IMPACT OF DIGITAL SOLUTIONS ON FOOD WASTE DIVERSION: PROMOTING SUSTAINABLE PRACTICES AND MODERATING ROLE OF ATTITUDES AMONG CONSUMERS

Ammar Alawadh *

* College of Business, Department of Marketing, Al-Baha University, Al-Baha, Saudi Arabia
Contact details: College of Business, Department of Marketing, Al-Baha University, Al-Baha, Saudi Arabia

OPEN ACCESS

How to cite this paper: Alawadh, A. (2026). Impact of digital solutions on food waste diversion: Promoting sustainable practices and moderating role of attitudes among consumers. *Corporate Governance and Sustainability Review, 10*(1), 30–38. https://doi.org/10.22495/cgsrv10i1p3

ISSN Online: 2519-898X
ISSN Print: 2519-8971

Received: 13.05.2025
Revised: 08.09.2025; 05.12.2025
Accepted: 29.12.2025

JEL Classification: M31, O33, Q18
DOI: 10.22495/cgsrv10i1p3

Abstract

This study examined the influence of digital solutions on food waste diversion behavior, while considering the moderating role of consumer attitudes towards food waste in Saudi Arabia. A quantitative research design was employed, and data were collected from 256 respondents using a structured questionnaire through a convenience sampling approach. The findings revealed that digital solutions, such as mobile applications, smart tracking tools, and awareness platforms, significantly and positively impacted food waste diversion behavior. Furthermore, consumer attitudes were found to moderate this relationship, indicating that individuals with stronger pro-sustainability views experienced greater benefits from digital interventions. These results suggested that technology-driven initiatives became more effective when combined with favorable consumer attitudes, supporting previous arguments that consumer awareness is a key factor in waste management (Abu-Bakar & Almutairi, 2024). By providing empirical evidence from Saudi Arabia, this study addressed a notable research gap in food waste management and digital innovation literature (Moufakkir & Auzun, 2024). The findings offered practical implications for policymakers and businesses aiming to integrate digital technologies with consumer-focused campaigns to promote sustainable food consumption practices.

Keywords: Digital Solutions, Food Waste Diversion Behavior, Attitudes Towards Food Waste, Saudi Arabia

Authors' individual contribution: The Author is responsible for all the contributions to the paper according to CRediT (Contributor Roles Taxonomy) standards.

Declaration of conflicting interests: The Author declares that there is no conflict of interest.

1. INTRODUCTION

Food waste is a global issue that has garnered increasing attention in recent years, particularly because of its environmental, economic, and social consequences. This is especially the case in many countries worldwide, and Saudi Arabia is no exception, as the quantity of food waste produced is extremely high. Food waste is the main cause of global environmental exploitation in food systems (Mir et al., 2024; Ting et al., 2025). As the Saudi population continues to expand at an alarming rate, accompanied by high consumption rates, proper food waste management is crucial because of the developed culture of throwing away consumable foodstuffs due to broken supply chain systems (Azazz & Elshaer, 2022). Solving the problem of food waste requires a new idea, and one such approach is

the adoption of digital solutions to help solve the problem, given the growing use of technology in daily life.

Some ways that focus on applying digital technologies to address this problem include apps and platforms to minimize the purchase of foods that are likely to go to waste, assist in monitoring food storage, and enhance the proper use of foods. They help consumers make accurate choices regarding food consumption, support meal sharing, and offer improved techniques for waste management (Fan et al., 2022; Poonia et al., 2022). Interest in efficient food utilization has also been increasing in Saudi Arabia, with the government advocating for sustainability and going digital (Shankar et al., 2022). However, all of these digital solutions are highly reliant on consumer attitudes and participation. However, as this study has found, programmatic solutions for food waste disposal are still possible, implying that there are other reasons for food waste diversion behavior in the sector.

Another important determinant of the efficacy of digital solutions in preventing food waste is the consumer's attitude toward food waste. Recent investigations show that perceptions of food waste contribute to the effectiveness of measures regulating behavior in the context of efficient waste disposal (Jabeen et al., 2023; Sharma et al., 2024). This study argues that the general culture in Saudi Arabia regarding food and waste, and more importantly, economic factors, can influence consumer reactions to such technologies. While some consumers are willing to make changes for the benefit of the environment or to save money, others may be hampered by problems such as a lack of information or changes in behavior (Lahath et al., 2021). This relationship between the adoption of digital solutions and consumer attitudes is intriguing and deserves further investigation to determine its impact on food waste diversion in Saudi Arabia.

Although the recent increase in concern with sustainable approaches to addressing the issue of food wastage has implied the application of digital solutions, few studies have investigated the implications of these technologies for consumers in Saudi Arabia (Salem et al., 2023). Many past studies are either largely based on the technological approach or the separate variables of organizational behavioral change, but not on the combination of both to help reduce food waste and divert it from landfills (Aljubairah, 2022). This study gap can be observed, especially in the Saudi Arabian context, and therefore presents a unique opportunity. Social multimedia context management set up this country as a model because it has an advanced digital infrastructure and is currently implementing sustainable solutions for food waste. Consequently, the current state of knowledge does not allow answering the question of how consumers' perceptions of food waste might act as a moderator between digital solutions and waste diversion behaviors.

The lack of contextual studies in Saudi Arabia presents a study gap in how digital interventions can be designed to address the attitudes that Saudi consumers exhibit when making purchases. Previous studies conducted in other parts of the world may not be easily transferable to Saudi Arabia, attributable to the social, economic, and cultural settings (Zhang & Zhang, 2025). The current study aims to contribute to the development of contextualized knowledge regarding the possibilities of digital interventions in encouraging consumers to divert food waste more effectively, considering the moderating role of consumers' attitudes towards food waste taken into account. Therefore, this study seeks to address this gap by investigating the link between digital solution adoption and food waste diversion intentions among consumers in Saudi Arabia, with reference to the moderating effect of consumer attitude toward digital solutions.

The purpose of this study is in the fact that it can contribute to the development of recommendations to enhance the approaches used in Saudi Arabia toward minimizing food waste. It adds to the knowledge of sustainable consumption and digital solution acceptance for food waste diversion behavior. Furthermore, work and post-work attitudes were found to moderate the aesthetic appeal of caliphate iconography among Saudi Arabian consumers, indicating that identifying these attitudes is crucial for creating culturally and psychologically relevant interventions in the Saudi Arabian context. This could translate into better policy advice for both private and public entities intending to curb food waste and promote sustainable eating habits across the region.

In addition, the results of this study may be relevant for other countries in the Gulf region and other parts of the world, where the problem of food waste remains acute and where digital solutions are discussed to address challenges in terms of sustainability. As such, this study could help design suitable digital platforms and campaigns that advance consumer engagement, decrease the level of waste produced by today's population, and support the United Nations' sustainable development goals to fight climate change by 2030 (Pandey et al., 2023). Thus, this study may contribute to the development of knowledge in the academic world and serve to alleviate modern environmental issues that have a significant positive impact on society.

The structure of this study was organized to provide a logical flow of ideas and empirical evidence. The rest of the paper is structured as follows. Section 2 presented a comprehensive review of the relevant literature, focusing on digital solutions, consumer attitudes, and food waste diversion behavior. Section 3 outlined the methodology, including research design, data collection procedures, and analytical techniques employed in the study. Section 4 reported the empirical findings. Section 5 discussed their implications in light of the existing body of knowledge. Section 6 concluded the paper by summarizing the key results, highlighting theoretical and practical contributions, and suggesting directions for future research.

2. LITERATURE REVIEW

2.1. Food waste

Food waste is a global concern as it has social and economic impacts and has negative impacts on the environment. In collaboration with other researchers, Parfitt and his team revealed that

between 1.3 and 2 billion tons of food is wasted globally every year, accounting for one-third of all food produced (Kirmani et al., 2023). These impacts are extremely significant, considering that food production is one of the leading causes of climate change, contributing approximately 25% of greenhouse gas emissions (Abdo et al., 2023). When food is dumped, the inputs in terms of water, land, energy, and labor spent in the production, processing, and transporting of the food product are also wasted, hence straining the resource base of the earth. Food waste decomposition in trash leads to greenhouse gas emissions, including methane, which is much worse than carbon dioxide emissions (Mazzucchelli et al., 2021; Mehrotra et al., 2024). Given the rapidly worsening environmental issues and scarcity of resources worldwide, combating food waste is recognized as an urgent problem in modern sustainable development policies of companies and states (Abu-Bakar & Almutairi, 2024). The consumer's role is to reduce food waste in the household so that global food systems contribute to a more sustainable form of consumption.

2.2. Digital solutions to prevent food waste

As smartphones and internet connections become more widespread, there is an opportunity that digital tools can significantly contribute to changes in food consumption. In consumer engagement through mobile applications and platforms as a strategic solution to combat food waste (Ong et al., 2023). Realism has also started to emerge in applications like "too good to go" which connects consumers with restaurants and stores that sell food at a lower price because they are in excess to the stores (Gao et al., 2024). The application also motivates consumers to buy unsold food produce that would have been wasted, hence saving the cost of food wastage while the consumer saves their money in the process (Filimonau et al., 2022). In addition, partnerships between Saudi governmental and non-governmental organizations (NGOs) and technology companies are making food redistribution programs more noticeable for funding and other support services (Kumar et al., 2025).

The prevention of digital solutions involves activities that prevent food wastage before they are implemented. Tools to address the problem of food waste have been created to enhance consumers' ability to perform meal planning, grocery purchasing, and product shelf-life tracking. Some of these solutions are meal planning applications, food tracking platforms, and inventory management applications that notify the end user about the freshness of food items to reduce instances of food spoilage (Abbas et al., 2023). These preventative options are becoming more imperative in the Kingdom of Saudi Arabia (KSA) for refusing, reducing and recovering food waste at the end consumer level due to factors such as rapid urbanization and high food consumption rates. For example, meal planning applications not only inform the consumer about what they can prepare given the ingredients in stock, but also assist in making better purchase decisions, hence minimizing the portions bought that go to waste (Almulhim & Abubakar, 2021).

2.3. Attitude towards food waste

Attitude towards food waste refers to the beliefs, feelings, and predispositions individuals hold regarding the discarding of food, which can significantly influence their behaviors and consumption patterns. Consequently, food waste has become the norm among the wealthy and the generous who prepare heaping quantities of food for family reunions, feasts, and social functions, knowing fully well that most of it will end up in the bin (Moufakkir & Auzun, 2024). In Saudi culture, food waste is sometimes acceptable and even encouraged because when those who are gathered together are given largesse during parties, the message being passed is the act of hospitality (Kennedy et al. 2024). A new consciousness is arising from the awareness of the impact of food waste on the environment and the economy, after the reduction of food waste has become the new norm. An increase in the realization of sustainability trends and the need to reduce waste is making users employ sustainable consumption patterns, especially youthful and urban users.

Studies indicate that there is a shift in the perception that Saudi consumers have of food waste, a change that is attributed to the younger generation of consumers who are more informed thanks to their access to information technology devices (Kaur et al., 2021). As environmental campaigns intensify, social media's impact, and the government's effective campaigns, including the "Zero Waste" campaign, positive attitudes toward food waste reduction have emerged (Elgammal et al., 2024). Studies suggest that such actions have increased people's concerns about the ecological consequences of wasted food and its role in environmental deterioration, both in terms of climate change and resource depletion (Gao et al., 2024). Moreover, regarding attitudes toward sustainable practices, the cultural level of resistance to change persisted, particularly among the elderly and those in rural areas, where hosting rituals involve preparing large portions of food (Ong et al., 2023).

2.4. Hypotheses development

Smart applications such as food tracking, meal planning, and food redistribution applications are well-known ways to enhance consumer awareness and efficient food consumption management along with sustainable utilization (Azazz & Elshaer, 2022; Filimonau et al., 2022). These tools provide real-life issue-solving strategies for personal food waste management, meal planning, and food re-portioning, which are useful for consumer food waste reduction. In Saudi Arabia, mobile phone ownership is high, and the Internet adoption rate is increasing, which means that there is a possibility of utilizing digital technologies to address food waste issues, especially in urban regions, where the adoption of such technologies is increasing (Salem et al., 2023). As the appreciation of the environmental impacts of food waste increases among the public, it can be postulated that the application of the mentioned digital tools may have a positive effect on behaviors associated with food waste diversion.

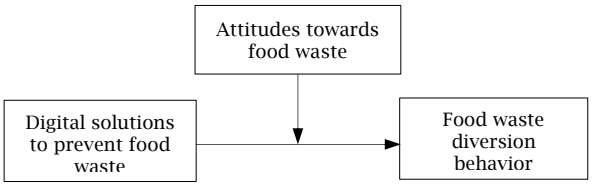
Research suggests that the adoption of digital technologies in consumer environments sends behavioral cues that may help reduce food waste by providing information and tips (Abu-Bakar & Almutairi, 2024). The application of digital solutions, including available recommendations and a tool for food donation, helps raise awareness and change people's behavior concerning food consumption and waste (Aljubairah, 2022). This body of evidence leads to the formulation of the following hypothesis:

H1: Digital solutions to prevent food waste positively influence food waste diversion behavior in Saudi Arabia.

According to Abdo et al. (2023), attitudes and inclinations toward food waste affect the chances of implementing sustainable practices in the food sector. This cross-cultural study reveals that Saudi Arabian consumer behavior regarding food waste is shaped by culture, norms, and newfound consciousness of environmental conservation. In the past, people were served large portions of food, particularly during meals and especially in groups, and the surplus was wasted (Zheng et al., 2023). However, in the present generation, the new change in attitude that can help promote sustainable consumption is better placed to design digital solutions to control food wastage among societies (Zia et al., 2022). Digital solutions used in the fight against food waste can be effective to a certain extent, but the attitudes of people who use these solutions can either improve or worsen their effectiveness. Studies have also indicated that if people have positive attitudes towards food waste reduction practices and passive digital technologies for food waste management, they will engage with them actively and effectively (Zhang & Zhang, 2025). However, people with negative attitudes towards or indifference to food wastage may not optimally adopt such tools even when they are provided. Specifically, in the Saudi Arabian sample, where the change in attitude may be evidenced in light of environmental campaigns and governmental policies, it is hypothesized that the link between the proposed technological interventions and food waste diversion behavior will be more robust in respondents with positive attitudes toward waste minimization. Thus, the following hypothesis is proposed:

H2: Attitudes towards food waste moderate the relationship between digital solutions to prevent food waste and food waste diversion behavior.

Figure 1. Theoretical framework



Source: Author's elaboration.

3. METHODOLOGY

The research was conducted using a deductive method to determine how digital solutions can reduce food waste diversion by Saudi Arabs. The target population was people engaged in food-related activities, making it a diverse group based on age and income levels. Participants were recruited using a convenience sampling method, which produced self-reported answers because they were readily available. The sample of 256 respondents obtained through this process was rich in data to be analyzed empirically.

Regarding the constructs of interest, the current study used well-established measurement scales based on previous research. The performance metrics of digital interventions in preventing food waste were calculated as five items based on Cane and Parra's (2020) scale, which centers on the effectiveness and accessibility of digital apps. The four items used by Aktas et al. (2018) were used to evaluate consumer attitudes towards food waste. Furthermore, five items measured the behavior of food waste diversion according to Alattar et al. (2020). These scales worked together to ensure the validity and reliability of the study constructs and allowed a detailed study of the interrelationship between digital solutions and consumer behavior.

An online questionnaire in the form of a survey link was used for data collection. The survey included questions that elicited the participants' perception of food waste, as well as their use of digital tools and behaviors regarding the practice of diversion. The answers were quantified using a five-point Likert scale, which enabled a subtle understanding of consumer behavior and attitudes. Administering the survey online meant increased accessibility and convenience for the participants and lowered barriers, including the physical presence of the participants or consent to audio-visual recording.

Partial least squares structural equation modeling (PLS-SEM) was used for data analysis using Smart-PLS software. This method of analysis was chosen because it is appropriate for testing complex models with moderating effects, is flexible in dealing with reasonably small sample sizes, and is predictive. PLS-SEM also allowed the evaluation of the direct impact of digital solutions, the mediating impact of consumer attitudes, and their interactive impact on food waste diversion behavior in Saudi Arabia.

Although this research embraced a quantitative PLS-SEM design, other methodologies might have been suitable as well. A qualitative study that uses semi-structured interviews or focus groups could yield more information about consumer experiences and attitudes toward digital food waste solutions. Equally, a hybridized methodology would have provided a more comprehensive picture through the interplay of the statistical results and qualitative interpretation. Statistically, the proposed relationships could also have been tested using covariance-based structural equation modeling (CB-SEM) or standard regression analysis. PLS-SEM was, however, deemed the most suitable approach due to its capability to examine complex moderating effects, its aptness in exploratory research settings and its high predictive power, which resonated well with the objectives of this research.

4. ANALYSIS AND RESULTS

4.1. Correlations

The correlation analysis was conducted to examine the strength and direction of relationships among the study variables. The results are presented in Table 1.

Table 1. Correlations

Variables	*Digital solution*	*Food waste diversion behavior*	*Attitudes towards food waste*
Digital solution	1		
Food waste diversion behavior	0.321***	1	
Attitudes towards food waste	0.304***	0.420***	1

*Note: *** significant at 0.001 level.*
Source: Author's elaboration.

The study showed that there is a positive relationship between digital solutions, consumer behavior, and consumer attitudes toward food waste management in Saudi Arabia. *H1* received a moderate positive correlation of 0.321 ($t = 9.951$, $p < 0.001$); thus, it was confirmed that as the provided digital solutions increased, the consumer's behavior in minimizing food waste improved. Furthermore, the findings of Waste's (2001) total digital solutions and attitude towards food waste ($r = 0.304$, $p < 0.001$) indicated that the adoption of such tools improved the views and behavioral concerns of the consumers. Notably, the strongest correlation observed (0.420, $p < 0.001$) between consumer behavior and attitudes underscored the importance of fostering positive attitudes as a critical factor in successful waste reduction initiatives. Such knowledge highlights the significance of investing more in digital media and consumer engagement to prevent food waste in compliance with Saudi Arabia's sustainable development agenda.

4.2. Average variance extracted and reliability

To assess the convergent validity and internal consistency of the constructs, the average variance extracted (AVE) and reliability measures were calculated.

Table 2. AVE and Cronbach's alpha

Variables	*AVE*	*Composite reliability (rho_c)*	*Composite reliability (rho_a)*	*Cronbach's alpha*
Digital solution	0.776	0.884	0.833	0.897
Food waste diversion behavior	0.749	0.937	0.941	0.938
Attitudes towards food waste	0.869	0.971	0.971	0.971

Source: Author's elaboration.

This showed the degree of stability and accuracy of the sets of variables concerning digital solutions, food waste behavior, and attitudes. Regarding reliability, the average AVE for digital solutions, a measure of the amount of commonality between its assessed indicators, was relatively low at 0.776, possibly implying that this construction could be refined further. On the other hand, food waste behavior presented a satisfactory AVE of 0.749, which proved its good convergent validity and reinforced the idea that the indicators used were able to measure the construct appropriately. Attitudes had an even higher AVE of 0.869 to support construct validity. Comparing them in terms of composite reliability, the rho_c value was 0.884, which is less than 0.7 but indicates moderate reliability of using digital solutions, while food waste behavioral intention (rho_c = 0.937) was highly reliable, followed by food waste attitude (rho_c = 0.971). Cronbach's alpha for such constructs was likewise parallel with these results: food waste behavior and attitudes met such values of 0.938 and 0.971, respectively, while digital solutions had a slightly smaller alpha of 0.897. In aggregate, these findings showed that food waste behavior and attitude measures could be assessed reliably and validly, but the construct associated with dig solutions needs improvement to optimize its measurement.

4.3. Factor loadings

To evaluate the measurement model, factor loadings of all items were examined for their respective constructs.

Table 3. Factor loadings

Factor loadings	*Original sample (O)*	*Sample mean (M)*	*Standard deviation (STDEV)*	*T-statistics (|O/STDEV|)*	*p-values*
Attitudes towards food waste					
AT1 ← AT	0.486	0.485	0.073	6.708	0.000
AT2 ← AT	0.307	0.304	0.083	3.7	0.000
AT3 ← AT	0.721	0.716	0.066	10.892	0.000
AT4 ← AT	0.501	0.497	0.079	6.307	0.000
Digital solution					
DS1 ← DS	0.879	0.876	0.052	16.81	0.000
DS2 ← DS	0.841	0.84	0.054	15.643	0.000
DS3 ← DS	0.751	0.748	0.059	12.759	0.000
DS4 ← DS	0.962	0.962	0.06	16.074	0.000
DS5 ← DS	0.881	0.876	0.053	16.637	0.000
Food waste diversion behavior					
FW1 ← FW	0.959	0.958	0.024	39.45	0.000
FW2 ← FW	0.958	0.957	0.026	36.367	0.000
FW3 ← FW	0.883	0.882	0.033	26.508	0.000
FW4 ← FW	0.939	0.938	0.026	35.679	0.000
FW5 ← FW	0.921	0.921	0.03	30.791	0.000

Source: Authors' elaboration.

The results of the factor loading analysis showed a high affinity between the variables and their respective hypothesized constructs of attitudes, digital solutions, and food waste behavior. For attitudes, loadings were significant at $p < 0.001$; the most discriminant was AT3 (0.721), followed by AT1 (0.486) and AT4 (0.501). The digital solutions constructed showed exceptionally high loadings and all surpassed the 0.7 threshold measures for good quality, particularly DS4 (0.962). Likewise, the food waste behavior construct had high values for all items; thus, FW1 (0.959) and FW2 (0.958) were taken as important indices for consumer behavior in food waste management.

4.4. Model fitness

To assess the overall quality of the measurement model, model fitness indices were evaluated. The results are summarized in Table 4.

Table 4. Model fitness

Model type	*SRMR*	*d_uls*	*D_G*
Saturated model	0.02	0.312	0.41
Estimated model	0.02	0.311	0.409

Source: Author's elaboration.

Using model fitness analysis, it was possible to assess the overall fitness of the estimated model of the saturated model of food waste behavior of the people of Saudi Arabia. Both models had a standardized root mean square residual (SRMR) of 0.02, which may be interpreted as very good, as a magnitude of 0.08 or less is considered excellent in the literature. The change in the unweighted least squares distance (d_uls) between the saturated model (0.312) and the estimated model (0.311) was very small, indicating that the structure of the estimated model was very close to that of the saturated model. In addition, the geodesic discrepancy (D_G) indices remained minimal, with values of 0.41 and 0.409 for the saturated and estimated models, respectively, which also supports the proposal that the estimated model was a proper model for the actual dataset.

4.5. Path coefficients

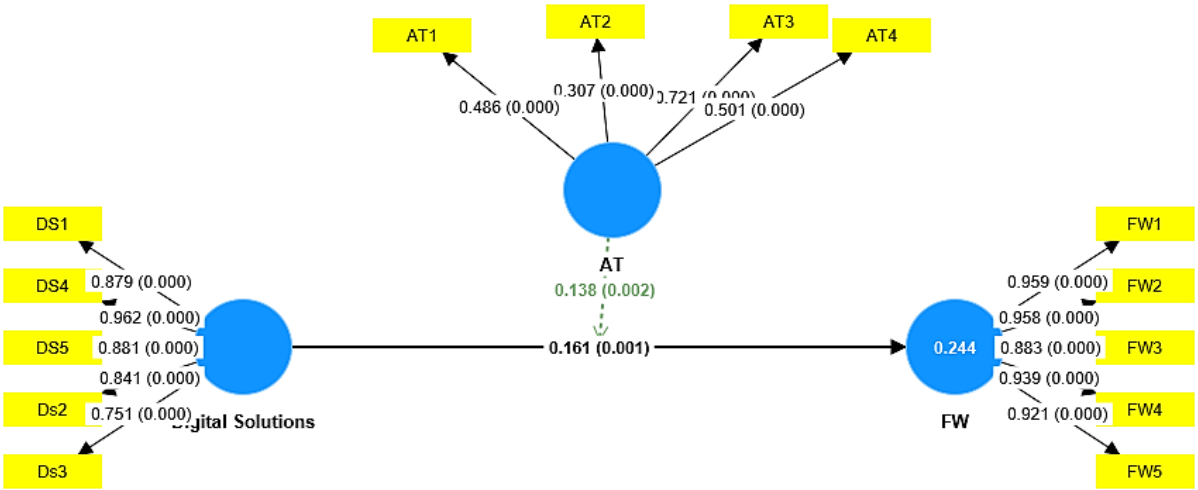
To test the hypothesized relationships among the constructs, path coefficients were analyzed. The results, presented in Table 5, indicate the strength, direction, and significance of the proposed paths in the structural model.

Table 5. Path coefficients

Paths	*Original sample (O)*	*Sample mean (M)*	*Standard deviation (STDEV)*	*T-statistics (|O/STDEV|)*	*p-values*
AT → FW	0.418	0.421	0.054	7.736	0
DS → FW	0.161	0.163	0.051	3.194	0.001
AT x DS → FW	0.138	0.137	0.045	3.086	0.002

Source: Author's elaboration.

Figure 2. Structural model results for hypothesized relationships



Source: Authors' elaboration.

The values of the path coefficients helped in gaining a much-needed understanding of the interactive associations between the attitudinal, digital solutions, and food waste behavior (FW). This means that consumer attitudes (AT) predicted the subsequent food waste behavior with a strong coefficient of 0.418 ($p < 0.001$), suggesting that favorable attitudes led to the desired consumer behaviors. The association between digital solutions and food waste behavior was also found to be substantial, with a coefficient of 0.161 ($t = 3.934$, $p = 0.001$), indicating that digital solutions influenced consumer behaviors regarding food waste, but to a lesser degree than attitudes. Furthermore, the interaction between attitudes and digital solutions (std estimate = 0.138**, $p < 0.05$) showed that the appreciation of attitudes and the utilization of excellent digital solutions significantly augmented food waste reduction behaviors.

5. DISCUSSION

The analysis in the present study also supports the assertion that consumer attitudes directly influence food waste behavior, especially in Saudi Arabia. The positive correlation between attitudes and behavioral intentions also confirms previous research, proving that a positive change in mindset towards sustainability can directly affect people's interaction with food waste practices. This supports earlier findings that focused on the psychological factors influencing environmental behavior. Consumers who embrace positive attitudes toward the reduction of food waste will engage in the use of apps, support farmers' markets, or any other strategies for fighting food wastage. Hence, studies aimed at increasing such levels and perceptions of consumers may be useful in encouraging appropriate consumer behaviors related to food waste.

In addition, the effect of digital solutions on food waste behavior demonstrates the potential of applying technology to change consumer behavior. This is because digital platforms are already a part of life, with more solutions to complicated issues such as food waste being found on these platforms. According to the research studies presented, consumers are willing to behave credibly when supported by easy-to-use technology, such as an application that offers consumers affordable products that are almost expired or share food online. This approach affirms aspects of social technology because the availability of technology can assist in making more sustainable decisions easier and more tempting than less sustainable options that are similarly available. Industry, government, and business consumers must embrace digital solutions to support consumer practices in their quest to reduce food waste.

The above analysis of the relationship between certain consumer attitudes and digital solutions highlights the necessity of an integrated approach to food waste reduction promotion. The study shows that positive attitudes reinforce the impact of effective means of engaging consumers in sustainable waste disposal. This appears to mean that offering technological solutions is not sufficient; it also requires creating a favorable predisposition among consumers to these tools. More specifically, educational campaigns and community outreach programs serve the valuable purpose of enabling consumers to know what digital solutions exist and creating awareness of the culture of sustainability to use them.

6. CONCLUSION

In conclusion, this study identifies the extent to which consumer attitudes, digital solutions, and food waste behavior are connected in Saudi Arabia. The results imply that attitudes towards the consumption of food items are a major determinant of the probability of carrying out proper sustainable food waste practices. Additionally, the role of technology is introduced as a positive means of strengthening these behaviors, with the appraisal that tech solutions can act as enablers on the path toward sustaining developments. Thus, using positive attitudes and available digital technologies, stakeholders can guide consumers toward implementing practices that prevent food waste. However, there is some interrelation between attitudes and digital solutions, which means that overall packages to reduce food waste need to be supported for them to be effective. The idea is not only to introduce technical improvements; efforts are needed to develop proper consumer orientation in terms of sustainability. By doubling down on both of these potential outcomes, this framework can help foster a culture that supports the behaviors necessary to meet more generalized sustainability goals, thus lowering levels of food waste and its related ecological damages.

Therefore, the implications of this study are useful for policymakers, companies, and organizations involved in the fight against food waste. When consumer attitude enhancement initiatives are considered alongside user-focused digital developments, it becomes possible for stakeholders to contribute to a more effective framework for change. Education programs and community engagement should be part of any strategy to abate food waste, as people of all ages and members of society need to embrace the right attitudes in the future and incorporate technological advances.

The factor analysis from this study can, therefore, offer unique contributions to the existing literature on factors that influence food waste behavior, but it must accept the following as its limitations and a potential for future studies. A significant limitation is the use of survey responses; hence, self-reported data may be neither accurate nor representative of actual behaviors. Future studies could use observational procedures or longitudinal paradigms in addition to overcoming these drawbacks. Furthermore, the analysis of differences in cultural attitudes towards wasting food by demographic indicators could also contribute to a society-level perspective on consumer behavior. Further research could also compare the performance of particular types of digital solutions in particular environments, which can lead to the development of relevant interventions for each segment of consumers. Such limitations should be overcome to improve our understanding of how attitudes and technology can be best implemented in the fight against food waste.

REFERENCES

Abbas, J., Al-Sulaiti, K., & Al-Sulaiti, I. (2023). Tourists' online information influences their dine-out behaviour: Country-of-origin effects as a moderator. In K. Al-Sulaiti & I. Al-Sulaiti (Eds.), *Country origin effects on service evaluation* (pp. 125–146). Qatar University Press. https://qspace.qu.edu.qa:8443/bitstream/handle/10576/49727/Country%20of%20origin%20Effects%20on%20Service%20Evaluation%20OA.pdf?sequence=3&isAllowed=y#page=136

Abdo, M. S., Ahmed, S. A., Awad, B. K., & Elsharnouby, M. H. (2023). Fostering green purchasing behavior: The moderated mediation role of customer disidentification. *Management & Sustainability: An Arab Review, 2*(2), 155–176. https://doi.org/10.1108/MSAR-10-2022-0046

Abu-Bakar, H., & Almutairi, T. (2024). Integrating sustainability and circular economy into consumer-brand dynamics: A Saudi Arabia perspective. *Sustainability, 16*(18), Article 7890. https://doi.org/10.3390/su16187890

Aktas, E., Sahin, H., Topaloglu, Z., Oledinma, A., Huda, A. K. S., Irani, Z., Sharif, A. M., van't Wout, T., & Kamrava, M. (2018). A consumer behavioural approach to food waste. *Journal of Enterprise Information Management, 31*(5), 658–673. https://doi.org/10.1108/JEIM-03-2018-0051

Alattar, M. A., DeLaney, J., Morse, J. L., & Nielsen-Pincus, M. (2020). Food waste knowledge, attitudes, and behavioral intentions among university students. *Journal of Agriculture, Food Systems, and Community Development, 9*(3), 109–124. https://doi.org/10.5304/jafscd.2020.093.004

Aljubairah, M. (2022). *Exploring the use of behaviour change in the design of a mobile application for food waste reduction: Considering users' culture and life stage* [PhD thesis, University of York]. University of York. https://etheses.whiterose.ac.uk/34198/

Almulhim, A. I., & Abubakar, I. R. (2021). Understanding public environmental awareness and attitudes toward circular economy transition in Saudi Arabia. *Sustainability, 13*(18), Article 10157. https://doi.org/10.3390/su131810157

Azazz, A. M. S., & Elshaer, I. A. (2022). Amid the COVID-19 pandemic, social media usage and food waste intention: The role of excessive buying behavior and religiosity. *Sustainability, 14*(11), Article 6786. https://doi.org/10.3390/su14116786

Cane, M., & Parra, C. (2020). Digital platforms: Mapping the territory of new technologies to fight food waste. *British Food Journal, 122*(5), 1647–1669. https://doi.org/10.1108/BFJ-06-2019-0391

Elgammal, I., Ghanem, M., & Al-Modaf, O. (2024). Sustainable purchasing behaviors in Generation Z: The role of social identity and behavioral intentions in the Saudi context. *Sustainability, 16*(11), Article 4478. https://doi.org/10.3390/su16114478

Fan, M., Khalique, A., Qalati, S. A., Gillal, F. G., & Gillal, R. G. (2022). Antecedents of sustainable e-waste disposal behavior: The moderating role of gender. *Environmental Science and Pollution Research, 29*(14), 20878–20891. https://doi.org/10.1007/s11356-021-17275-y

Filimonau, V., Coşkun, A., Derqui, B., & Matute, J. (2022). Restaurant management and food waste reduction: Factors affecting attitudes and intentions in restaurants of Spain. *International Journal of Contemporary Hospitality Management, 34*(3), 1177–1203. https://doi.org/10.1108/IJCHM-07-2021-0899

Gao, H., Jia, H. (Michael), & Guo, B. (2024). Resources available for me versus us: Implications for mitigating consumer food waste. *Journal of Marketing Research, 61*(4), 619–637. https://doi.org/10.1177/00222437231162615

Jabeen, F., Dhir, A., Islam, N., Talwar, S., & Papa, A. (2023). Emotions and food waste behavior: Do habit and facilitating conditions matter? *Journal of Business Research, 155*, Article 113356. https://doi.org/10.1016/j.jbusres.2022.113356

Kaur, P., Dhir, A., Talwar, S., & Alrasheedy, M. (2021). Systematic literature review of food waste in educational institutions: Setting the research agenda. *International Journal of Contemporary Hospitality Management, 33*(4), 1160–1193. https://doi.org/10.1108/IJCHM-07-2020-0672

Kennedy, L., Safi, S., Osaili, T. M., Al Rajabi, A., Alblooshi, A., Al Jawarneh, D., Al Kaabi, A., Al Rubaei, F., Albreiki, M., Alfadli, M., Alhefeiti, A., Faris, E. F., Allaham, K., Junaidi, J., & Khan, A. B. (2024). The attitudes and practices of United Arab Emirates consumers towards food waste: A nationwide cross-sectional study. *F1000Research, 12*, Article 911. https://doi.org/10.12688/f1000research.135678.2

Kirmani, M. D., Uddin, S. M. F., Sadiq, M. A., Ahmad, A., & Haque, M. A. (2023). Food-leftover sharing intentions of consumers: An extension of the theory of planned behavior. *Journal of Retailing and Consumer Services, 73*, Article 103328. https://doi.org/10.1016/j.jretconser.2023.103328

Kumar, S., Mehrotra, A., Yaqub, M. Z., Gupta, B., & Agarwal, V. (2025). The role of values and attitude in food waste reduction: Exploring ideal sustainable business strategies. *Business Strategy and the Environment, 34*(2), 2341-2360. https://doi.org/10.1002/bse.4087

Lahath, A., Omar, N. A., Ali, M. H., Tseng, M.-L., & Yazid, Z. (2021). Exploring food waste during the COVID-19 pandemic among Malaysian consumers: The effect of social media, neuroticism, and impulse buying on food waste. *Sustainable Production and Consumption, 28*, 519–531. https://doi.org/10.1016/j.spc.2021.06.008

Mazzucchelli, A., Gurioli, M., Graziano, D., Quacquarelli, B., & Aouina-Mejri, C. (2021). How to fight against food waste in the digital era: Key factors for a successful food sharing platform. *Journal of Business Research, 124*, 47–58. https://doi.org/10.1016/j.jbusres.2020.11.055

Mehrotra, A., Agarwal, R., Awan, U., Walsh, S. T., & Yaqub, M. Z. (2024). Zero waste solutions in hospitality: Technology alignment and agile management practices for responsible consumption and production of food. *Journal of Sustainable Tourism*. https://doi.org/10.1080/09669582.2024.2427821

Mir, M. A., Chang, S. K., & Hefni, D. (2024). A comprehensive review on challenges and choices of food waste in Saudi Arabia: Exploring environmental and economic impacts. *Environmental Systems Research, 13*(1), Article 40. https://doi.org/10.1186/s40068-024-00364-5

Moufakkir, O., & Auzun, B. (2024). *Leveraging religion to reduce food waste: Examining food waste through the lens of Islam and Arab hospitality*. Preprints. https://doi.org/10.20944/preprints202409.1659.v1

Ong, D., Chiu, S., Andrews, E., & Nadarajan, G. (2023). One needs to be reminded and motivated: Mediating role of digital nudging for food waste reduction. *Journal of Social Marketing, 13*(3), 449–471. https://doi.org/10.1108/JSOCM-02-2023-0025

Pandey, S., Budhathoki, M., Perez-Cueto, F. J. A., & Thomsen, M. (2023). Factors influencing consumers' food waste reduction behaviour at university canteens. *Food Quality and Preference, 111*, Article 104991. https://doi.org/10.1016/j.foodqual.2023.104991

Poonia, A., Sindhu, S., Arya, V., & Panghal, A. (2022). Analysis of drivers for anti-food waste behaviour — TISM and MICMAC approach. *Journal of Indian Business Research, 14*(2), 186–212. https://doi.org/10.1108/JIBR-02-2021-0069

Salem, M., Baidoun, S., Abu Sharekh, N., Sammour, N., Alnajar, G., Alasttal, F., Alghusain, I., & Saqer, H. (2023). Factors affecting Arab consumers' attitudes toward online shopping in light of COVID-19: The moderating role of digital marketing. *Journal of Enterprise Information Management, 36*(2), 480–504. https://doi.org/10.1108/JEIM-04-2021-0175

Shankar, A., Dhir, A., Talwar, S., Islam, N., & Sharma, P. (2022). Balancing food waste and sustainability goals in online food delivery: Towards a comprehensive conceptual framework. *Technovation, 117*, Article 102606. https://doi.org/10.1016/j.technovation.2022.102606

Sharma, M., Kaushal, D., Joshi, S., Kumar, A., & Luthra, S. (2024). Electronic waste disposal behavioral intention of millennials: A moderating role of electronic word of mouth (eWOM) and perceived usage of online collection portal. *Journal of Cleaner Production, 447*, Article 141121. https://doi.org/10.1016/j.jclepro.2024.141121

Ting, S.-H., Leong, C.-M., Lim, T.-Y., Kuek, T. Y., & Lim, B. C. Y. (2025). Advancing corporate sustainability: Empowering the young consumers to reduce food waste for the sake of our planet. *Asia-Pacific Journal of Business Administration, 17*(1), 239–257. https://doi.org/10.1108/APJBA-01-2024-0018

Zhang, S., & Zhang, D. (2025). Factors affecting food waste at food festivals: The moderating effect of "Camera Eats First". *Journal of Sustainable Tourism, 33*(2), 357–379. https://doi.org/10.1080/09669582.2024.2345693

Zheng, H., Chen, K., & Ma, Z. (2023). Interactive effects of social norms and information framing on consumers' willingness of food waste reduction behavior. *Journal of Retailing and Consumer Services, 75*, Article 103525. https://doi.org/10.1016/j.jretconser.2023.103525

Zia, A., Alzahrani, M., Alomari, A., & AlGhamdi, F. (2022). Investigating the drivers of sustainable consumption and their impact on online purchase intentions for agricultural products. *Sustainability, 14*(11), Article 6563. https://doi.org/10.3390/su14116563