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Impact of environmental training, awareness, and green values on sustainable food waste management

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With increasing concerns about food waste and its environmental impact, environmental training (ET) is important in improving waste management practices in businesses. Despite its significance, its impact on sustainable food waste management behavior (SFWMB) has received little attention, especially considering the effects of environmental awareness (EA) and green values (GV) in the food sector. To address this knowledge gap, our research investigates these relationships using the theory of planned behavior and the elaboration likelihood model as theoretical frameworks. Analysis was conducted using SMART PLS 4 and structural equation modeling on responses to a survey of 286 fast-food restaurant employees and their supervisors. Our data indicate that ET has a significant impact on SFWMB and this effect is mediated by EA. ET fosters EA by improving cognitive abilities and information, leading to the adoption of ecologically friendly behaviors. Furthermore, a significant increase in GV reinforces the relationship between ET and SFWMB, indicating that this relationship is more prominent among employees who adhere to strong GV. Finally, the Importance–Performance Map Analysis indicates that although ET is highly important for SFWMB, it exhibits low performance. These findings have important implications for businesses, particularly those in the food industry, that are working to improve their waste management practices. Investments in ET can help businesses improve their reputation, reduce their environmental footprint, and contribute to a more sustainable future.

Keywords Environmental training, Environmental awareness, Sustainable food waste management behavior, Green values, Theory of planned behavior, Elaboration likelihood model

In recent years, the food industry has grown in importance, affecting global resource consumption patterns, with fast-food restaurants playing a critical role[1]. The rapid growth of the fast-food industry is driven by the increasing demand for convenient dining options, which is influenced by variables such as time constraints, shifting eating patterns, and economic factors[2]. Fast food has become a popular choice in today's fast-paced, budget-conscious culture due to tempting marketing such as discounts and special offers[3]. This change reflects the evolution of the food industry and its economic significance.

Fast food, despite its convenience, quick service, and affordability, significantly impacts the environment, primarily due to food waste[4]. Modern practices associated with the production of fast food have given rise to a variety of ecological concerns, such as land degradation, water resource depletion, increased greenhouse gas emissions, deforestation, and biodiversity loss[5]. This environmental impact is increased further by the significant food waste caused by fast food places, with a considerable concentration in smaller restaurants with specific customer profiles and operational procedures[6]. Improper behavior towards food waste management not only

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contributes to greenhouse gas emissions but also results in the waste of natural resources such as water and land, all of which are required for food production[7,8]. Additionally, inappropriate food waste management not only threatens human life and the environment by emitting dangerous compounds Kumar, Sharma[9], but it also contributes to climate change by creating methane gas, a potent greenhouse gas[10]. In developing countries, ineffective waste management practices result in economic losses and suboptimal resource utilization[11]. In light of these obstacles, Kharola, Ram[12] have drawn attention to the intricate nature of attaining effective food waste management, hence contributing to the difficulties encountered in wider sustainability initiatives. Wakefield and Axon[13] identified a fundamental challenge, including lack of knowledge and awareness, as major hurdles to encouraging sustainable behavior. This ongoing debate is on whether this apparent lack of understanding significantly hinders individuals from making well-informed decisions regarding decreasing food waste. The prominence of concerns regarding excessive packaging, rooted habits, and cultural norms contributes to the complexity of the intellectual discourse[14]. External factors, such as the costs associated with garbage pickup, are also topics of dispute, raising concerns that they might hinder waste reduction initiatives[15].

In response to these environmental challenges, significant efforts have been devoted to investigating and promoting sustainable waste management behaviors. These efforts aim to efficiently reduce the negative environmental implications of present waste management procedures[16–24]. However, to tackle the urgent problem of food waste in the fast-food industry, this research highlights the significance of incorporating environmental training as a core component of responsible HR practices[25]. Despite its significance, there has been a scarcity of empirical research on the SFWMB in response to environmental training, particularly in the context of fast-food restaurants[26]. Moreover, eco-friendly practices, including waste reduction, energy efficiency, sustainable ingredient procurement, responsible water usage, and regulatory conformance, are essential for training both staff and management in fast food restaurants through environmental training, whereas these are least focused, resulting in deterioration of environmental conditions and enhancement of greenhouse gases. Research conducted on these grounds, emphasizing such practices in developing country's context, is a valuable contribution to the scientific community since most of the developing countries, like Bangladesh, India, Pakistan, and Indonesia, are all facing similar challenges with regard to sustainable waste management practices. Such research can be generalizable to a huge population of developing countries providing greater guidance to manage fast food businesses' environmental impacts on society. The research suggests that training equips employees with the requisite knowledge and skills to enhance overall sustainability efforts and mitigate environmental influences[27,28]. However, the impact of environmental training on the environmental challenges associated with food waste management in fast food settings has been frequently disregarded in the prior literature especially in the said context[29]. Therefore, the primary objective of this research is to ascertain the impact of environmental training on SFWMB in the fast-food industry in a developing country's context.

The second key objective of this study is to recognize the critical need for a mechanism, as demonstrated by the conceptualization of environmental awareness, to bridge the gap between ET and SFWMB, which is becoming increasingly evident in our efforts to address ecological challenges[30]. Environmental training equips individuals with knowledge of the environmental impact of their actions, nurturing a sense of responsibility toward sustainable living. However, this knowledge may not be sufficient for establishing concrete change[31]. Environmental awareness works as a bridge between the theoretical knowledge acquired through training and its practical application in developing food waste management behavior[32]. It helps individuals internalize the significance of sustainable food practices, encouraging them to reduce food waste by making conscious decisions and implementing responsible consumption practices.

Furthermore, scholarly research indicates that ET not only serves as a predictor of SFWMB but also works synergistically with employees' GV[33]. ET works as a catalyst for communicating information and developing understanding regarding the ecological consequences associated with food waste[34]. However, the practical application of this understanding is greatly influenced by the GV held by employees[35]. Those, who value environmental perception and sustainability are more likely to integrate the GV taught in ET, resulting in a closer alignment between information acquisition and practical application in SFWMB[36]. GV, therefore, serves as a guiding principle that enhances ET's influence in molding employees' mindsets and behaviors regarding sustainable food waste management. The dynamic relationship among these elements underscores the significance of imparting ET but also acknowledging and relying on employees' GV to optimize the efficacy of endeavors seeking to promote sustainable practices in food waste management.

Theoretical disposition

This research makes substantial scholarly contributions to the growing field of environmental sustainability in the food industry, particularly concerning fast-food establishments located in a developing country, by applying the theory of planned behavior (TPB) and the Elaboration Likelihood Model (ELM). This research delves into the impact of environmental sustainability at the organizational level, particularly emphasizing its growing significance. According to TPB, the study shows that fast-food restaurants can improve their food waste management procedures by implementing ET. This dual-theory approach enhances our understanding of how organizational behavior aligns with environmental sustainability goals in the fast-food sector and provides actionable insights for businesses seeking to improve waste management through ET. The cognitive TPB is largely based on human intentions. Personal attitudes, subjective norms, and perceived behavioral control are among the variables used to predict behavioral outcomes[37]. As employees become more aware of the organization's commitment to sustainability, training them on sustainable practices not only improves their attitudes towards environmentally responsible behavior but also reinforces their understanding of subjective workplace norms[38]. Furthermore, this training program enhances employees' perceived behavioral control, equipping them with the required confidence and abilities to effectively execute approaches for reducing and managing food waste[39]. Consequently, these changes align with environmental goals, effectively demonstrate the organization's

dedication to sustainability, and hold the potential to decrease operational expenses by implementing improved waste management techniques[40].

Another important contribution of this study is the ELM analysis of central route processing in the context of environmental awareness (EA) as a mediating mechanism between ET and SFWMB. Psychologists Petty, Cacioppo[41] created the ELM of persuasion to explain how people make sense of information and how attitudes evolve. ELM has central and peripheral persuasion channels. This study examines central route processing because ET is a powerful message that encourages employees to think critically. This central route processing helps workers grasp environmental challenges, especially fast-food waste management[42]. Smart training content design can create EA, which can lead to SFWMB[20]. This phenomenon is a cognitive transition in which employees recognize the ecological impacts of their actions, generating accountability and personal significance to change their workplace behavior.

Strategically creating and conducting an ET program to raise EA is another food industry managerial obligation. This program should raise environmental awareness and teach staff about SFWMB. By emphasizing the connection between individual activities and the environment, the training program can raise employees' EA. Interactive workshops, instructional materials, and real-life examples can help employees understand food waste's environmental impact and the importance of sustainable behavior. Employees may adopt greener food waste management methods due to the training program's increased EA. Green values (GV) may have a big influence, so it's important to foster a company culture that prioritizes sustainability and EA. This can be done by infusing environmental ideas into mission statements, values, and strategic goals. To promote green concepts throughout the organization, HR managers should emphasize environmental stewardship in employee communication, training, and performance evaluations[43]. A supportive environment that motivates and empowers personnel to apply ET to their daily tasks will help management promote SFWMB. HR policies and practices must reflect green ideals to promote sustainability consistently. HR managers must include eco-friendly ideals in policy, performance appraisals, and staff reward programs[44]. This fosters sustainability and improves environmental training with trash reduction.

Additionally, drawing on TBP, the study aims to evaluate the moderating effect of GV between the relationship of ET and SFWMB. As TBP concentrates on the influence of attitudes, subjective norms, and perceived behavioral control on individual behavior, the TPB is a suitable theoretical framework for this investigation. Individuals are more likely to demonstrate pro-environmental activities when their attitudes, subjective norms, and perceived control are positively changed, according to the TPB[45]. Employees with strong GV, indicating a profound commitment to environmental sustainability, are likely to enhance the influence of ET on their intentions and actual behaviors linked to SFWMB[46]. Their principles serve as a reinforcing catalyst, increasing the effectiveness of ET and leading to a deeper integration of sustainable practices into business culture[47]. This alignment, which is backed by the TPB, not only emphasizes the importance of integrating employees' values in training activities but also underlines the possibility of a synergistic relationship that develops long-term environmentally responsible behaviors.

Environmental training methods and interventions

Research has shown that effective environmental training methods include by not limited to interactive workshops, gamification techniques, hands-on sustainability projects, and continuous feedback mechanisms[48]. For example, interactive workshops help employees internalize sustainable behaviors by engaging them in real-world problem-solving scenarios. Gamification, such as reward-based incentives for reducing waste, has also been identified as an effective tool in engaging employees and reinforcing sustainable behaviors[49]. Additionally, implementing behavioral nudges, such as visible signage and eco-friendly reminders in the workplace, further enhances the impact of training[50].

While past research has primarily focused on manufacturing and large-scale food production, studies have indicated that similar interventions can be adapted to the fast-food industry to instill a culture of waste reduction and sustainability[51,52]. These studies expand upon these findings by investigating the direct impact of environmental training and green values on SFWMB in fast-food settings, filling a critical gap in the literature.

The relationship between environmental training & sustainable food waste management behavior (SFWMB)

According to TPB, individual behavior directly describes, by its very nature, how the performance of that behavior has every intention of influencing said behavior, which is then shaped by attitudes toward subjective norms and perceived behavior control[37]. Placed in the context of SFWMB, environmental training would be a tool that could deliver change; it would equip individuals with the knowledge and skills needed to change the working methods toward sustainability[53]. Environmental training cannot be inborn; it can develop with deliberate and focused attempts. The significant role played by ET in fostering a culture of sustainability, especially in food waste management, cannot be gained. It can be accounted for within the theoretical framework given by Ajzen[37] TPB, through which the individual attitudes, subjective norms, and perceived behavioral controls toward SFWMB are molded by the mechanisms of ET. It means that ET has highly instigated attitudes toward sustainability. The study conducted by Wang and Katzev[54] underscored the positive attitude change towards the pro-environmental actions brought in by ET. This transformational change is further sensitized by the insights drawn from Al Mamun, Prasetya[55] on how ET embeds responsibility and accountability towards the planet. The influence of ET goes beyond personal attitudes, touching on the effect of subjective norms. An educational intervention presents to individuals the social expectations of food waste sustainability. Arvola, Vassallo[56] further argue that this further entrenches the forces from within the norms that guide behavior within social networks. Such kind of ET helps define acceptable and commendable behavior in the context of food waste management.

Perceived behavior control is another core element based on the TPB. Training empowers; it does not only inform. The empowerment, in terms of stress, leads to a greater propensity for sustainable behavior, as people feel more equipped and capable of managing food waste sustainably[57,58]. The synergistic effect embodies an enhanced attitude, stronger subjective norms, and increased perceived behavioral control in direct relationships with ET and SFWMB. This relationship based on TPB reveals to us that ET holds the power for great transformation[59]. It is not just about equipping the individual with knowledge but igniting an all-round transformation in how human beings perceive and relate to their environment. These trainings are not learning experiences but sustainability campaigns that open the doors for society to become more responsible and aware of their environment. Altogether, SFWMBis complicated and multifold; however, the strategic application of ET based on the TPB would make it transparent and fair. It is a testament to the power of education in molding not just minds but behaviors toward a more sustainable future. Hence, we present the following hypothesis;

H1 *Environmental training positively influences sustainable food waste management behavior.*

The relationship between environmental training & environmental awareness

Environmental training is integral to enhancing environmental awareness, acting as a catalyst for the development of informed, sustainable behaviors. It provides a structured approach to deepen individuals' understanding of environmental issues, enabling informed decision-making and fostering significant behavioral shifts towards sustainability[60]. Environmental awareness's effect is at the epicenter of its influence on cognitive processing through the central route of the ELM. Following this model, the central route produces deliberate and reflective information processing, which brings about[41]. It involves structured scrutiny of the information in ET that improves understanding to fully comprehend the outcome of ecology, such as those related to food wastage. Structured ET programs assist individuals in discerning the interconnectedness of human activities, ecological issues, and the wider environment. The ELM's central route promotes a comprehensive understanding by facilitating the accumulation of knowledge and ethical reflection necessary to effectively apply sustainable behaviors (Darling-Hammond et al., 2019). It establishes a foundation where environmentally friendly behaviors are not merely adopted superficially but are ingrained through transforming attitudes and perceptions. It highlights the transformative role of information processed via the central route, underscoring its importance in fostering an ecologically conscious professional community[61].

The relationship between ET and EA is significantly tilted toward methodological and deep cognitive processing expounded by ELM's central route. This systematic approach will ensure that the training will enhance knowledge and develop a responsible, ethically reflective professional who can make informed decisions in promoting environmental sustainability. It strengthens the critical requirement that findings regarding precisely such a structured ET program, emphasizing the training of depth rather than the training of breadth, be put forth so that sustainability can come through informed and conscious decision-making, leading to the following research hypothesis.

H2a *Environmental training positively influences the environmental awareness.*

The relationship between environmental awareness & sustainable food waste management behavior

Food waste is one of the things that needs an increase in EA for sustainability (Parizeau et al., 2015). ELM is a daunting attempt to propose a more integrated theoretical framework for researching the influences of EA on individual attitudes and behaviors toward sustainability in food waste. The primary motivation is that comprehensive and elaborate knowledge about environmental issues would improve awareness[42]. This increased consciousness is supposed to provoke extensive reflection on the ecological consequences food waste can bring and raise a sincere commitment to environmental sustainability.

An individual will apply central route processing of the ELM, where he or she will be engaged in thoughtful, analytic information processing, manifested by a robust and enduring intention to adopt the sustainable practice of managing food waste. In this way, what is emphasized is that inner cognitive efforts are integral in bringing about much more stabilized and enduring changes in behavior than external influences[62]. While the peripheral route of the ELM also plays a role by leveraging external, ancillary factors like social norms and peer pressure, it typically induces changes with minimal cognitive engagement, often resulting in less durable behavioral modifications[63]. However, the focus remains predominantly on the central route, where the depth of information processing and quality of cognitive engagement are crucial. The central route highlights the need to increase EA by carefully analyzing and processing information about the environment. It can also significantly enhance people's attitudes toward adopting sustainable practices for managing food waste[64]. It efficiently entails implementing specific educational messages, initiatives, and community-driven activities to improve comprehension and actively involve individuals at a cognitive level[65].

The ELM provides a critical view toward understanding the complex dynamics in consideration of the determination of EA and sustainable behavior in managing food waste. It points to why the interventions need to be designed so that cognitive processes and external influences can be effectively highlighted. Therefore, key that this intervention be designed to raise behavior change given sustainability and ensure the behavior reflects a deep understanding and genuine care for sustainability. Based on such arguments, we propose the following hypothesis.

H2b *Environmental awareness positively influences sustainable food waste management behavior.*

The mediating role of environmental awareness between the relationship of environmental training and sustainable food waste management behavior

From the food industry perspective, one of the basic approaches that could be taken to maintain sustainability in managing waste is training on the environment. Under the central route of the ELM, the program would help develop higher sensitivity levels toward environmental concerns among professionals[66]. The primary pathway of the central route is to undergo deep cognitive processing, ensuring the individual gets the correct information on the environmental reflection of food waste and its consequences[67]. Increased cognitive involvement enhances their understanding and appreciation of sustainable techniques, resulting in continual and consistent behavior change in food waste management[68]. In considerable measure, responsibility becomes one of EA, translating this information and the ethical gains from ET into practical activities that would be sustainable within the sector. Therefore, it is drawn from this hypothesis that training affects behavioral change, encouraging the adoption of more sustainable techniques in managing food waste through increased environmental awareness.

H2c *Environmental awareness mediates the relationship between environmental training and sustainable food waste management behavior.*

Moderation of green values

Green Values, reflecting the intrinsic commitment to ecologically responsible operations, play a pivotal moderating role in the relationship between ET and SFWMB. These values encompass the ecological benefits derived from sustainable practices and the social and economic advantages that contribute to long-term business success and resilience[69]. ET in the food industry provides personnel with essential knowledge and skills about the environmental effects of their actions, such as controlling food waste. This training is intended to alter attitudes and deepen the understanding of the impact of unsustainable action[70]. However, this kind of efficacy for this training turns out to be much more effective when people have strong GV in them. These values inspire the implemented knowledge of acquired training, thus motivating individuals to integrate practical activities and sustainable practices in the activity and decision-making process[71].

According to the TPB, individual SFWMBis a function of attitude toward behavior, subjective norms, and perceived behavioral control[18]. These GV help underscore the findings of ET—i.e., they increase the impact of positive attitudes on and alteration of subjective norms for environmentally sensitive practices. It means that high-scorers on the GV are likely predisposed to the training and act on their environmental beliefs, including ethical treatment regarding food waste. Therefore, Green Values' moderating role is critical[71]. By enhancing the connection between the knowledge acquired from ET and its application, GV ensures that the training's impact on SFWMB is profound and enduring. This moderating role is essential for maximizing the effectiveness of ET programs, making it crucial for organizations in the food industry to cultivate and reinforce these values among their employees. It provides a comprehensive examination of how GV can significantly influence the effectiveness of ET in promoting SFWMB.

H3 *Green Values moderate the relationship between environmental training and sustainable food waste management behavior.*

Methodology

Participants and procedure

Data for this time-lag, two-wave study was gathered from Pakistan's "Fast-Food" industry. This includes the enterprises that are involved in the supply, distribution, preparation, and processing of food items. The food industry was chosen because of its extensive food waste that results in serious environmental issues and biodiversity loss[72]. Another important factor was the food industry's significant role as an operational constituency in enhancing the nation's economic growth, necessitating a critical evaluation, improvement, and control of its environmental management procedures. These sectors attract much government attention due to their significant economic contributions and job possibilities[73]. A particular criterion was used to identify and include the targeted firms.

First, only fast-food restaurants that engage in environmentally friendly operations and are regarded as socially responsible were allowed to join. Second, the study encouraged and permitted participation from those with at least 1–2 years of exposure to green practices. The social and ecological activities information that could be found on websites and other secondary data sources was used to select the sampled firms. This information showed that the firms were following green organizational/social policies and that their staff members were knowledgeable about the associated ideas and practices, which aligns with previous research on employee behavior and social responsibility[74]. To confirm that these companies are engaged in eco-friendly and sustainable operations, we also reached out to senior executives and HR managers.

Organizations that satisfied the aforementioned conditions were disseminated copies of the self-administered survey questionnaire along with a cover letter outlining the study's objectives, the voluntary nature of participation, the confidentiality of the data collected, and the implications of returning a completed survey as confirmation of participation. Using a field survey team to assist, the research used a convenience sample strategy to collect data. Employees and their direct supervisors were the two sources of data that were gathered in two phases. Employees' demographics and information about their awareness of environmental issues and GV were requested in the first round. Data about their employees' training and SFWMB were asked from the managers and supervisors in the second round. This strategy was implemented to avoid common method bias due to single data source. Data collection for the first and second rounds was conducted at a time interval of 20–25 days apart. This study will stay cross-sectional as little is anticipated to change in the next 20–25 days[75]. In phase 1, three ways for data collection were applied, i.e., electronic mail, referrals, and hand delivery; a total

of 650 questionnaires were issued, with about 450 participants reverting back to filled questionnaires. However, in the second phase, 318 surveys were returned by supervisors, significantly above our required sample size. The researchers were able to associate the data from the surveys of employees and supervisors by finding one person with the same name or job code on both the employee and supervisor surveys. Accordingly, 286 employees' replies were included and used for the study, because they met the respondents' standards and were complete in every way.

The overall response rate is approximately 44%, as indicated by the demographics and data-gathering findings. Of the whole employee respondents, 28% of the individuals are female and the remaining 72% are male. Twenty percent of the workforce is in the 18–23 age range, twenty-four percent is in the 24–33 age range, thirty-four percent is in the 34–39 age range, and eighteen percent is in the 40–45 age range. Additionally, a larger percentage of the workforce participants—around 32%—have master's level qualifications. There are about 26% graduates. A quarter of the participants are undergrads. Further, 74% of the participants held lower-level positions, such as junior officers or assistants and general staff. Since they engage with food preparation, developing/processing, and other operations, the majority of them (72%) were from the production/operations department, which explains their involvement in related fields. The researchers concentrated on fast food restaurants in Pakistan where green practices are more prevalent and necessary. Purchase and warehousing (20%) was, therefore, the department with the second-highest employee assessed, followed by logistics (8%).

The research questionnaire's scales were arranged in a random sequence, and the items derived from published sources were combined with the other items. Information regarding the measuring tools (or scales) used is provided in the following section to help minimize measurement errors.

Tools and measurements

We employed a 5-point Likert scale (1- strongly agree and 5- strongly disagree)to rate the items on our questionnaire, which selected all established constructs from prior research. The study adopted the Environmental Training scale from Singh, Chen [76] that comprises of 5-item scale. The items sample items used in this study are "Employees in this organization receive adequate environmental training" and "Employee in this organization get opportunities to use environment training in the job". The scale of Environmental Awareness was adopted from a 7-items instrument developed by Purwanto, Yulianto[32]. The sample items are "I am aware that food waste is terrible for the environment" and "I recognize the need for a food waste control mechanism" and "I recognize the need for a final disposal policy". The scale of SustainableFood Waste Management Behavior was adopted from D'Adamo, Desideri[72] and Luu[77], consists of 7 items. SFWMB items were measured through 5-point Likert Scale (1-To negligible extent and 5-To higher extent). The sample items are "How much food (in general) is thrown away by this employee in your work-related contexts (your lunches or work-related gatherings) of what you buy, in a regular week?" and "Do you think this employee is aware of best alternative to use waste food?" and finally the scale of Green Values was adopted from Mansoor and Paul[78]. This scale has 4 items. The sample items are "I feel a personal obligation to do whatever I can to prevent environmental degradation" and "People like me should do whatever they can do to protect the environment from degradation".

Common method variance

Statistical measures were employed in addition to a number of procedural ones, such as data gathering from two sources and by temporal separation, and other measures as previously mentioned. As recommended by MacKenzie and Podsakoff[79], Harman's test was performed to ensure that common method variance (CMV) is not a problem. Consequently, it was discovered that the first factor values accounted for 32% of the total variance, indicating that there was no CMV issue[79]. Additionally, temporal separationthat is, a 15–20-day lag in data collection between the first and second roundsensures the other endogeneity problems, like simultaneity and reverse causality[80].

As Bellemare, Masaki[81] contended that this method does not invariably resolve the endogeneity problem, we utilized a complete collinearity test to evaluate the VIFs for every variable[82]. As suggested by Sarstedt, Hair[83], the VIF value should be less than five. As indicated by the VIF scores (< 5), our results do not support the notion that multi-collinearity existed in this study, further supporting Kock[82] assertion that CMV did not pose a problem.

Data analysis

Using the program SmartPLS 4, the partial least squares structural equation modeling (PLS-SEM) approach has been used to evaluate the gathered data. The utilization of the PLS-SEM approach in social science research has significantly increased recently, as demonstrated by the publications of[84–86]. Furthermore, studies involving employee behavior, such as this one, tend to have non-normal data; in fact, it is impossible to verify the accuracy of the model specification. This is where Smart PLS comes into play. SmartPLS is known for handling violations of data normality easily[74].

Assessment of measurement model

The quality of the measurement model was evaluated by assessing its discriminant validity, convergent validity, and reliability (Sarstedt et al., 2019). The findings of the measuring model assessment are displayed in Table 1. The convergent validity criteria were satisfied by the average variance extracted (AVE) of each variable being above 0.5 and the factor loadings being above 0.7[87]. The composite reliability (CR) ratings demonstrated the internal consistency of every construct and were likewise above 0.7. According to Hair et al. (2017), all of these results demonstrated that the constructs' convergent validity and internal consistency were satisfactory. After careful analysis, two items each from ET and SFWMBthat had lower loading and were also insignificant have been removed. Figure 1 also shows the estimated analysis of the proposed model.

Variables	Items	VIF values	Outer loadings	CR	AVE
		<5	>0.70	>0.70	>0.50
Environmental training	ET-1	1.736	0.818	0.893	0.736
	ET-2	1.905	0.862		
	ET-3	1.945	0.893		
Environmental awareness	EA-1	1.795	0.719	0.889	0.540
	EA-2	1.177	0.864		
	EA-3	2.085	0.827		
	EA-4	3.044	0.842		
	EA-5	1.468	0.820		
	EA-6	2.609	0.798		
	EA-7	2.319	0.795		
Sustainable food waste management behavior	SFWMB-1	1.086	0.776	0.865	0.565
	SFWMB-2	2.219	0.736		
	SFWMB-3	2.482	0.782		
	SFWMB-4	2.738	0.865		
	SFWMB-5	1.855	0.768		
Green values	GV-1	3.405	0.899	0.907	0.712
	GV-2	3.400	0.909		
	GV-3	1.577	0.700		
	GV-4	1.880	0.850		

Table 1. Validity and reliability analysis.

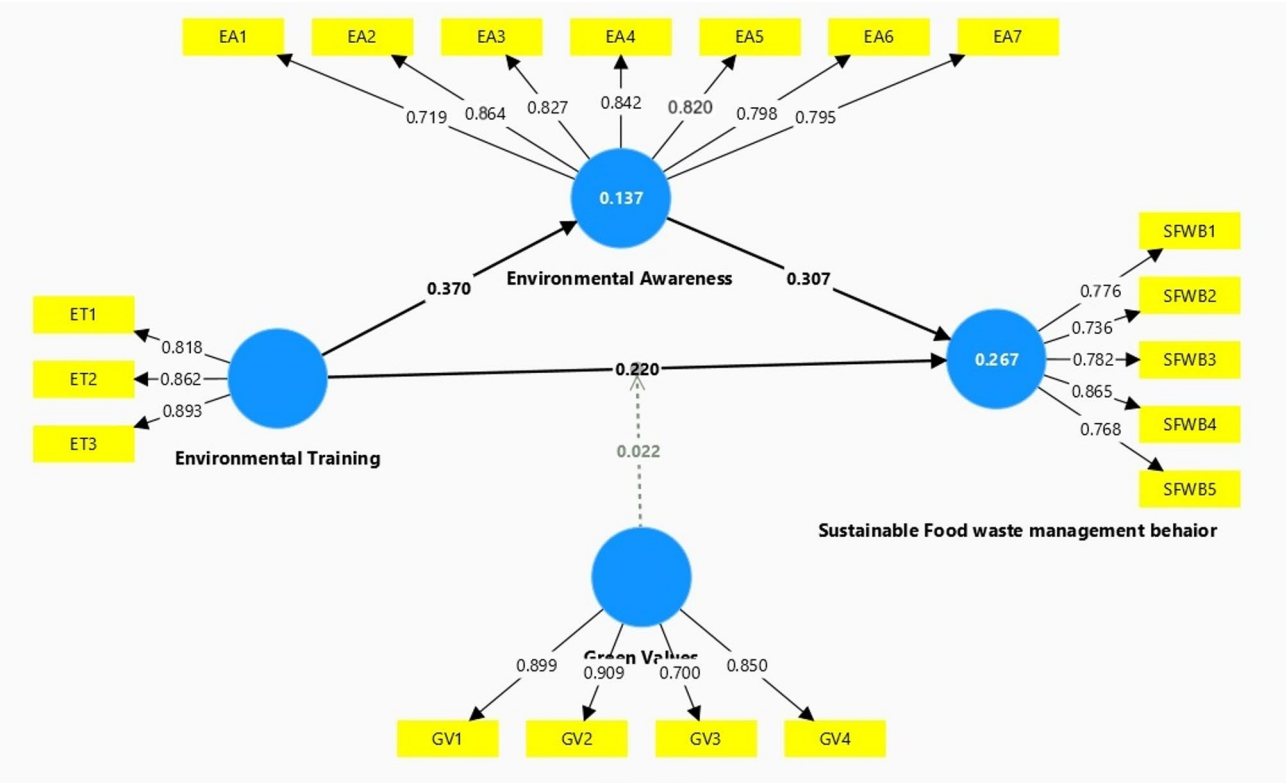

Fig. 1. Estimated analysis of proposed model.

Using the heterotrait-monotrait (HTMT) ratio of correlations technique, the discriminant validity was assessed. Table 2 presents the results and shows that every construct had HTMT ratios below the cutoff of 0.85 (Hair et al., 2019), indicating a substantial difference between the constructs. As a result, discriminant validity had been established using the measuring model. Furthermore, according to Hair et al. (2019), the

Constructs	1	2	3	4
1. Environmental Awareness				
2. Environmental Training	0.419			
3. Green Values	0.446	0.303		
4. Sustainable Food waste management behavior	0.504	0.375	0.354	

Table 2. Heterotrait-monotrait-HTMT ratio (Discriminant validity).

	Path coefficients	Standard deviation	T-value	*P*-value	95% Confidence Intervals	Decision
ET → SFWMB	0.220	0.085	3.907	0.012	{0.146, 0.475}	Accepted
ET → EA	0.370	0.069	5.370	0.000	{0.235, 0.505}	Accepted
EA → SFWMB	0.307	0.055	5.616	0.000	{0.205, 0.420}	Accepted

Table 3. Direct effects—Bootstrapping. ET, Environmental training; SFWMB, Sustainable food waste management behavior; EA, Environmental awareness.

	Direct effect	T value	Indirect effect	T value	*P* values	Confidence interval	Type of mediation
ET → EA → SFWMB	0.220	3.907	0.114	4.282	0.000	{0.069–0.173}	Complementary mediation

Table 4. Result of Mediation analysis. ET, Environmental training; EA, Environmental awareness; SFWMB, sustainable food waste management behavior.

HTMTinference results showed that none of the constructs' confidence intervals include the threshold value of 1.0.

Assessment of structural model

An assessment of the structural model was done following the measurement model's validation (see Tables 1 and 2). Path coefficients, coefficient of determination (R2), effect size (F2), and multicollinearity were all evaluated for the structural model in accordance with the recommendations made byHair Jr, Sarstedt[87,88]. The multicollinearity test findings showed that the exogenous variables' VIFs ranged from 1.086 to 3.405, all of which were below the set threshold of 5[88]. This result implies that there was no substantial reason for concern regarding multicollinearity in the current investigation. To evaluate the impact of ET on SFWMB and other relationships, a regression test was carried out. Using the bootstrapping method with 5000 re-samples and a single t-test (the relationships' direction was known). Table 3 indicates a substantial association between ET and SFWMB (beta coefficient = 0.220 and *p*-value = 0.012). Environmental awareness and training both have a strong relationship, with a *p*-value of 0.000 and a beta coefficient value of 0.370. Additionally, the study discovered a substantial association between EA and SFWMB (beta coefficient value = 0.307 and *p*-value = 0.000).

Additionally, the R-square value (R^2) for ET → SFWMB and ET → EA indicated a decent model fit with 26.7% and 13.7% variance explanation, respectively, for predictive accuracy. A second test was performed in addition to the one mentioned above in order to determine F^2 (F square values, which evaluate the contribution of individual variables to R square). F square values for moderate, strong, and low contributions should all be at least 0.02, 0.15, and 0.35, respectively. According to our findings, ET has a moderate impact on raising EA; as a result, it has a F square value of 0.157, which indicates that it is a moderately significant factor that raised R square. However, the values of ET→SFWMB = 0.56 and EA→SFWMB = 0.96 representing lower contribution to R square. (Cohen et al., 2013).

Mediation analysis

Using a bootstrapping function, the current study examined the mediating role of EA in the link between ET and SFWMB in order to assess the magnitude of the indirect effect. Since the direction of the association was known, the single t-test and the bootstrapping technique with 5000 resample were employed. The results indicate a strong indirect influence of ET through EA on SFWMB (Beta = 0.114, T value = 8.624). Complementary mediation would occur if both the direct and indirect effects were significant and pointed in the same direction[87]. The mediation analysis's outcomes are displayed in Table 4.

Moderation analysis

Table 5 displays the moderation analysis results. According to our research, there is a substantial moderating impact through path, environmental training * green values → sustainable food waste management behavior (Beta = 0.022, T value = 3.184). Our moderator was significant, with a *p*-value of less than 0.05, using a bootstrapping approach with 5000 samples in the study.

	Path coefficient	Standard Deviation	T value	Significance	Decision
ET * GV → SFWMB	0.022	0.068	3.184	0.032	Accepted

Table 5. Moderation results. ET, Environmental training; GV, Green values; SFWMB, Sustainable food waste management behavior.

Variables	Sustainable food waste management behavior	
	Total effects (importance)	Index values (performance)
Environmental awareness	0.426	75.455
Environmental training	0.521	76.289
Green values	0.217	82.321

Table 6. IPMA results.

Importance-performance map analysis (IPMA)

In addition to the PLS analysis, an importance–performance map analysis (IPMA) was used. In this context, the IPMA incorporates both the importance (total effects) and performance (index values) of the variables, thereby establishing which specific variables should be prioritized to enhance the performance of a critical target construct—SFWMB.

In Table 6, the IPMA results are summarized, and Fig. 2 illustrates these findings. Notably, environmental training (ET) was identified as a relatively high priority for sustainability food waste management behavior (SFWMB); however, it exhibited inferior performance. This suggests that initiatives to improve SFWMB should prioritize the development of environmental training practices. To enhance sustainability behavioral outcomes, this may entail enhancing investment in innovative processes, cultivating a culture of sustainability-driven innovation and increasing awareness, and aligning business practices with environmental and social responsibility.

Discussion

The crux of the study lies in harmonizing the fusion of ET, awareness, and GV that draw out a course for the SFWMB. It produces a journey grounded in the TPB constructs and enriched by the insights brought to bear by the ELM into a very different, nuanced landscape in which intentions change into actions. This study aims to fill a notable research gap by specifically investigating the impact of ET on sustainable food waste management practices in the food sector (H1). It focuses on the mediating role of environmental awareness (H2c) and the moderating effect of Green Values (H3). While prior research has extensively examined the influence of ET on sustainability, there needs to be more investigation into its effects on food waste management. Additionally, few studies have combined the TPB with the ELM to evaluate the cognitive processes involved in this context, as mentioned above. This study addresses the theoretical gaps and provides practical insights by thoroughly investigating the effective implementation of ET in business settings to promote sustainable behaviors. However, the literature lacks to define the relationship between ET and SFWMB (H1), but provides evidence on the role of EA on the pro-environment individuals molding towards the SFWMB[89]. The bottom line of ET is that it serves as a beacon to steer people through the fog of uncertainty toward seeing their role in the environmental continuum ever more clearly.

Theoretical implications

Our findings underline the pivotal role EA plays in nurturing ET[90]. It is not an academic exercise but a transformational experience that reshapes perceptions, aligns intentions with actions, and ultimately forges a deep commitment to sustainability. EA fills the gap between knowledge and action: one of the most essential catalysts of the process. The awareness, in turn, was heightened by our research and became an essential mediator in translating ET into concretely executed SFWMB. Unlike previous research primarily focused on awareness campaigns, this study empirically demonstrates that structured environmental training significantly enhances sustainable food waste management behaviors in fast-food settings.

Our research extends the findings of Ajzen[37], who highlighted the influence of attitudes, subjective norms, and perceived behavioral control on behavior by contextualizing these elements within the food industry's waste management practices. The positive changes in attitudes towards sustainability observed in this study resonate with the transformative impacts described by Wang and Katzev[54] and Al Mamun, Prasetya[55], where ET significantly altered individual and collective approaches to sustainability. Additionally, our study elaborates on the mechanism described byPetty, Cacioppo[41] in the ELM, illustrating how deep cognitive processing facilitated by ET can lead to lasting behavioral changes. By combining the TPB and the ELM, this study presents a novel framework explaining how environmental awareness mediates the relationship between training and sustainable behaviors.

Along this transformative journey, GV emerged as important moderating factor that catalyze the effect of ET on SFWMB (H3) Wang, Liang[59]. The research provides new insights into the moderating role of green values, illustrating that employees with stronger environmental values show more incredible behavioral shifts following

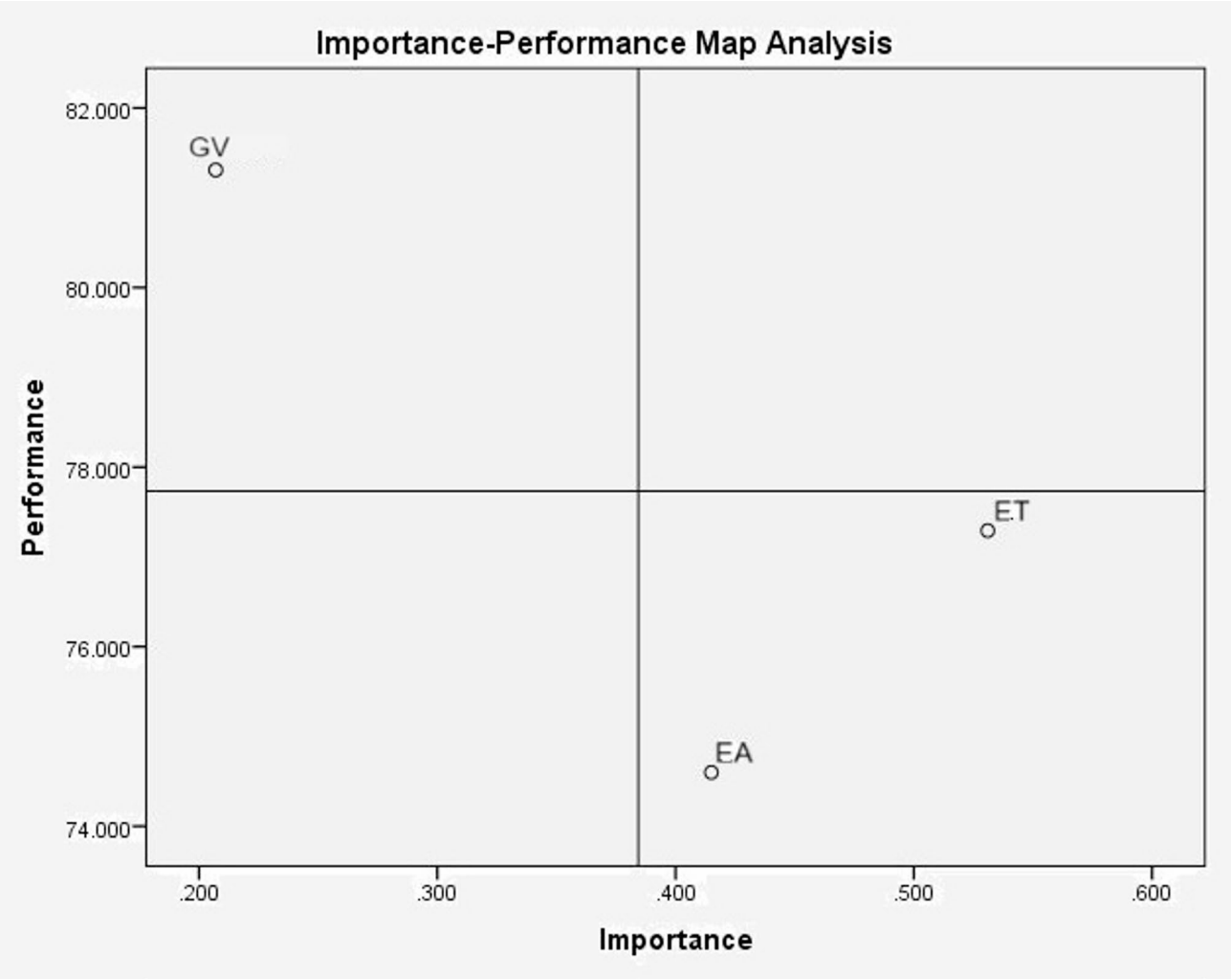

Fig. 2. IPMA Analysis for sustainable food waste management behavior.

environmental training. It means that sustainability is so profoundly inculcated in one's set of beliefs and values, shaping one's interaction with the world, that the subject of sustainability becomes a way of life rather than a set of actions. However, the GV is an untouched variable in the sustainable behavior. Yet, it concurs with the TPB in that it focuses on how subjective norms, attitudes, and perceived behavioral control deeply lay within personal values for guiding the path toward sustainability[91,92]. Our study in the dynamics of SFWMB unveils a beautiful symphony where TPB and ELM's central route converge to bring out an all-comprehensive framework for understanding the mechanisms that drive sustainable food waste management. These contributions bridge the gap between theoretical sustainability models and practical applications within food service operations, providing valuable insights for researchers and practitioners alike.

Reflecting on all these findings, the current way towards SFWMB is complex and very personal. It has to be earnest to be trained in the environment and develop the kind of society wherein EA and GV grow[93]. Therefore, it enables us, on the whole, to steer ahead towards a better future—one that is more sustainable, from well-informed action and driven by a responsible planet stewardship mindset.

Practical implications

This study has substantial practical implications for food business management. For instance, it is suggested that managers should start implementing sustainable food waste management ET programs. These programs should cover waste reduction, food handling and storage, recycling, and supply chain waste minimization. Additionally, the training programs must incorporate practical learning opportunities where employees actively participate in waste reduction projects under experienced trainers. These programs will succeed if HR managers foster a culture of continuous improvement and encourage staff to actively seek ways to boost productivity and reduce inefficiencies.

Strategically creating and conducting an ET program to raise EA is another food industry managerial obligation. This program should raise EA and teach staff about sustainable food waste management. By emphasizing the connection of individual activities and the environment, the training program can raise employees' EA[43,94]. As discussed above, interactive workshops, instructional materials, and real-life examples

can help employees understand food waste's environmental impact and the importance of sustainable behavior. Employees may adopt greener food waste management methods due to the training program's increased EA.

Green values may have a big influence, so it's important to foster a company culture that prioritizes sustainability and EA. This can be done by infusing environmental ideas into mission statements, values, and strategic goals. To promote green concepts throughout the organization, HR managers should emphasize environmental stewardship in employee communication, training, and performance evaluations. A supportive environment that motivates and empowers personnel to apply ET to their daily tasks will help management promote sustainable food waste management. HR policies and practices must reflect green ideals to promote sustainability consistently. HR managers must include eco-friendly ideals into policy, performance appraisals, and staff reward programs[95,96]. This fosters sustainability and improves ET with trash reduction. The findings highlight actionable recommendations for business leaders, suggesting that customized training programs, behaviorally driven interventions, and reinforcement mechanisms can significantly improve food waste management outcomes in the fast-food industry.

Furthermore, organizations should conduct a needs analysis to identify specific environmental objectives and issues. This helps in creating tailored training programs for sustainability issues like energy efficiency and waste management. Regular updates on best practices and clear commitment from senior management are crucial. Managers should focus on designating the green values or forming interdisciplinary teams promotes environmental activities across departments. Recognition programs and tracking progress through performance indicators can encourage staff participation as well as regular updates to training programs promote sustainability trends and employee input.

Limitations and future research directions

Eventually, this analysis uncovers a few limitations that necessitate additional investigation. One possible limitation of the research is its restricted applicability to different contexts; the results might be specific to the investigated region, i.e., developing countries. Subsequent investigations could aim to reproduce the study in various settings to improve the validity and relevance of the results in other geographical locations. Specifically**,** this study was conducted within Pakistan's fast-food industry, which presents unique socio-cultural and economic factors that may limit the generalizability of the findings to other regions. Cultural attitudes toward food waste, religious influences on consumption patterns, and variations in regulatory frameworks could influence the effectiveness of ET programs. In many Western and high-income economies, government regulations and corporate sustainability mandates vigorously enforce food waste reduction policies, whereas in developing economies like Pakistan, implementation depends more on individual business initiatives and employee motivation[97,98]. Additionally, since the respondents of this study were related to the fast-food industry only, therefore, it could not be generalized in this sense to other various industries. Future research may be conducted on other industries which are more vulnerable to wastes especially in developing countries, like chemical industry, cement and textile.

Moreover, the influence of GV may differ across cultural contexts. For instance, employees in countries with higher environmental consciousness may respond more favorably to training programs than regions where economic constraints take precedence over environmental concerns[99]. Future research should explore cross-cultural studies to compare the efficacy of ET in diverse socio-economic settings. Another possible limitation concerns the study's cross-sectional design. Its capacity to establish a causal relationship between ET, EA, and SFWMB may be hindered. Experimental or longitudinal research designs may provide more robust evidence for causality through the investigation of behavior changes over time or the manipulation of variables to evaluate their impacts.

Furthermore, the study solely focuses on examining the mediating and moderating effects that are specifically associated with EA and GV. Examining additional moderators and mediators in the link between ET and sustainable food waste management behavior could provide deeper insights. Future studies should investigate the influence or mediation of variables such as green organizational culture[100], green transformational leadership style[101], and individual attributes[102] on this relationship. Moreover, responsible leadership and circular economy practices could be significantly important determinants of employees' green and sustainable behaviors therefore, future research may investigate micro level or multi-level studies to measure their impact for developing sustainable behaviors.

Data availability

Upon publication of this article, the data for this study can be made available based on requests from the corresponding author.

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Conceptualization: BG, MZ, and MKL; Methodology: BG, KRM and AAS; Software: BGAnd NCB; Validation: MZ; Formal Analysis: BG and MKL; Investigation: MZ and AAS ; Resources: NCB, MZ, and ASS; Data Curation: BG and MKL : Writing Original Draft GB, MZ, KRM and AAS, Preparation: KRM, BG and NCB, Writing Review and Editing: GB, MZ, KRM and AV; Visualization NCB, Supervision MZ and ASS and Project Administration: MZ and BG . The author has read and agreed to the publication.

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Declarations

Competing interests

The authors declare no competing interests.

Additional information

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