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Impact Of Green Knowledge Management On Green Innovation In Food Supply Chain Smes In Developing Country: The Mediating Role Of Environmental Awareness

Ikramuddin Junejo[1*], Muhammad Sufyan Ramish[2], Dr. Taskeen Zahra Buriro[3], Sumera Kazi[4], Dr Syed Salahuddin[5], Abdul Ghafoor Kazi[6]

[1*]Assistant Professor, Department of Management Sciences, SZABIST University Hyderabad Campus, Pakistan.
E-mail: ikramuddin8022@yahoo.com
[2]Associate Professor, Institute of Business and Health Management (IBHM), Ojha Campus, Dow University of Health Sciences, Karachi, Pakistan. E-mail: smsufyan@gmail.com
[3]Assistant Professor, University of Sufism and Modern Sciences Bhitshah, Pakistan. E-mail: zahra.taskeen1@gmail.com
[4]Lecturer, Department of Management Sciences, Isra University, Hyderabad, Pakistan. E-mail: sumerakazi.sk83@gmail.com
[5]Assistant Professor, Department of Business Administration, Indus University, Karachi, Pakistan
E-mail: salahuddinpk@gmail.com
[6]Assistant Professor, Department of Management Sciences, SZABIST University Hyderabad Campus, Pakistan.
E-mail: agkazi78@gmail.com

Abstract
The objective of the present study is to examine the impact of green knowledge management on green innovation and the mediating role of environmental awareness, which has been studied in food supply chain SMEs in a developing country, Pakistan. Data was gathered through adopted questionnaires from past studies and connivance and snowball sampling strategies adopted in order to achieve the study objectives of the present study. A total of 309 cases were considered after the data cleaning process in SPSS version 25 for testing the proposed hypothesis structural equation modelling applied via SmartPLS version 3. The present study's findings confirmed the direct effect of green knowledge management and environmental awareness on green innovation in food supply chain SMEs. However, environmental awareness was found to have a more positive and significant impact on green innovation than green knowledge management due to a higher beta value—furthermore, the partial mediation effect of environmental knowledge revealed between green knowledge management and green innovation. Therefore, the present study suggested to top management food supply chain SMEs and policymakers that they should consider these variables in their future policies to get better results in green innovation in developing countries such as Pakistan.

Keywords: Green knowledge management, Green Innovation, Environmental awareness, food supply, SMEs manufacturing

Introduction

Green knowledge management (GKM) is of pivotal strategic character for many companies due to its role as a source of competitive advantage in today's era that pays attention to nature (A. N. Khan et al., 2024). GKM- stands for a company's tailor-made environmental sustainability and green practices management policies, which is a systemic approach. The deployment of green knowledge based on the technology of capturing, organizing, distributing, and applying it in support of green business activities, innovation, and business management is a vital link in this process. GKM - Green empowers the growth of green technologies, products, and services. Applying knowledge of sustainable practices allows companies to perform product innovation and develop environmentally friendly offerings as consumers become more environmentally conscious. This manner contributes to their competitive edge and attracts environmentally concerned customers. To this end, GKM seeks to build ties with other state organizations, research institutions, and corporate specialists. By collaboratively sharing green knowledge and the best practices, firms can elevate innovation, learn optimal lessons from others' experiences, and cohesively solve sustainability problems (Kaur, 2024). Working together, industries can shape up a set of standards, allowing for the sharing of resources and projects with mutually profitable results. GKM helps businesses develop and roll out sustainable strategies that align with their organization for the long term. The capacity of green knowledge management allows the corporate world to structure itself in line with sustainable development goals and ensure resilience and continuity in the face of the changing environment (Russ, 2021).

The idea of "green innovation" being a sustainable ideological pillar supports a wider goal of sustainable development, which is contained in the United Nations' Sustainable Development Goals (SDGs) (Belmonte-Ureña et al., 2021). Regrettably, yet to be a target within the SDGs, it specifically addresses the difficulty of green production processes for organizations; however, the numerous goals that allude to the idea are indirect connections that emphasize the need to sustain production and innovation. The sector concerned with resilient infrastructure facilitation, sustainable industrialization adoption, and innovation is called Industry, Innovation, and Infrastructure. This goal appreciates the role of innovation in making sustainable development's engine run while embracing greener technologies. Green technologies and practices are nowadays being

incorporated into production processes. The responsible production and consumption agenda aims to raise public awareness of conserving and producing sustainably (Giannetti et al., 2020). It upholds the fact that it is the drop in resource consumption rather than economic growth that causes less damage to the environment. In this sense, organizations are prompted to switch to sustainable production processes so that their activities in the field do not cause environmental problems and good management of the resources (Tu & Wu, 2021). A topic relevant to our current problems, Climate Action, speaks for the necessity of the solution to global climate change and its consequences. On the other hand, making green production of enterprises simple may facilitate the increase in the emission of greenhouse gases, the energy efficiency of processes, and the low-carbon and sustainable production methods and processes.

Green knowledge management plays a decisive role in the emergence of innovative green ideas and solutions within small and medium enterprises (SMEs) (Wang et al., 2022). Resource limitations always confront SMEs, and as such, they may need to possess adequate competence and knowledge to apply and develop sustainable strategies and innovations. Eco-aware knowledge management systems that help solve the hurdles related to green knowledge acquisition, development, sharing, and application within SMEs can be achieved (Yerram, 2021). Knowledge management from a green perspective contributes to SMEs' decisions about what kind of knowledge they need and where to access information on eco-friendly practices, technologies, and regulations. This involves continuous monitoring of the fashion trends, modernizing best practices, and catching up with the latest innovations around the world in sustainability. Through knowledge of green innovation, SMEs may develop awareness of the environmentally beneficial innovations they can implement and the effective methods to carry out the environmentally friendly solutions (Khan et al., 2022). Eco-knowledge management is an activity geared toward this knowledge within SMEs. This involves discerning and collecting personal memories, educative experiences, and successes in implementing green projects. Cooperation between different departments affords SMEs the exceptional opportunity to build a learning culture and a cooperative working environment through which employees will be encouraged to develop, contribute, and implement more innovative ideas and sustainable solutions (Irawan & Aulia, 2022).

In past studies, the direct effect of green knowledge management on green innovation in the context of SMEs and the service sector has been checked. Therefore, in the present study, mediating variable environmental knowledge is introduced in the model, and data is gathered from food supply chain SME manufacturing firms. Moreover, in previous studies, samples were taken from managers only, but in the present study, data was collected from all levels of employees to verify the past findings.

Literature Review

Theoretical foundation

According to Ajzen (1991), the Theory of Planned Behavior posits that behaviors are a product of personal attitudes, subjective norms, and perceived control strategies concerning the behavior (Lim & Weissmann, 2023). In addition to that, this theory may serve as an instrumental tool for grasping how the variables are connected to the current research and is also referred to as just a tool used for managing people's green orientation, which in turn affects their green behavior and subjective norms of SMEs in the supply chain of food. Environmental management knowledge (including promoting eco-practices) is a part of this management system that defines employees' understanding of the importance of sustainability and how to use sustainability and innovation tools inside the company (Parida & Brown, 2021). The awareness of the environment is a (mediating) factor within the framework of acquiring green knowledge and driving green innovation. It represents employees' knowing and holding of relevant attitudes and personal behaviors about ESG issues. Green practice cumulation in knowledge management can raise employees' awareness of environmental problems, sustainability approaches, and the results of green innovations. All this could contribute to their socio-cognitive theories, with positive or negative attitudes, subjective norms, and perception of behavioral control shaping their intention to participate in implementing green innovations. Green innovation embodies green business practices regarding food systems, products, and operations within food chain SMEs (Muller et al., 2022). Various kinds of employee attitudes towards environmental research arouse behavioral norms and perceived behavioral control that result from their ecological perceptions. Workers who have more environmental awareness also support innovation, thereby directly or indirectly promoting good health of the environment and the business situation (Peng et al., 2021).

The present study could analyze the interconnections among green knowledge management, environmental consciousness, and green innovation in middle-scale enterprises in developing countries engaged in the food chain industry. This theory summarizes the comprehensive framework for understanding that green knowledge management practices lead to a change in the individual's attitude toward environmental issues. This attitude is then affected by environmental awareness, such that the person engages in green innovation activities.

Hypothesis development

Green knowledge management

Resourceful knowledge management aids the dynamics of knowledge relay and amalgamation of environmental knowledge within organizations (Sherif et al., 2024). Information about sustainable technologies, practices, and regulation processes is expected to be managed and distributed efficiently by the organization. Through this process, the organization can conveniently understand green problems and use the knowledge gained to innovate products, services, and eco-friendly technologies. Only companies that embody and use green knowledge can succeed in the ever-changing market competition (Barakat et al., 2023). Through visible dedication to sustainability and eco-friendly products and services, organizations can

gain the attention of eco-conscious consumers. This helps differentiate them from competitors and sets them up for new business opportunities. This thus motivates more research in the green economic sectors of product design, production processes, and supply chain management. A lush green knowledge management system provides employees access to multiple information sources. It inspires their minds to come up with new and creative solutions by allowing them to compare and think of different things simultaneously.

Through stimulating trans-disciplinary inclusiveness and ideation, an organization provides instances to make breakthrough sustainable designs such as new products, approaches, and business models directed towards environmental preservation (Purg et al., 2023). Green knowledge management is one of the main ways organizations stay updated with their legal obligations and professional standards, thus avoiding the reputational problems linked with non-compliance and correlated fines. Proactively responding to environmental risks also helps build trust with stakeholders, and by adopting sustainable practices, organizations safeguard themselves from environmental hazards (Ejibe et al., 2024). Establishing a transparent and regular (the rule of law) regime is a catalyst for innovation (which in turn brings stability to the environment favorable for forming confidence in sustainable investment) (Aden, 2023).

H1: Green knowledge management has positive and significant impact on green innovation.
H2: Green knowledge management has positive and significant impact on environmental awareness.

Mediating role of Environmental awareness

Raising awareness of environmental issues exudes a sense of sensitivity, which, in turn, is the key to their recognition, especially regarding ecological problems and the consequences they might bring (Casmana et al., 2023). This heightened consciousness becomes the tipping point for possible alternatives to be commissioned towards that end. A case for that has been climate change. Researchers might create a new generation of carbon capture and storage technologies. The rising environmental consciousness causes the need for new solutions that cut down on environmental impact and promote sustainability. - a day ago (Jain & Hudnurkar, 2022). This requires enhancing investment in R&D to develop green technologies and sustainable approaches. Industries, governments, and beneficiaries may enroll their resources in the search for research and development projects aimed at introducing new solutions to environmental troubles, including, but not limited to, clean energy technologies, eco-friendly cars, or green materials (Yadav, 2021).

By incorporating green knowledge, management organizations can learn about sustainability through information and resources (Shahzad et al., 2020). Thoroughly control the process and share the knowledge; then, environmental issues and opportunities within organizations will increase. This heightened consciousness about environmental issues creates a framework for driving developments like that in green technologies, processes, and methods. The green knowledge management culture improves knowledge sharing and makes employees knowledgeable and better organizational learning (Azeem et al., 2021). The generation and communication of these environmental green intelligences become possible through knowledge management platforms that enable employees to discuss and share information and experience regarding environmental preservation. The knowledge exchange process allows employees to assimilate the facts about environmental issues and the solution of embracing creative technology to amend these problems. An organization's resilient and sustainable innovative competence is enhanced by the capacity to make short- and long-term strategies based on green knowledge management and environmental awareness (Karman & Savanevičienė, 2021).

H3: Environmental awareness has positive and significant impact on Green Innovation.
H4: Environmental awareness mediates the relationship between green knowledge management and green innovation.

Methodology

Data collection procedure

This qualitative research determines how green knowledge management affects green innovation in food supply chain SMEs in Pakistan, with environmental awareness as the mediating role. In Pakistan, primary data from food supply chain SME employees located all over the country is collected using a cross-sectional survey design. The initiative will reach the HR department staff of Pakistan's food supply chain SMEs as its target population. Convenience sampling is a technique used to select participants for this survey. The researchers would implement the Enter HR departments of small and medium enterprises in the food supply chain in Pakistan and distribute a Google Form-based survey to collect responses. Ethical principles will be maintained, getting attention all the way through. Data collection is performed after healthy volunteer consent, with privacy and anonymity assured. Participants of the study are the ones who are informed about the nature of such participation as a voluntary one, and they are also aware that they have the right to drop out of the study without any consequences whatsoever. We distributed 350 questionnaires and received 329 questions from them. It was realized that 309 responses for data interpretation were obtained after an analysis of null values and missing data. A set questionnaire has been constructed to gather information from the respondents. A survey comprises multiple-choice and Likert-scale measurements of the variables connected to green knowledge management, environmental awareness, and green growth. The pre-test involves the questionnaire given to a small respondent sample group to confirm clarity, relevance, and honesty.

Scale development

"Green knowledge management is taken from the study of (Khan et al., 2024). Five items are "Employees and partners at our organization have easy access to information on best-in-class environmentally friendly practices", "Our organization has

procedures in place to gain knowledge about the environmental practices of our competitors, suppliers, clients, and strategic partners", "Our organization has structured mechanisms in place to exchange best practices across multiple disciplines of business operations", "Our organization develops initiatives (such as seminars, periodic meetings, and collaborative projects) that promote green information exchange across divisions/stakeholders" and Our organization actively engages in processes that apply knowledge to solve new challenges across organizational departments and beyond departmental boundaries".

"Environmental awareness was adopted from the research of (Polas et al., 2023). Six research items are "The top managements of the enterprise attach importance to the impact of relevant environmental laws and regulations on the enterprise", "The top managements of the enterprise attach importance to the adverse effects of the production and business activities on the environment", The top managements of the enterprise attach importance to understanding and mastering environmental protection measures", Business environmental initiatives are of little benefit to my company", "There is currently no commercial benefit to my company in having an environmental policy" and "It is unclear what represents "best practice" in environmental performance".

"Green innovation also was taken from study of (Polas et al., 2023). Six items are given as "The enterprise adjusts its business practices or operations to reduce the damage to the ecological environment", "Although the government does not require, the enterprise still takes environmental remedial actions", "The enterprise adjusts its business practices or operations to reduce wastes and emissions", The enterprise adjusts its business practices or operations to recycle non-renewable raw materials, chemicals and components", The enterprise reduces the use of traditional fuels by the substitution of some less polluted energy sources", and "The enterprise adjusts its business practices or operations to reduce energy consumption".

Software tool

SmartPLS is for its reserve and user-oriented operation. Therefore, it is considered a user-friendly and intuitive interface. It is a flexible kind of software that researchers can utilize, as they may not have a long experience using statistical software or SEM techniques (Collier, 2020). Considering the real difficulties of doing research in a developing country setup and the need for user-friendly data processing, SmartPLS will be a simple solution for anyone to use. SmartPLS applies the PLS method, a powerful algorithm for structural models with multiple latent effect variables and observed indicators. SmartPLS enables the specification of the structural and measurement models all in one and simultaneously proves the validity and reliability of constructs while exploring the interconnections of relationships among constructs (Collier, 2020).

Results and Discussion

Reliability and Validity

Constancy represents the determination or constancy of measurement during the multiple of sustainment or viewing. In psychometric assessment or questionnaire construction, we have reliability as the amount of every item reliably and consistently measures the underlying construct the test wants to measure. Reliability refers to measures such as Cronbach's alpha and composite reliability (Sürücü & Maslakci, 2020).

Cronbach's alpha is a well-established coefficient for evaluating consistency accuracy (Izah et al., 2023). It measures items' constant within a scale or questions' correlation with each other. Cronbach's alpha runs from 0 to 1, interpreted as higher values, and found that internal consistency is stronger. On average, a Cronbach's alpha value of 0 will generally indicate. Of note is that the threshold of 70 is counted as the acceptable limit in research, and, in some specific cases, researchers may prefer the threshold of 0. Both cases can be useful and will meet the needs of different research purposes. However, more precise signs could be useful if optimized under stricter reliability standards. Composite reliability is an internal consistency coefficient indicator usually found in structural equation modeling (SEM) and confirmation factor analysis (CFA) (Fu et al., 2022). Like Cronbach's alpha, composite reliability aims to identify the level of agreement among all the scale items within. In the present study all variables have Cronbach's alpha and Composite reliability more than recommended value (0.70). (See Table 1 & Figure 1).

The close relationship between the idea of validity and precision of measurement instruments is that they approximate rightly what they are supposed to measure. Because of this, test validity measures whether the tests effectively measure the instruments they purport. Content validity is the fairness of the representative issue suggested by the content of the test tools, which determines what the construct measures. Its pertinence should be checked if the test is neutral in all the ranges or manifestations of the construct.

The average variance extracted refers to the total variance traced back to the given construct relative to the measurement error variance (dos Santos & Cirillo, 2023). Convergent validity is an interesting aspect of the scale, and the sample aims to inspect the items in a scale or questionnaire, whether converging or converging toward the construct. AVE requirements are usually determined by variables entailed in a particular research outfit and the kind of construct being assessed. On the contrary, AVE with a generally 0 threshold is more common—50 or higher. Accordingly, the underlying construct explains the share of the important case and the unimportant variation ascribed to measurement error. In the present study all variables have AVE more than recommended value (0.50). (See Table 1 & Figure 1).

Table 1. Reliability and Validity

Factors	Item SPSS coding	Items loading	Cronbach alpha value	Composite Reliability	Average Variance Extraction (AVE)
Green Knowledge Management	GKM1	0.804	0.872	0.907	0.662
	GKM2	0.804			
	GKM3	0.819			
	GKM4	0.843			
	GKM5	0.798			
Environmental awareness	EA1	0.818	0.904	0.926	0.676
	EA2	0.788			
	EA3	0.848			
	EA4	0.863			
	EA5	0.852			
	EA6	0.757			
Green innovation	GI1	0.803	0.888	0.914	0.640
	GI2	0.799			
	GI3	0.826			
	GI4	0.756			
	GI5	0.792			
	GI6	0.823			

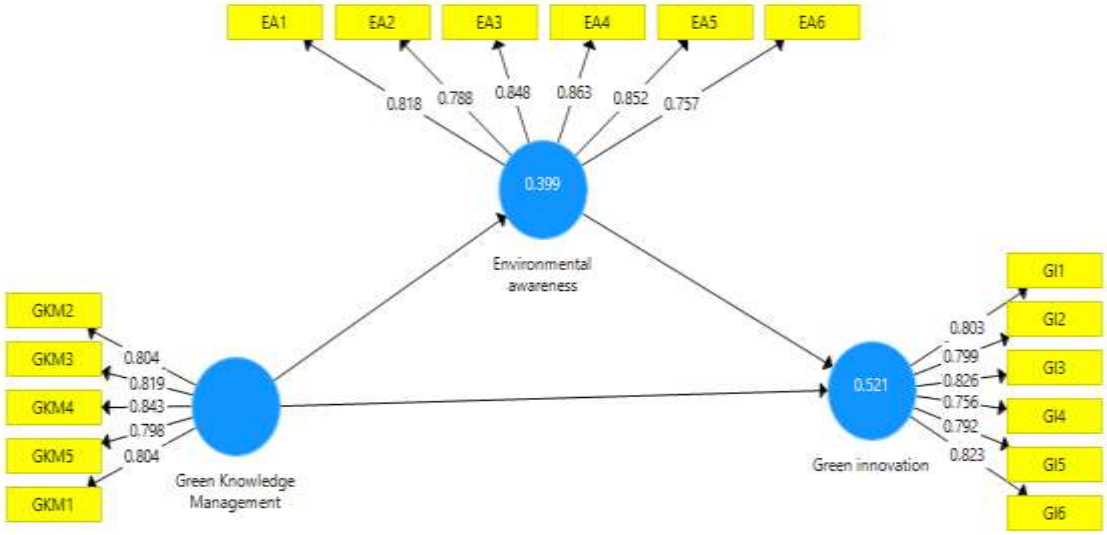

Figure 1. Measurement Model

Hypotheses Testing and Discussion

H1, the relative effect between green knowledge management and green innovation is 0β. 0.375. This clearly shows the two variables' increasing and much higher connection points. The standard deviation of 0 stands for the exact duplication of values. This stated that balance exists generally. The t-value of 7.288 the determination that a relationship is significant at a very high level of confidence (See Table 2 & Figure 2). As a result, it confirmed that green knowledge management has a positive and crucial impact on green innovation for food production industries. The facilitating role of green knowledge management in green innovation is clear. Thereby, the institutions that pay attention to and invest in green knowledge transfer and application have higher chances to engage in sustainable innovation initiatives that contribute to environmental sustainability (Duque-Grisales et al., 2020). This fact correlates with the results of former studies where the significant role of media and human resources in developing sustainable environments and innovations is mentioned (Awwad Al-Shammari et al., 2022).

H2, the path coefficient between green knowledge management and environmental awareness becomes 0.631. The positive sign showed that environmental information management contributes to raising environmental consciousness. The t-value of 18.993 is the trial e value for the statistical significance (See Table 2 & Figure 2). This finding showed that for the members of employee communion in food supply chain SMEs, environmental knowledge management practices were one of the essential factors for them to evolve their environmental consciousness. Past study confirmed that the green knowledge management is a concept that coincides with environmental consciousness to enable the knowledge creation system to preserve environmental sustainability (Al-Omoush et al., 2022). It is a process where a mix of gathering, circulating, and using knowledge and information is done to avoid the environmental impacts instead of being sustainable and being the cornerstone for environmental information management; such interrelations imprecise the business's environmental impact. It is suggested that the green knowledge management implies correct data gathering, processing, and sharing of environmental information

for the leaders to make relevant, sustainable decisions and the green campaigners to know current situations (Al-Omoush et al., 2022).

H3, Green innovation and environmental awareness have a b-path coefficient of 0. 424. This manifests a tight union between the two of them. The standard deviation of 0 shows no spread or dispersion in these data. The t-value is 9.090 (See Table 2 & Figure 2). The discovery affirmed that environmental knowledge affects green innovation in a positive and significant way. The result showed that workers more aware of environmental issues are more likely to participate in green innovation activities through small- and medium-sized supply chain food businesses. On the other hand, environmental consciousness frequently serves as a spark, encouraging the reproduction and creation of fresh technological inventions, products, and processes that address environmental impact concerns and promote sustainability (Kohli et al., 2024). Another past study recommended that the eco-innovation could alter this by boosting cost-effectiveness through better resource management, less waste, and energy conservation (Janahi et al., 2021). Therefore, companies introduce new technologies and processes rather than simply altering old ones as they can minimize their impact on the environment and make greater profits than was possible before the innovation (Tohănean et al., 2020).

H4, the path coefficient of green knowledge management and environmental awareness green innovation beta value revealed 0. 268. This showed a positive relation between the two factors, although the coefficient is smaller than the direct relationships. The t-value of 8.433 showed that the relationship is significant in the statistical position (See Table 2 & Figure 2). This result demonstrates that green knowledge management indeed becomes one of the criteria for green innovation at the level of a partially mediating process. It implies that green knowledge management involves environmental awareness, which explains to green innovation in food supply chain SMEs. A past study suggested that the sustaining environmental green knowledge management needs the facilitation of passing over environmental knowledge via dissemination and nurturing a sustainable culture of environmental awareness (Khuc et al., 2023). People becoming aware of environmental challenges subsequently synchronize demand for green innovations by providing information about environmental projects and creating a market space for green solutions. Lastly, a recent study recommended that the innovation in green technology combines green knowledge management and environmental awareness to establish new products, technologies, and ways of functioning that build on knowledge sharing, support sustainability, and address ecological issues much better (Yin & Yu, 2022).

Table 2. Direct effects and Indirect effect

Paths	**Value of Beta**	**Standard Deviation**	**T-Value**	**Remarks**
Green knowledge management-> Green innovation	0.375	0.051	7.288	Supported
Green knowledge management-> Environmental awareness	0.631	0.033	18.993	Supported
Environmental awareness-> Green innovation	0.424	0.047	9.090	Supported
Green knowledge management -> Environmental awareness -> Green innovation	0.268	0.032	8.433	Partial mediation effect

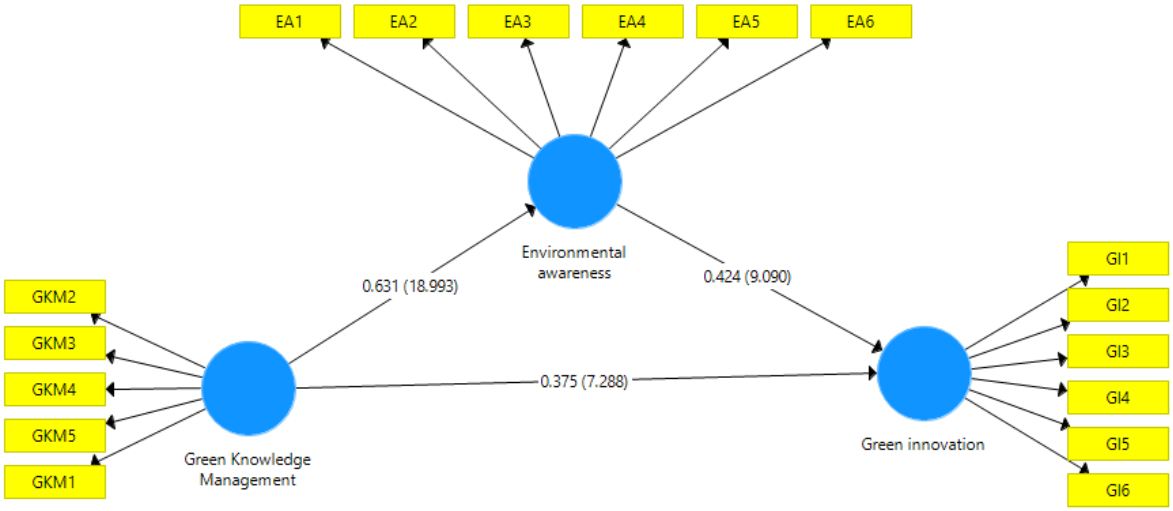

Figure 2. Structural Model

Conclusion

The present research evaluates how green knowledge management influences green innovation in SMEs of the developing country's food supply chain. Further, the research investigated the possible mediating effect of environmental awareness on this equation. The study resulted in the fact that for each hypothesis, there is supporting evidence that proves meaningful links between the variables examined. The result shows that green knowledge management positively impacts greener techniques and eco-consciousness. Besides, it is perfect that environmental awareness is recognized as one factor that encourages green innovation. Besides, green knowledge management helps green innovation take place through awareness of

the environment. Research uncovers that green knowledge-sharing practices not only result directly in green innovation but also impact it indirectly since they motivate environmental awareness among individuals and organizations. Overall, such a performance can contribute to better green innovation.

Practical implication

The study emphasizes that organizations should strategize and adopt efficient management of green knowledge know-how just like any other strategy in managing the organization. A sense of ownership should allow SMEs to amass, systematize, and transmit pertinent knowledge about green practices and innovations in the food chain. This can be done by setting up knowledge-sharing platforms, training sessions, and cooperation with key actors. The study results consider the importance of all the key figures within the organization, such as employees, managers, and stakeholders, to improve environmental consciousness. SMEs can put money into creating more of these types of events by conducting training workshops, holding workshops, and participating in educational programs. Individuals will understand better the connection between their behavior and the negative environmental impact, and they will also understand more about green practices. The study also reveals the absolute bind between green knowledge management and innovation. SMEs should create a standard that celebrates and rewards inventions, especially considering sustainability. Through actions such as resource provision, setting up motivational schemes, and giving support to staff to implement environmentally-friendly solutions and ideas, one can achieve this.

Theoretical contribution

The present study researching the influence of green knowledge management on green innovation in food supply chain SMEs in a developing country, with environmental awareness as a mediator, makes a significant conceptual advancement by focusing on applying the Theory of Planned behavior (TPB) to this context. TPB remains an established theoretical model that examines the interplay of different variables influencing consumer choices and behaviors. By employing TPB as the tool of this study's research, the model starts with the identity of the outlining mechanism of green innovation in the food supply chain.

Secondly, the paper establishes a theoretical basis from which the hypothesis is confirmed during the study. Results show that green know-how plays a significant role in environmental awareness and innovation, and environmental awareness of green innovation is positive. Furthermore, the study advocates for environmental awareness to mediate the relationship between green knowledge management and green innovation. So, this study enlarges the current vision of the TPB by exploring it in the narrow level of green knowledge management and green development in food supply chain SMEs of a developing country. However, the results are not limited; instead, they accentuate green knowledge management's crucial role in the green innovation process. Through the combination of green knowledge management with the TPB framework, the study tries to illustrate that not only is knowledge related to green innovation important, but disseminating knowledge and making it utilize it is as well. This elucidates the role of knowledge management strategies by outlining the role of knowledge management practices as a key pathway for developing food retail on a sustainable basis and fostering organizational innovation.

In addition, the paper's interplaying role of environmental conscience deepens the theory even more. This implies that we should pay attention to the ecological consciousness part of green knowledge management, which yields real and useful results in green innovation. These results supplement the TPB concept, emphasizing the role of people's knowledge and their perception of environmental problems that determine their intentions and behaviors toward green innovations. It aspires to create strong environmental awareness through educational ventures, providing professional training, and organizing awareness campaigns to improve the level of green innovation related to the food supply chain.

Limitation and Future direction

Firstly, the study base is a specific developing country, so it may not represent the complexity of diversity that exists in various countries in different settings. In future research, the number of developing countries could increase, or the investigation could be made to compare with some other regions to reinforce the findings' applicability.

Secondly, the obtained results are based only on a specific sample size. Therefore, a broader range of the population may not be represented. In the next studies, it is also necessary to use a larger sample size and respondents who are from different sectors. This would address the bias issue and be generalizable to many more business organizations other than the targeted ones.

Another important aspect is that the current study is based on a cross-sectional design, providing information about the relationship between variables at a specific time. Next, research may use more robust approaches, such as longitudinal and experimental designs, that assess the process and reason for the impact of green management, knowledge, and awareness of green innovation across time.

Besides that, green knowledge management was found to be the undercover factor of the ecosystem, which was operated by the mediate. Nevertheless, it is possible that missing mediators vary this process and can escape our attention in the present work. For future research to be complete, it has to look at other probable moderating variables, such as the company's culture, leadership, or the person's motivation, and provide a wide understanding of the relationship between them.

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