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THE IMPACT OF GREEN INNOVATION ON PERFORMANCE AND COMPETITIVE ADVANTAGE: TOP MANAGEMENT COMMITMENT AS MODERATOR

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ABSTRACT

The primary objective of study is to investigate effect of green innovations on firms' performance & competitive advantage. Top management's long-term support is a prerequisite for the effective implementation of the green innovation initiatives. Hence, second objective is to highlight moderating role of top management commitment. 350 duly filled questionnaires were received with response rate of 70%. The results of SEM analysis performed in Smart PLS show that green innovation practices significantly contribute to the financial performance, environmental performance, and competitive advantage of firms working in food and beverage industry. Moreover, the findings of this study reveal that top management commitment to green initiatives enhances the impact of green innovation practices. Environment ethics, green product development innovation, green process innovation, and market demand for green products, all contribute to environmental performance of firms. The study offers significant results and suggests that policymakers support green innovation initiatives by providing financial and technical resources for achieving desired sustainable development & growth of firms.

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INTRODUCTION

The green innovation has become primary approach for all communities for inspiring and attaining environmental sustainability (Guzmán, Garza & Pinzón, 2023). It promotes development of various innovations that reduce the negative impacts on environment (Hart & Dowell, 2011). Governments are executing stringent steps to protect environment by enacting legislation & controlling emissions and ecological footprints (Bansal & Roth, 2000). This promotes the production of environmentally

sustainable goods & diminishes consumption of natural resources (Gibson, Hassan & Tansey, 2013). Green innovation is essential for achieving long-term economic growth and stability (Hardcastle, Ganguli & Giocomo, 2015; Zhang, Rong & Ji, 2019). The sustainable organization seeks to mitigate global warming, save money by adhering to rules, acknowledge benefits of ecological conservation, & give the organization a sense of security (Liu, 2024). Thus, gaining insight into an organization's collaboration and interaction with its environment is valuable. As a result, businesses have adopted practices that enable them to adopt progressive and environmental stances. Kirkwood and Walton (2014) argued that the sustainable environmental technologies are overseen by environmentally conscious businesses that effectively manage their eco-friendly actions using green performance measurements & services.

The second component is development within businesses to attain innovation and greatly advance the goals of lowering the negative effects on environment (Kemp & Pearson, 2008). Climate change risks and resource scarcity are burning issues in realm of environmental pollution and sustainable utilization of resources (Wang & Song, 2014; Liu, 2024). This challenge necessitates the adoption of the highly economically efficient and ecologically friendly methods. Fernando, Jabbour and Wah (2019) suggested that ecological progress could boost process technology and improve operational efficiency. In this linking, environmental technology plays crucial role in promoting environmental sustainability by facilitating technical progress that conserves resources, prevents emissions, and mitigates pollutants (Benzidia, Bentahar, Husson & Makaoui, 2023; Chang, 2011; Rahmani, Naeini, Aboojafari, Daim & Yalcin, 2024). Biswas and Roy (2015) state that individuals are motivated to purchase environmentally friendly products mostly for social recognition rather than for economic benefits. Chen, Lai and Wen (2006) found that there is a direct relationship between the green innovation and competitiveness of firms in the industry. This link leads to enhanced creativity and competitive benefits.

López, Azorín and Cortés (2009) stated that top management support for environmental projects has resulted in a favorable effect on organizational performance and competitiveness. Despite this, the considerable amount of literature fails to take into account the internal context and particular circumstances that are associated with the sustainable growth and business efficiency. For instance, Chang (2011), Chen, Lai, and Wen (2006), Chiou, Chan, Lettice, and Chung (2011), Wong (2012), and Sezen and Çankaya (2013) are some examples of such literature. According to Demirel and Kesidou (2011), conventional methods of food production harm the climate. Effective collaboration between senior executives and staff is essential for the attainment of sustainability goals. Currently, Pakistan is grappling with sustainability challenges and facing a rapid increase in environmental issues, including air pollution, environmental deterioration, loss of forests, and water contamination. Hence, in absence of sufficient health and safety precautions, the estimated cost of environmental harm amounts to around 30% (Janjua, Samad & Khan, 2014). Based on data provided by Ministry of Environment, the utilization of plastic bags has been steadily rising at an annual growth rate of the fifteen percent.

Prior studies in Pakistan have examined environmental sustainability by focusing on technological characteristics and the acceptance of green innovation, with government intervention acting as a

moderating factor (Kousar et al., 2017). Later, Mushtaq et al. (2019) investigated environmental participation as a mediator amid green organizational image and performance of green innovation in Pakistan's World-Wide Fund. The important question is whether ecological technology would promote development and uphold its sustainable benefits (Gibson et al., 2013). Yen and Yen (2012) highlighted the impact of active participation of senior leadership on successful implementation of green innovation projects for the sustainable financial performance. They noted that the successful implementation of environmentally friendly practices and active involvement of senior leadership are closely linked. Despite significant impact of green innovation and top management support, we failed to find empirical evidence from existing literature. Therefore, this study aims to contribute to academic perspective by providing empirical evidence of relationships among green innovations, performance, and competitive advantage in the presence of management commitment serving as a significant moderator.

LITERATURE REVIEW

Green innovation has recently gained significant attention from academics. Many research projects have focused on studying relationship amid green technology, advancements in environmentally friendly products, and enhancements in eco-friendly processes, as well as the impact of these factors on competitive advantages of eco-friendly products that have been comprehensively explained in this section.

Resource-Based View Theory

Specifically, the resource-based viewpoint (RBV) framework of the company is subject of this study. Companies have to concurrently improve their internal & external capacities to foster innovation. According to the resource-based view (RBV) theory, businesses can gain a competitive advantage by cultivating strategic assets and capabilities that have characteristics of being valuable, scarce, difficult to replicate, non-transferable, and non-substitutable (Barney, 1991; Barney et al., 2001; Sirmon et al., 2011).

Green Innovation and Organizational Performance

Green innovation encompasses both the production of environmentally friendly products and the implementation of sustainable behaviors. Both of these aspects are included in category of green innovation. Cheng, Yang and Sheu (2014), RBV suggests that there are two categories of business assets: innovation in the environmentally friendly products and processes. Green process innovation focuses on improving the procedures and protocols, whereas green product innovation focuses upon improving actual products. Both of these types of innovations are important. According to Wong, Lai, Shang, Lu and Leung (2012), term "green product innovation" refers to the process of developing a new product or service that either does not have any negative effects on environment or has lower environmental impact in comparison to other products that are currently on market or those that compete with it. As organizations navigate environmental challenges & regulatory pressures, green innovation has become vital factor influencing firm performance and long-term success. According to findings of Lin, Chen and & Ho (2013), deployment of environmentally friendly innovation leads to increase in costs.

Dangelico and Pujari (2010) have outlined several benefits that can be obtained by incorporating environmental considerations into the process of product development or operations of a business. Advantages like greater competitiveness, increased sales, wider market reach, improved resource efficiency, higher investment returns, improved corporate reputation, and improved competency are included in this category. As extra benefit, Porter and Linde (1995) assert that environmentally responsible product design can cut costs by transforming trash into a resource that can be put to good use and by enhancing effectiveness of utilization of raw materials. Given the various pressures & challenges faced by organizations in carrying out environmentally friendly economic operations, they must evaluate techniques that improve their strategic, financial, & environmentally friendly advantages. Guzmán, Garza and Pinzón (2023) established a significant positive relationship of the firms' innovation practices with their economic as well as environmental performance. Rahmani et al. (2024) reported that green innovation practices of firms have important effect on environmental performance of firms.

H1a: There is positive relationship amid green innovation practices & environmental performance of firms.

H2a: There is a positive relationship between green innovation practices & financial performance of firms.

Green Innovation and Competitive Advantages

The research has shown that adopting environmentally sustainable technology can reduce adverse effects on firm performance & enhance corporate efficiency, resulting in increased competitiveness (Porter & Linde, 1995). Earlier studies have shown that conventional new items perform better with competitive edge (Gatignon & Xuereb, 1997; Swink & Song, 2007; Veldhuizen, Hultink, & Griffin, 2006). Enhancing the company's efficacy and competitiveness is the main goal of these factors, in addition to minimizing negative environmental effects. Chen et al. (2006) investigated relationship between green innovation and process innovation, discovering that both are useful for achieving competitive advantages and improving the quality of green products. Chen et al. (2006) and Chen (2008) investigated effects of ethical product innovation & process improvement on organization's competitiveness & green identity. Still, effectiveness of green innovation in enhancing performance and competitive advantage can be significantly moderated by top management commitment. They found a significant positive impact of the green product innovation, and process innovation on the competitive advantages.

H3a: There is a positive relationship between green innovation and the competitive advantages of firms.

Moderating Role of Top Management Commitment

To examine the potential moderating effects of top management commitment upon the relationship between green innovation and organizational performance, it is necessary to first explicitly report overall correlation between green innovation and organizational performance. Hall and Wagner (2012) reported that creative processes yield a positive influence on environmental performance. The term "TMC" refers to the extent of dedication demonstrated by the senior management of the organizations being surveyed to accomplish their sustainable objectives (Chuang & Lin, 2015). An unwavering commitment from the top-level management is vital for developing and boosting the

performance of both management and organization as a whole (Hoejmose, Brammer & Millington, 2012). Concerning the management commitment, the degree of devotion and assistance provided by management positively impacts the correlation between green innovation and the organization's overall performance.

H4a: Top management commitment has moderating effect on relationship amid green innovation and environmental performance of firms.

H5a: Top management commitment has moderating effect on the link among green innovation and the financial performance of firms.

H6a: Top management commitment moderates the link between green innovation & competitive advantage.

RESEARCH METHODOLOGY

To investigate the impact of green innovation on firm's performance and competitive advantage, a survey was conducted by sharing a Google form link (containing a questionnaire) among the senior & middle-level managers of food, beverage firms working in Lahore. The managers were contacted through their email IDs retrieved from the websites of companies. Initially, the questionnaire was emailed to 500 managers out of which 400 responded. After discarding 50 incomplete responses, 350 responses with a response rate of 70%, were used for conducting analysis. This study utilizes a purposive sample technique, often known as the non-probability sampling which involves selecting participants relevant to phenomenon under the investigation. Thus, a structured questionnaire was developed to collect data about demographic attributes of respondents and the firm's performance, competitive advantage, green innovation, and top management commitment. Demographic data of senior and middle-level managers include gender, age, educational attainment, and employment categorization.

Taking into consideration several different levels of analysis, the second section of questionnaires contained questions about the green innovation practices & variables that make green innovation possible. A total of 40 questions were adopted from Chang (2011) to measure the organization's performance, organization competitive advantage, and green innovation practices of the food and beverage firms. Further, consistent with the Weng et al. (2015a) stakeholder perspectives were also emphasized. Adoption of environmental policies & activities was assessed by several stakeholders, including internal and external parties like consumers, competitors, and industry representatives. The market demand for green products (MDGP) was assessed based on four elements, as outlined by Lin et al. (2013). These factors evaluated market dynamics like pricing competitiveness, consumer benefits, and demand criteria for environmentally friendly products. The four question items were borrowed from Chiou et al. (2011), to calculate green product development innovation practices of firms (GPDIPF).

To meet environmental criteria, green process innovation practices of firms (GPRIPF) were measured based on four question items adopted from Chiou (2011). To measure top management commitment for green initiatives (TMCGI) five question items were adopted from Liang (2007). Organizational performance was measured in terms of financial and environmental performance. To measure the environmental performance of the firms (EPF), five elements were derived from Lin et al. (2013). The

financial performance (FP) is evaluated by using a mix of financial and non-financial variables like as productivity, market share, revenue growth, efficiency, and stakeholder engagement (Lumpkin & Dess 1996). Chiou et al. (2011) established a scale that was used to calculate the Competitive Advantage of firms (CAF) based on six components. An evaluation was led based upon reductions in waste and pollution, as well as the decreased utilization of energy in conjunction with adherence to regulatory requirements.

Table 1 Defining Variables for Operationalization

Variables Name	Symbol	Variables	Operational Definitions
Environmental Performance of Firms	EPF	Dependent	Lin et al. (2013)
Financial Performance of Firms	FPF	Dependent	Lumpkin and Dess (1996)
Competitive Advantage of Firms	CAF	Dependent	Chiou et al. (2011)
Environmental Ethics of Firms	EEF	Independent	Chang, (2011)
Stakeholders' View Concept	SV	Independent	Weng et al. (2015a)
Market Demand for Green Products	MDGP	Independent	Lin et al. (2013)
Green Product Innovation Practices of Firms	GPDIPF	Independent	Chiou et al. (2011)
Green Process Innovation Practices of Firms	GPRIPF	Independent	Chiou et al. (2011)
Top Management Commitment for GI	TMCGI	Moderating	Liang et al. (2007)

The structural equation model was estimated in Smart PLS to estimate the effect of green product development and green process innovation on the organizations' performance and their competitive advantage. In this connection, the analysis includes confirmatory factor analysis, the structural path analysis, latent variables causal modeling, as well as multiple regression analyses to corroborate the desired conclusions.

RESULTS OF STUDY

To determine the nature of the connection that exists between the variables, the data was analyzed to test the reliability and validity, AVE, and PLS path coefficient. The PLS-SEM methodology was chosen through the conventional methods that emphasize covariance, while CB-SEM necessitates a substantial sample size (Kline, 2017). The conceptual model was analyzed and the correlations were evaluated using the Reliability, Validity, Average Variance Extracted (AVE), and Path Coefficient Model tests.

Value of Construct Reliability & Validity

The Cronbach Alpha values reported in Table 2 for all constructs except CAF, EPF and MDGP are higher than 0.70, evidencing higher measurement consistency of the constructs Results reported in Table 2 indicate that the composite reliability of all constructs is higher than 0.60 except CAF and MDGP. The AVE reported in Table 2, is higher than 0.50 for all constructs evidencing their validity. Thus, it implies that variation in concepts is rightfully captured by all constructs used to measure that concept.

Table 2 Reliability & Validity Analysis

	CAA	RHO_A	CR	AVE
Competitive Advantages of Firms (CAF)	0.291	0.861	0.022	0.577
Environmental Ethics of Firms (EFF)	0.885	0.900	0.928	0.812

Environmental Performance of Firms (EPF)	0.216	0.795	0.640	0.527
Green Process Innovation Practices of Firms (GPIPF)	0.809	0.844	0.867	0.572
Green Product Innovation Practices of Firms (GPIPF)	0.863	0.883	0.909	0.715
Market Demand for Green Products (MDGP)	0.196	0.796	0.511	0.556
Financial Performance of Firms (FPF)	0.784	0.822	0.863	0.618
Stakeholders' View (SV)	0.895	0.908	0.924	0.712
Top Management Commitment (TMCGI)	0.814	0.844	0.879	0.648

After testing the convergent validity, the discriminant validity was confirmed using the standards suggested by Hamid et al. (2017). If the HTMT ratio for a construct is less than 0.85 evidence of the presence of discriminant validity (Hamid, Sami & Sidek, 2017). HTMT ratios for most of constructs reported are less than 0.85 indicates the presence of the discriminating validity. A few HTMT ratios reported bold are higher than the 0.85 threshold value & indicate problem of discriminant validity between constructs.

Table 3 Discriminant Validity

	CAF	EEF	EPF	GPRIPF	GPDIPF	MDGP	FPF	SV
CAF								
EEF	0.835							
EPF	0.594	0.124						
GPRIPF	0.901	1.026	0.744					
GPDIF	0.378	0.083	0.572	0.409				
MDGP	0.768	0.767	1.282	0.696	0.633			
FPF	0.978	0.879	0.709	0.943	0.978	0.709		
SV	0.257	0.105	0.422	0.262	0.399	0.182	0.257	
TMCGI	0.884	1.042	0.757	1.078	0.887	0.678	1.101	1.099

Structural Equation Model Estimation & Results

The evaluation of the structural model in Partial Least Squares (PLS) comprises five specific tests: derivation of path coefficients to test hypotheses, analysis of R-Square values, determination of effect sizes, assessment of predictive significance, and evaluation of fitness. The importance of each hypothesis is evaluated using a regression coefficient. In this particular experiment, the model was able to get an SRMR score of 0.157, which is within the acceptable range of 0 to 1. In addition, the NFI model standard should be close to one. Therefore, our model's NFI values of 0.716 and 0.712 shows a strong fit.

Table 4 Model Fitness

	Saturated Model	Estimated Model
SRMR	0.157	0.159
dULS	19.956	20.020
NFI	0.713	0.717

Henseler and Sarstedt (2013) expressed some concerns with the use of GoF index in PLS-SEM. Their objection to application of this methodology stemmed from the fact that measurement method had not been verified. GoF Index was settled by Tenenhaus et al. (2005) & is calculated by multiplying

average-square score by square root of average AVE scores. The given GoF values are as follows: GoFsmall = 0.1, GoFmedium = 0.25, and GoFlarge = 0.36. The results of moderation analysis for the environmental performance of firms are reported. Coefficients of analysis show that environmental ethics, process innovation practices, product growth innovation practices, demand for the green products, and shareholders' values are positively related to environmental performance of food and beverage firms. Moderation analysis reveals that top management support is a pure moderator and enhances the effect of process innovation practices on environmental performance of firms. Still, the results demonstrate that top management's commitment to green initiatives does not moderate the effect of EEF, GPDIPF, MDGP, and SV on EPF. Thus, results reported in Table fully support hypotheses H1a. and H4a.

Table 5 Path Coefficient Estimates

	OS	SM	SE	t- Statistic	PV
EEF ---> EPF	0.085	0.078	0.031	2.703	0.007
EEF---TMCGI---> EPF	(0.0160	(0.025)	0.028	0.562	0.575
GPRIPF ---> EPF	0.076	0.075	0.042	1.804	0.032
GPRIPF--TMCGI--> EPF	0.102	0.105	0.032	3.167	0.002
GPDIPF --> EPF	0.021	0.027	0.043	0.475	0.035
GPDIPF---TMCGI --> EP	0.007	0.009	0.021	0.328	0.743
MDGP ---> EPF	0.962	0.960	0.040	24.163	0.000
MDGP--TMCGI--> EPF	(0.039)	(0.037)	0.022	1.803	0.072
SV ---> EP	(0.332)	(0.340)	0.073	4.541	0.000
SV—-TMCGI---> EPF	0.058	0.058	0.032	1.793	0.074
TMCGI ----> EPF	0.053	0.064	0.074	0.717	0.474

Environmental Performance of Firms (EPF); Environmental Ethics of Firms (EFF); Environmental Performance of Firms (EPF); Green Process Innovation Practices of Firms (GPRIPF); Green Product Innovation Practices of Firms (GPDIPF); Market Demand for Green Products (MDGP); Financial Performance of Firms (FPF); Stakeholders' View (SV); Top Management Commitment (TMCGI).

Table 6 Path Coefficient Estimates

	OS	SM	SE	t- Statistic	p- Value
EEF ---> CAF	(0.254)	(0.109)	0.251	1.009	0.314
EEF—TMCGI---> CAF	0.141	0.106	0.149	0.944	0.007
GPRIPF ---> CAF	(0.465)	(0.396)	0.177	2.628	0.009
GPRIPF--TMCGI --> CAF	0.764	0.613	0.361	2.119	0.035
GPDIPF --> CAF	0.139	0.169	0.151	0.922	0.357
GPDIPF—-TMC---> CAF	(0.473)	(0.161)	0.430	1.101	0.009
MDGP---> CAF	0.324	0.163	0.278	1.163	0.032
MDGP—TMCGI--> CAF	(0.133)	(0.121)	0.072	1.858	0.012
SV ---> CAF	1.373	0.992	0.869	1.580	0.115
SV--TMCGI --> CAF	0.520	0.180	0.472	1.103	0.002
TMCGI ---> CAF	0.240	0.082	0.263	0.913	0.361

The results reveal that only green process innovation practices of firms have a significant positive impact on competitive advantage of firms. Whereas, direct effect of EEF, GPDIPF, MDGP, and SV

on CAF is insignificant. Results of moderation analysis reported in Table 9 establish that TMCGI is a pure moderator and in its presence, EEF, GPDIPF, GPRIPF, MDGP, SV all have a significant indirect effect on competitive advantage of firms. Thus, results reported in Table 8 fully support hypothesis H6a but partially support H3a. The results of moderation analysis for financial performance of firms are reported in Table 7.

Table 7 Path Coefficient Estimate

	OS	SM	SE	t- Statistic	p-value
EEF --> FPF	0.235	0.231	0.0789	3.008	0.004
EEF--TMCGI--> FPF	(0.068)	(0.064)	0.057	1.198	0.003
GPRIPF---> FPF	(0.143)	(0.127)	0.124	1.152	0.251
GPRIPF--TMCGI--> FPF	(0.293)	(0.264)	0.105	2.801	0.006
GPDIPF ---> FPF	0.207	0.197	0.088	2.305	0.023
GPDIPF--TMCGI-->FPF	0.124	0.128	0.078	1.614	0.008
MDGP ----> FPF	0.006	-0.002	0.054	0.098	0.921
MDGP--TMCGI---> FPF	(0.021)	(0.023)	0.051	0.392	0.007
SV----> FPF	0.461	0.457	0.166	2.788	0.005
SV---TMCGI---> FPF	0.108	0.064	0.166	0.647	0.519
TMCGI ----> FPF	0.129	0.122	0.131	0.987	0.325

The impact of green innovation on the businesses' financial performance was investigated using SEM analysis; findings are shown in Table 9. The findings reveal that stakeholders' values, environmental ethics, and green product innovation strategies all significantly improve a company's financial success. On the other hand, businesses' financial performance is negatively impacted by their green process innovation initiatives. The market's desire for environmentally friendly items has little effect on businesses' financial results. The moderating influence of top management commitment to green initiatives is confirmed by the moderation analysis for indirect analysis presented in Table 9. The results show that TMCGI as a suppressor changes the direction of the relationship of the EEF, GPDIPF, and MDGP with FPF. Thus, the results reported in Table 9 partially support hypotheses H2a and H5a.

DISCUSSION

The main objective of this study is to examine the effect of green innovation on the performance and competitive advantage of the food and beverage firms. This study also aimed to test the role of top management support in moderating relationship amid green innovations and firms' performance and competitive advantage. The findings of this study revealed that green innovation practices of firms (environmental ethics, green product innovation, green process innovation & market demand for the green product innovation & stakeholders' value) have significant effects on environmental performance, financial performance, and competitive advantage of the firms working in food and beverage industry of Pakistan. The first component of the green innovations, environmental ethics significantly and positively contributes to the financial and environmental performance of firms. However, its impact on competitive advantage is not considerable. On the other hand, the second component, green process innovation significantly enhanced competitive advantage of firms but

did not significantly contribute to increase in financial and environmental performance. It implies that adoption of new eco-friendly production technologies offers a competitive advantage to firms over their rivals.

Further, adoption of new green technology increases the fixed cost of firms which might negatively affect performance of firms. The third component of green innovations, green product development innovation practices of the firms have a significant positive effect on both the environmental and financial performance of the firms. Whereas, its impact on competitive advantage is insignificant. Market demand for green products of firms has a significant positive effect on their environmental performance and the competitive advantages. However, it does not significantly contribute to the financial performance of firms. The fifth component of green innovations, Stakeholders' value has a significant positive effect on both the environmental and financial performance of firms but it has no significant impact on the competitive advantage of firms. Top management has no direct effect on the performance and competitive advantage of firms. However, its moderating role is significant. It implies that top management support is essential for the effective implementation of the green innovation practices. Securing the active participation of upper management and implementing state-of-the-art green technology practices are essential for improving organizational performance & competitive advantage.

The findings of this study are consistent with the findings of earlier studies. For example, Dalcin et al. (2014) advocated that firms engaged in manufacturing of ecological and green products perform better and enjoy a competitive edge over their rivals in market. Similarly, Chen et al. (2006) and Molina et al. (2009) reported that the introduction of innovative organic products and the adoption of environmentally friendly production technologies have a favorable impact on the performance and competitive advantage of firms. Recently, Liu (2024) documented the positive impact of green innovation practices on their performance and risk. Benzidia et al., (2023) emphasized that green process innovation reduces the carbon emission effect and increases sustainability of organizations by ensuring compliance with environmental protection regulations. The growth of new products or modifications to existing products that reduce environmental impact through their lifecycle. Also, the findings of this study show that the impact of green product innovation is more favorable and substantial in terms of an increase in financial and environmental performance. Developing a novel environmentally-friendly product appears to be a more feasible task as compared to altering the manufacturing method.

The results demonstrated significance of implementing sustainable product innovation strategies based upon the corporate environmental ethics, stakeholder perspectives, and market requirements for environmentally friendly products. According to Chang (2011) and Weng et al. (2015a), there appears to be direct correlation between CEE and SV and the advancement of sustainable products and development. Studies by Zailani et al. (2015) and Lin et al. (2013) showed that market demand for green products has little effect on the creation of sustainable products but was advantageous to the creativity of environmentally friendly processes. The use of innovative green technologies and sustainable practices results in decreased the energy consumption, reduced emissions of pollutants, minimized waste generation, increased utilization of renewable resources, and the development of

friendly product designs (Rahmani et al., 2024). Over cost savings resulting from energy efficiency, waste reduction, and resource optimization. To address limits imposed by technology on ecological development, prior studies have established that effective management involvement is essential for achieving improved business performance & competitiveness (Chatterjee et al., 2002; Gunasekaran et al., 2017; Zhang., 2019).

CONCLUSION

The findings of the study conclude that green innovation practices have significant impact on the environmental and financial performance of food and beverage firms. Further, it is established that the adoption of green technology and the development of eco-friendly products give the firms a competitive edge over their rivals in the market. The findings of moderation analysis conclude that top management commitment to the implementation of green innovation has a significant bearing on the relationship of green innovation practices with the performance and competitive advantage of firms. Thus, firms must take proactive measures in implementing sustainable initiatives, mainly those of the sustainable development, to tackle their internal and external competition. The current study shows that businesses can enhance their organizational performance & competitive advantage by actively engaging in environmentally conscious innovation processes. When engaging in green production, it's critical to consider demands of market, the influence of stakeholders, and company's ethical values about environment. The use of cutting-edge environmentally friendly technological methods and the active engagement of senior management are critical for the business to achieve optimal performance. The demands of market, the company's ethical standards for the environment, and the influence of stakeholders must all be considered while implementing the green product innovation practices.

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