 0.083$, $p < 0.001$) as well as GMO ($\beta = 0.259$, $p < 0.001$), and align with studies by Bhatti et al. (2023). The finding sounds logical as the individuals with high green EO tend to create innovative products and services and behave in an eco-friendly manner. At the same time, firms are becoming greener oriented by adapting eco-labelling, paperless communication, social media adoption, e-commerce, etc., as a means to satisfy customers who prefer eco-friendly and health-conscious food products in Kerala.

Concerned with H6, H7, and H8 hypotheses, the study investigates the direct and indirect relationship of government support between GI and SP. The findings reveal GS as a strong predictor towards GI with values of ($\beta = 0.718$, $p < 0.001$), validating that firms that adopt green practices are more likely to benefit from government schemes and incentives in the food sector. In the same way, the interaction of government support on SP portrayed the strongest direct effect with values of $\beta = 0.804$. This underscores the critical role of government support in Kerala's food processing sector by way of subsidies, tax-incentives, and institutional interventions to enable sustainability. The indirect effect or mediation effect of government support is also seen as very strong with a path coefficient of $\beta = 0.578$, indicating that innovation enhances sustainability majorly through government backing.

5.1 Theoretical implication

The present study marks several theoretical contributions by exploring the complex relationships of green entrepreneurial orientation, green market orientation, green innovation, government support, and sustainable performance, within the food processing sector of Kerala, incorporating the NRBV and Stakeholder theories. Integrating these constructs, the study attempts to fill a substantial gap in how internal strategic orientations and external institutional mechanisms jointly drive sustainability outcomes in the food processing sector in developing economies through literatures.

Primarily, this study attempts to advance NRBV theory by introducing GEO as one of the key determinants for GI (Muangmee et al. 2021). The conceptual perspective of GEO lines up with the NRBV theory, which insists that firms prioritise ecological responsibility as a strategic tool to outperform the competitors over the long run.

The second contribution lies in integrating GMOs as another internal strategic resource towards achieving green innovation. The theoretical perspective of GMO aligns with the NRBV theory, as it conceptualises GMO to be an intangible strategic resource to acquire environmental management capabilities, and stakeholder theory argues that firms should be socially conscious towards the interests of multiple stakeholders such as consumers, legislators, and societies (Aboalhool et al., 2024). The empirical support of this study confirms that firms that leverage GMO strategies are able to convert intangible resources to tangible assets through green innovation, thus driving sustainable business growth.

The third contribution lies in the direct and indirect influence of GI on GEO, GMO, and SP. The emergence of GI into NRBV theory unlocks significant insights, especially in the food processing industry, which links to SDG goals in terms of food security, nutrition development, sustainable agriculture, and fostering responsible consumption and production practices (Ishaq et al., 2023).

The fourth contribution applies to the function of government support. The findings report that the institutional support acts positively, thus addressing the challenges of providing tailored financial incentives and technological support to the desired beneficiaries.

Overall, the current investigation extends the NRBV and Stakeholder theories by demonstrating that an integrated approach combining GEO and GMO, supported by innovation and government facilitation, provides a robust pathway to sustainable performance, especially in resource-constrained and policy-influenced sectors, such as Kerala's food processing industry.

5.2 Practical implications for entrepreneurs and managers

The empirical findings of the study provide substantial guidance towards the entrepreneurs and managers of micro and small-scale food processing sector in India. The present study helps industry practitioners to understand the strategic influence of GEO and GMO in implementing GI and, eventually, to identify the eco-friendly business priorities aimed at achieving sustainability by grabbing apt strategic opportunities. The findings highlight government support as the most critical driver of sustainability, with 51% of variance explained in micro and small setting enterprises in developing economies. Therefore, the study recommends micro entrepreneurs to emphasise on low-cost innovation techniques such as the use of energy-efficient machinery, waste minimisation approaches, and eco-friendly packaging and processes, which help to reduce operational costs and boost potential for availing more government incentives.

5.3 Policy implications and recommendations

From a policy perspective, the findings of the study recommend the need for sector-specific and regionally differentiated practical

policy approaches for GI behaviour adoption, and foster SP in the food processing sector. National initiatives, such as the PMFME scheme in 2020, have helped the sector to formalise 89% of unorganised food enterprises, thus indicating effectiveness in providing credit-linked subsidies, access to technology, and market linkages among micro enterprises. Another sector-specific initiative, such as PMKSY (Kisan Sampada Yojana), has played a significant role in supporting the food processing sector by reducing postharvest losses and encouraging efficient supply chain management. The scheme could benefit 52.24 lakh farmers (MOFPI report, 2024). Make in India initiative shares a broader scope in fostering an enabling environment for manufacturing industries to adopt technology, access investment, and enhance value addition. Despite its significant contributions, these initiatives face persistent limitations in implementing green innovation effectively among micro and small enterprises.

Hence, government and regulatory organisations are encouraged to support GEO and GMO by incentivising green strategic orientation through tax credits, grants, subsidies, and low-interest loans, along with technical assistance and capacity-building initiatives, which help to translate green innovation to sustainable performance. This also demands the necessity to standardise the benchmarks for sustainability performance within international, national, and state-wise policies that can further enhance the influence of green strategic orientations on economic as well as environmental performance. The study points out the need to have tailored policy at regional and state levels, to subsidise micro units for energy efficient systems based on agriclimatic conditions such as upgrading to solar rooftops or biomass systems etc., establishing district-level green common facility centres to help community networks such as SHGs (Self Help Groups) to collaborate with incubators, academic partners, and industry associations targeting at training women enterprises towards green movement.

Moreover, the study demands government organisations to focus on the digitalisation of marketing and branding of green products among micro and small food processing enterprises, which constitute 90% of the businesses, by facilitating grants for green certification, and eco-label design, in India. In addition to the above points, the study recommends that policy makers implement a single license system and a single window clearance in manufacturing sector which may mark a significant reform in an emerging economy by reducing regulatory complexities, approval delays, compliance costs, and ultimately enabling micro and small business entrepreneurs to start, operate, and scale their ventures in a seamless way of doing business.

6 Conclusion

The empirical evidence of the study validates that integrating key strategic green orientations and external support can encourage green initiatives, thus leading to SP in the food processing sector in India. The findings demonstrate a novel attempt to figure out the effect of these variables through the lens of the NRBV theory and the Stakeholder theory. The study identifies GI to be a crucial mechanism in converting green strategic orientation to SP, while the support of the government strengthens these effects by way of policies and subsidies. Overall, the study contributes to the theoretical and practical understanding of the food processing sector in India by integrating a comprehensive framework of linking GEO, GMO, innovation, and policy support to sustainable outcomes.

6.1 Limitations and future scope

Despite its novel framework, the study undergoes certain limitations. First, the study focussed exclusively on the food processing sector in India, which limits the generalisability of the findings to other sectors, regions, and countries. Therefore, the study recommends to extend scope of the study to other sectors and geographical contexts. Second, the present study employed a cross-sectional design and hence recommends future studies to consider a longitudinal research design to capture temporal dynamics and causality of green practices over time. Third, the study recommends testing other theories such as open innovation theory, bricolage theory in the sustainable-oriented conceptual framework to overcome the constraints of limited resource creatively and innovatively. Fourth, the current study focussed on two key dimensions of green strategic orientation, which recommends future scope to integrate additional green strategic dimensions such as green international orientation, learning orientation, knowledge management orientation, and moderating variables, such as digital capabilities, firm culture, social networks, and demographic factors. Hence, future studies are recommended to examine these factors to give a more comprehensive outlook of the mechanisms that drive sustainability in the food processing sector.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Amrita vishwavidyapeetham, Mysore Campus. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

VR: Resources, Methodology, Formal analysis, Investigation, Conceptualization, Writing – original draft. PR: Supervision, Writing – review & editing, Validation. BG: Supervision, Writing – review & editing.

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Generative AI statement

The author(s) declared that Generative AI was not used in the creation of this manuscript.

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