

AI in Green Marketing: Promoting Sustainable Consumer Choices Through Artificial Intelligence

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Abstract

This paper examines the role of artificial intelligence (AI) in improving green marketing strategies to drive sustainable consumer decisions through personalization, transparency, and communication. It bridges the knowledge gap regarding the effects of AI-based systems on consumer trust, perceived usefulness, and purchase intentions, and alleviates technological anxiety, especially in emerging markets such as Pakistan. In a cross-sectional, quantitative design, the data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to investigate the direct, mediating, and moderating relationships among AI-driven marketing constructs. The research assessed reliability, validity, and model fit using SmartPLS 4 with 385 respondents with experience with AI-based marketing tools. The findings showed that transparency and green marketing communication using AI is the most significant predictor ($R^2 = 0.773$) of sustainable consumer choice. Consumer trust and perceived usefulness play significant roles in mediating these relationships, whereas technological anxiety does not. The arguments are supported by the findings that AI is a technological and behavioral attacker of encouraging sustainability. The study is an expansion of the Resource-Based View (RBV) and the Technology Acceptance Model (TAM), as it frames AI as an ethical strategic asset that can fill the gap between digital innovation and environmental responsibility, providing practical recommendations on how AI can be used to sustain marketing activities and AI policy development.

Keywords: Artificial Intelligence, Green Marketing, Sustainability, Consumer Trust, Transparency, Technological Anxiety, Resource-Based View, TAM.

Introduction

The integration of Artificial Intelligence (AI) into green marketing has changed the way businesses interact with consumers, encouraging them to adopt environmentally responsible clothing behaviors. Sustainable consumer decisions made through AI-powered machine learning, predictive analytics, and intelligent recommendation engines are currently being marketed via personalization, transparency, and targeted communication (Zaman et al., 2025d). Such smart technologies allow marketers to act on the behavioral patterns of large groups, create green campaigns, and shape purchase intentions for green products (Zaman et al., 2025a). AI will help firms boost their capacity to achieve marketing targets aligned with the Sustainable Development

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Goals (SDGs), particularly those on responsible consumption and climate action (Zaman et al., 2025b). Nevertheless, even with its prospects, data ethics, algorithm transparency, and technological apprehension issues disrupt the reliability and approval of AI-driven sustainability work (Khan et al., 2024). Thus, understanding how AI-based personalization, communication, and transparency affect consumer trust, perceived usefulness, and green purchasing intentions is vital for creating intelligent, ethical, and sustainable marketing ecosystems (Ahmed et al., 2025).

There is a radical shift in the future of global marketing, and artificial intelligence (AI) takes centre stage in promoting sustainability and transforming consumer experiences. Industries such as retail, fashion, hospitality, and e-commerce are increasingly utilizing AI-based tools to further customize their offerings, make their operations more transparent, and convey environmental conservation values in a more meaningful way (Iqbal & Ali, 2024). For example, AI-driven analytics can help businesses accurately predict demand, reduce overproduction, and minimize waste, aligning business efforts with circular economy principles (Zaman et al., 2024). Recommendation systems and conversational agents lead consumers toward sustainable products and eco-conscious brands (Owais et al., 2025). Likewise, AI in services helps improve efficiency, reduce waste, and support sustainable development and responsible consumption objectives (Zaman et al., 2025c). Consequently, AI-based green marketing is a strategic transformation in which technology, consumer values, and environmental responsibility converge to create eco-friendly competitive environments (Iqbal et al., 2023).

Even though artificial intelligence (AI) is a revolutionary tool in marketing, its full adoption in green marketing remains limited due to a lack of consumer trust, technological fear, and ethical concerns. Although AI supports environmentally friendly decisions through personalization, predictive analytics, and sustainability communication, some consumers remain reluctant to rely on AI when making sustainable choices (Ahmed et al., 2024). Furthermore, infrastructural and regulatory challenges in emerging markets restrict the full potential of AI to promote sustainable consumption. Therefore, while AI in green marketing has the potential to foster responsible consumer behavior and support the Sustainable Development Goals, it has not yet fully translated technological capabilities into real behavioral change. This highlights the importance of examining how AI-driven personalization, transparency, and communication affect trust, perceptions of usefulness, and green purchase intentions toward sustainable consumer behavior (Iqbal et al., 2025).

Literature Review

The combination of artificial intelligence (AI) and green marketing has transformed the specifics of the sustainability communication process, enabling organizations to engage consumers through intelligent systems that foster personalization, transparency, and trust. One of the main constructs is AI-powered personalization, which uses machine learning and predictive analytics to establish sustainability messages and product recommendations based on consumer behavior and preferences (Zaman et al., 2025d). Incorporating real-time data and behavioral insights, AI enables marketers to match environmentally friendly offers to specific needs and build a stronger emotional and cognitive bond between consumers and eco-friendly brands (Khan et al., 2024). Equally, green marketing communication concerns the way AI supports effective, focused, and clear broadcasting of sustainability messages that stimulate awareness of environmental concerns and sway consumer opinion toward responsible consumption (Zaman et al., 2025a). By leveraging personalized digital campaigns, AI systems minimize information overload and enhance message

credibility, thereby increasing engagement and trust among sustainability-supportive consumers (Owais et al., 2025).

Another construct of great importance is AI-enabled transparency, which increases consumer confidence by providing verifiable information on product sources, environmental impact, and ethical sourcing (Iqbal & Ali, 2024). Such intelligent disclosure systems not only build trust but also reduce skepticism toward greenwashing by enabling informed decision-making and strengthening brand–consumer relationships (Ahmed et al., 2024). In addition, consumer trust in AI and perceived usefulness of AI act as critical psychological mediators that define the relationship between technological features and positive behavioral intentions (Zaman et al., 2024a). Consumers are more likely to form strong green purchase intentions when they perceive AI as trustworthy and beneficial, thereby encouraging sustainable consumption decisions that support environmental and societal objectives (Zaman et al., 2025b). Nevertheless, technological anxiety influences this connection, shaping user comfort with AI technologies and often discouraging participation in AI-supported sustainability initiatives (Iqbal et al., 2023). Together, these constructs form a multidimensional strategy that links the technological qualities of AI with psychological and behavioral processes of sustainable consumption (Zaman et al., 2025c).

Theoretical Framework

Resource-Based View (RBV) Theory

The theoretical basis of the study is the Resource-Based View (RBV) Theory, which holds that competitive advantage arises from a firm's unique, valuable, rare, and inimitable resources and capabilities. Within the framework of AI-based green marketing, AI is used as a strategic intangible resource that contributes to firms' marketing efficiency and innovation potential, as well as their environmental responsibility (Ashal & Morshed, 2024; Nayal et al., 2022). According to the RBV, companies that adopt AI-based personalization, predictive analytics, and transparency infrastructure build stronger competitive advantages, which their rivals have little opportunity to understand (Dangelico and Vocalelli, 2017; Aggarwal et al., 2023). With such innovative technologies, businesses turn marketing intelligence into sustainable marketing practices, including waste reduction, responsible communication, and energy optimization, which enhance competitive edge and support the delivery of Sustainable Development Goals (Awogbemi et al., 2024; Cuesta-Valino et al., 2023). Thus, RBV contributes to a strategic perspective on how companies use AI as a resource to simultaneously generate environmental and economic value, supporting sustainability as a competency of performance.

This background is upheld by the Technology Acceptance Model (TAM) and the Sustainable Marketing Theory. Ethical guidelines for how AI-based applications can be focused on ecological and societal well-being are grounded in the theory of sustainable marketing (Elkington, 1994; Dangelico and Vocalelli, 2017), which would allow marketing innovation to serve the targets of long-term environmental stewardship, rather than short-term profitability. In the meantime, this is supplemented by TAM (Liu et al., 2021; Gkikas and Theodoridis, 2022), which presents the consumer perspective on how perceptions of usefulness and trust may affect the acceptance of AI technologies in shaping green purchase intentions. A combination of RBV and these supportive theories ties the organizational, ethical, and behavioral facets of AI-enabled sustainability. It demonstrates that AI not only plays a strategic role in the business but also serves as a behavioral facilitator, inspiring consumers to make sustainable decisions driven by evidence and to act responsibly through informed consumption.

Supporting, Negating View

An emerging body of literature confirms that green marketing practices can be significantly enhanced and that sustainable consumer behavior can ultimately lead to organizational competitiveness when integrated with Artificial Intelligence (AI). According to scholars, AI-based personalization and analytics help companies create environmentally responsible marketing strategies that align with consumer values and sustainability goals (Ahmed et al., 2025; Zaman et al., 2025a). Intelligent systems enable organizations to evaluate consumption patterns, anticipate green product demand, and optimize supply chains to minimize waste and emissions (Khan, Zaman & Alam, 2024; Zaman et al., 2024). Research also shows that AI fosters consumer trust and perceived usefulness by ensuring transparency and credibility in sustainability communication through verifiable information (Ahmed et al., 2024; Owais et al., 2025). From a strategic perspective, the Resource-Based View (RBV) suggests that AI capabilities are valuable, rare, and inimitable intangible resources that support firms in achieving long-term sustainability and competitive advantage (Zaman et al., 2025b; Iqbal et al., 2023). Similarly, aligning AI-driven insights with sustainable marketing principles allows organizations to develop ethical, data-driven campaigns that enhance environmental awareness and encourage positive behavioral change (Zaman et al., 2025d; Zaman et al., 2025c).

On the other hand, critics caution that although AI has strong potential for sustainability, its application in green marketing also introduces ethical, psychological, and operational challenges. Scholars highlight concerns such as data privacy, algorithm bias, and risks of misleading claims, which may damage consumer trust and weaken the effectiveness of AI-based sustainability initiatives (Iqbal & Ali, 2024; Ahmed et al., 2024). From a consumer behavior perspective, overreliance on AI insights may reduce emotional engagement with sustainability messages and result in shallow behavioral change (Iqbal et al., 2025). Additionally, technological anxiety, limited awareness, and digital literacy barriers in emerging markets may negatively influence AI-driven sustainable purchasing behavior (Khan et al., 2024). Despite these concerns, AI remains a transformative force, and its ability to enhance sustainable consumer decision-making depends on how effectively organizations address transparency, ethics, accessibility, and trust in intelligent marketing systems (Owais et al., 2025).

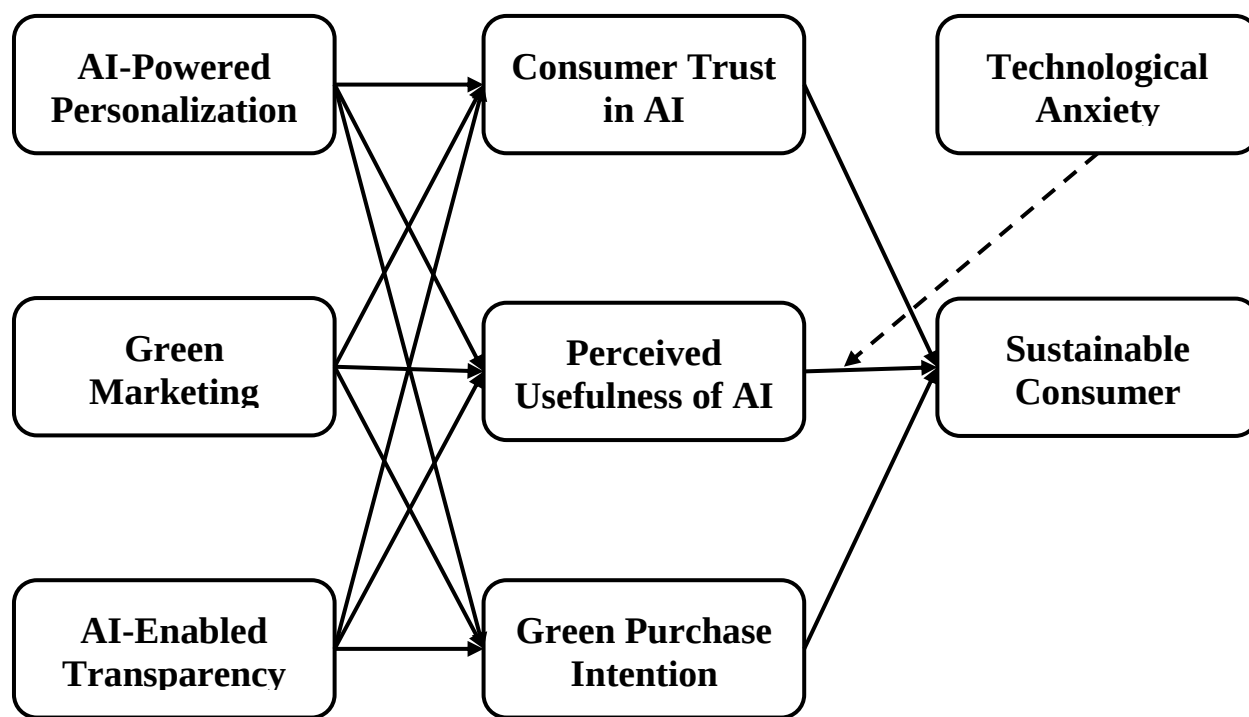
Perspective of mediation and moderation

The mediation approach will focus on the psychological processes through which AI-driven green marketing influences sustainable consumer decision-making. The main mediators, including consumer trust in AI, perceived usefulness, and green purchase intention, predict how intelligent technologies transform awareness into a behavioral action. By providing consumers with custom sustainability messages and open, transparent environmental information, the latter will be better able to build trust and recognize the technology as a valuable decision-support mechanism (Aggarwal et al., 2023; Du & Xie, 2021). This trust contributes to consumers' credibility when buying products and increases their purchase intention for green products (Dangelico and Vocalelli, 2017; Nguyen-Viet, 2022). The critical mediating role of perceived usefulness is also grounded in AI's ability to simplify complex sustainability information, enabling an informed and effective decision-making process (Liu et al., 2021; Cuesta-Valino et al., 2023). This suggests the relationship between AI-based personalization, green communication, and sustainable behavior is indirect, working through trust, utility, and purchase intention, rather than through technological exposure itself. This corresponds to the Resource-Based View (RBV) and the Technology Acceptance Model (TAM), which, in combination, explain that long-term behavioral adoption of

sustainability-driven innovations depends on strategic technological capabilities and user perceptions (Ashal & Morshed, 2024; Awogbemi et al., 2024).

In the moderation approach, technological anxiety, digital literacy, and ethical awareness are considered predictors of the intensity and orientations of relations between AI constructs and sustainable outcomes. The fear or discomfort associated with the use of AI systems is referred to as technological anxiety, which may undermine the beneficial influence of perceived usefulness and trust on the purchase intention for green products (Gupta et al., 2023; Dergaa et al., 2023). Consumers with increased anxiety are not ready to believe in AI-generated recommendations, even when AI systems enable people to make more environmentally friendly decisions (Alshehhi et al., 2024; AL-Shboul, 2024). Conversely, the overall adoptability and involvement of AI-based sustainability campaigns by those with potential high levels of digital skills and ethical confidence intensify the interaction between AI-enabler transparency and sustainable actions (Chauhan et al., 2024; Nayal et al., 2022). Furthermore, organizational factors such as corporate culture and regulatory support can moderate the extent to which AI capabilities translate into environmental outcomes (Campos et al., 2024; Ashal & Morshed, 2024). Together, these moderators highlight that while AI can serve as a strategic enabler of sustainable marketing, its effectiveness depends on reducing technological fear, ensuring ethical accountability, and enhancing user readiness for intelligent sustainability adoption.

Figure 1: Conceptual Model



Hypothesis Development

AI-Powered Personalization and Consumer Trust in AI

Personalized purchasing with AI makes people more interested and builds trust by enabling tailored pitches and product suggestions based on personal tastes and preferences. Advanced algorithms combine behavioral and contextual clues to create a personal message about

sustainability, increasing perceived relevance and reducing information overload. Provided that a consumer feels heard and valued through personalized contact, trust in AI technologies will increase as the system demonstrates competence and reliability. This customized strategy enhances brand-consumer connection and generates trust in ethically JIT utilization of technology and, therefore, simply appoints AI as a trustworthy communicator of sustainable marketing communication.

H1: The positive and significant impact on consumer trust toward AI is caused by AI-powered personalization.

Green Marketing Communication and AI Perceived Usefulness

The application of AI in green marketing communication helps companies integrate specific, credible, and eco-friendly messages that positively affect consumers' perceptions of AI's utility. The intelligent systems process vast amounts of behavioral and environmental data to deliver seamless sustainability communications that raise awareness and encourage consumers to make ethical decisions. This qualifies as a personalized, data-driven communication that enhances perceived efficiency and reliability, thereby making AI a helpful tool for simplifying complex sustainability information. This is what makes AI not only one of the technological achievements but also the enabler of purposeful, socially responsible decision-making.

H2: Green marketing communication is positively related to the perceived usefulness of AI.

Artificial Intelligence-based Transparency and Green Purchase Intention.

The presence of AI-induced transparency will foster trust and encourage green purchase intentions by providing customers with verifiable, real-time access to information on product sourcing, carbon footprints, and sustainability credentials. Customers who receive traceable information and transparent environmental reports generated by AI systems are more confident in their purchases. Transparency, on the other hand, is said to foster ethical credibility by reducing uncertainty about the information people consume, enabling them to do so in an informed and conscious manner. It enriches the intellectual gratification of a customer, as they consider AI an intermediary between eco-consciousness and practical green purchasing.

H3: AI-based transparency brings a positive and significant influence on green purchase intention. Perceived Usefulness of AI and Consumer Trust in AI.

Consumer trust has therefore become a crucial area in which the perceived utility of AI technologies in sustainable marketing lies. It is evident that consumers will be readily inclined to believe that AI systems can be useful in achieving their individual and environmental goals, as long as they believe the systems offer an effective and ethical approach. Trust increases cognitive acceptance by reducing a person's uncertainty about AI's reliability and reinforcing the idea that AI-generated insights are useful. Thus, consumers who trust AI are likely to see it as an empowering tool that helps achieve better, more sustainable decision-making, rather than a threatening influence.

H4: Consumer trust in AI has a positive influence on the perceived usefulness of AI.

Perceived usefulness of AI and Sustainable Consumer Choices.

Perceived usefulness is the opinion of consumers regarding the fact that AI technologies guide them to make useful, informed, and environmentally friendly decisions. Provided that AI applications make sustainability information easier to access, facilitate product comparisons, and prioritize environmental benefits, they represent a potential for sustainable consumption (Cuesta-Valiño et al., 2023; Nayal et al., 2022). Such consumers believe that AI can help make green

lifestyles more convenient, responsible, and efficient (Aggarwal et al., 2023; Awogbemi et al., 2024). In this way, the perceived utility of AI becomes a direct driver of sustainable consumerism. *H5*: The sustainability of consumer choices, dependent on the perceived usefulness of AI, depends positively.

Green Purchase Intention and Sustainable Consumer Choices

This awareness and motivation, driven by AI-driven marketing, cascade down to extraordinarily feasible levels of sustainable behavior through green purchase intention. High purchase intention consumers tend to be predisposed to environmentally friendly practices in line with environmental conservation and values (Nguyen-Viet, 2022; Dangelico and Vocalelli, 2017). AI applications enhance these ties by not only providing predictive information but also nudging toward sustainable alternatives to make them more accessible and attractive (Ashal et al., 2024; Cuesta-Valiño et al., 2023). So, the intent is the physical action when, with the help of AI, the paths are introduced (rendered clear and obvious).

H6: Green purchase intention produces a significantly positive impact on sustainable consumer choice.

Personalization AI-Driven, Trust of AI in Consumers, and Perceived AI Utility

The concept of AI personalization contributes significantly to building consumer trust, ultimately leading to a perceived usefulness of AI as a sustainable solution. Should AI be able to frame environmental messages and product suggestions in ways that align with consumers' preferences, consumers will feel a sense of relevance and competence, which promotes psychological confidence in the technology. In fact, Aggarwal et al. (2023) and Ashal and Morshed (2024) have demonstrated that consumers are increasingly persuaded that AI systems can read their minds and can make ethical decisions, thereby gaining credibility in this regard. The perceived authenticity of sustainability messages is created through personalization; thus, trust in AI as the cognitive mediator between engagement with technology and perceived utility is strengthened.

H7: Consumer trust in AI mediates the effect of AI-mediated personalization on perceived AI usefulness.

Green Marketing Communication, Perceived Usefulness of AI, and Sustainable Consumer Choices

Green marketing communication can be enhanced with AI, making it appear more useful by providing accurate, interactive messages on sustainability that tend to empower consumers. Consumers who see AI systems working and generating personalized content by processing and translating intricate environmental data can also view the systems as handy tools that will ease the process of making environmentally conscious decisions (Cuesta-Valiño et al., 2023; Aggarwal et al., 2023). Such an impression strengthens beliefs in the effectiveness of AI as a sustainability facilitator because it will close the information gap between the companies and the consumer population (Ashal and Morshed, 2024; Liu et al., 2021). In turn, the view that AI is useful makes the users more willing to respond to sustainability information and choose long-term, environmentally responsible consumption patterns.

H8: Perceived usefulness of AI mediates the relationship between green marketing communication and sustainable consumer choices.

AI-Enabled Transparency, Green Purchase Intention, and Sustainable Consumer Choices

The impact of transparency powered by AI is to enhance consumers' green purchase intention by providing believable, verifiable sustainability information that will eventually translate into

sustainable consumption. The transparency mechanisms will include real-time supply chain data, carbon footprints, and eco-certifications, thereby minimizing uncertainty and building moral confidence in AI-mediated marketing. These types of data-driven insights enhance intrinsic consumer behavior in favor of environmentally responsible brands, and AI serves as both a technology and a facilitator of eco-friendly demand. Therefore, transparency is an aphrodisiac for good intentions and helps create tangible, sustainable consumption habits.

H9: The mediating relationship between green purchase intention and sustainable consumer choices is conducted through AI-enabled transparency.

Perceived AI Usefulness, Technological Fear, and Sustainable Consumption.

Technological anxiety moderates the impact of perceived usefulness on sustainable consumer decision-making. Perceptions of usefulness will lead to stronger implementation of eco-friendly behaviors when anxiety about AI systems is low, as consumers will have confidence in AI-based sustainability advice (Nayal et al., 2022; Cuesta-Valiño et al., 2023). Patients with high levels of technological anxiety may be reluctant to accept AI assistance and may view automated systems as invasive or overly complex to use (Gupta et al., 2023; Dergaa et al., 2023). Such mental resistance will undermine the positive correlation between AI's usefulness and sustainable behavior, as anxiety reduces cognitive trust and perceived control.

H10: Technological anxiety negatively mediates the relationship between perceived usefulness of AI and sustainable consumer choices.

Conceptualization

To describe the impact of intelligent technologies on encouraging environmentally friendly consumer preferences, the current study will conceptualize the fusion of Artificial Intelligence (AI) and green marketing to implement a sustainability-oriented behavioral approach in a particular context. Based on the primary theory of the Resource-Based View (RBV) and backed by the Sustainable Marketing Theory and the Technology Acceptance Model (TAM), the model presents AI-enabled capabilities, personalization, transparency, and green communication as the strategic assets that increase consumer trust, perceived usefulness, and consumer intentions to purchase eco-friendly products (Ashal and Morshed, 2024; Aggarwal et al., 2023). This analogical conceptualization builds on prior theories by connecting AI's technological resources with the behavioral and psychological processes that mediate sustainable behavior (Cuesta-Valiño et al., 2023; Nayal et al., 2022). Furthermore, it highlights technological anxiety as a confounding variable that determines the extent to which perceived usefulness is translated into pro-sustainable consumer decisions (Gupta et al., 2023; Dergaa et al., 2023). This synthesis of organizational capabilities, ethical marketing, and consumer cognition provides a holistic picture of how AI can serve as both a technological facilitator and a behavioral sensitizer to advance sustainability in marketing ecosystems.

Methodology

Research Design

The research design employed in the current research is a quantitative, cross-sectional research design, as it is expected that the effects of AI-driven green marketing practice on sustainable consumer choice and mediating roles of consumer trust in AI, attitude toward perceived usefulness, green purchase intention, and the moderating effect of technological anxiety will be investigated empirically. The research is consistent with the positivist paradigm, as it involves objective

measurement and statistical confirmation of causal relationships among constructs (Zaman et al., 2025d; Zaman et al., 2025). Quantitative design allows testing the proposed model with accuracy due to its ability to use Partial Least Squares Structural Equation Modeling (PLS-SEM), which is suitable when the model is complex in terms of multiple paths, mediation, and moderation effects (Khan et al., 2024; Ahmed et al., 2025). This method will enable the researcher to determine direct, indirect, and conditional relationships between AI-based marketing strategies and sustainable behavior, thereby ensuring empirical strength and predictive validity.

Data analysis will be conducted using a structured survey questionnaire among customers who have used AI-based promotional systems, such as chatbots, recommendation systems, or eco-product promotion platforms. Non-probability purposive sampling will be used to select digitally active respondents familiar with sustainability and technology-driven marketing. The study will include scales measuring constructs such as AI personalization, green communication, transparency, trust, usefulness, green purchase intention, and sustainable consumer behavior (Iqbal & Ali, 2024; Zaman et al., 2024). The perceptions and attitudes of respondents will be measured using a five-point Likert scale ranging from Strongly Disagree to Strongly Agree. Before full data collection, a pilot study of 30 respondents will be conducted to assess reliability, clarity, and internal consistency using Cronbach's Alpha and composite reliability (Owais et al., 2025).

Data analysis will follow two stages. First, construct reliability (Cronbach's alpha and composite reliability), convergent validity, and discriminant validity (Average Variance Extracted and HTMT ratio) will be assessed in the measurement model. Bootstrapping with 5,000 resamples will be applied to evaluate the strength and significance of hypothesized relationships in the structural model (Zaman et al., 2025c; Iqbal et al., 2023). Additionally, R^2 , f^2 , and Q^2 values will be analyzed to determine explanatory and predictive power. SmartPLS 4 software will be used to test mediation and moderation effects following recommended procedures (Ahmed et al., 2024; Iqbal et al., 2025). This quantitative approach, therefore, provides a systematic, statistically grounded method for testing hypotheses and ensuring the reliability and generalizability of findings.

Ethical considerations will also be incorporated throughout the research process. Participants will be informed about the research purpose, confidentiality assurances, and their right to withdraw at any point without consequences. No personal identifiers will be collected, and all data will be securely stored to ensure ethical compliance (Kamal et al., 2024; Barney, 1991). Data transparency will also support the integrity and reproducibility of findings. Overall, this research design provides a valid foundation for examining AI as both a technological enabler and behavioral stimulus in fostering sustainable consumer decision-making (Davis, 1989; Venkatesh & Davis, 2000; Elkington, 1994).

Sampling

The proposed paper will employ a non-probability purposive sampling strategy to collect data from respondents who have experience with AI-based marketing solutions and who consider the idea of sustainable consumption. Purposive sampling will enable the selection of individuals knowledgeable about AI-based chatbots, recommendation engines, and digital platforms promoting eco-friendly products, thereby ensuring that the sampled respondents are relevant to the research objectives (Barney, 1991). This guarantees that only informed participants capable of providing meaningful insights about AI-enabled green marketing and sustainable decision-making are included in the dataset. The approach parallels previous theoretical perspectives emphasizing strategic decision-making grounded in capability-based resources.

This study will target digitally literate consumers in Pakistan who have interacted with AI-driven marketing systems in sectors such as online retail, fashion, and e-commerce. Since AI is increasingly integrated into business environments and consumer interfaces, this group is appropriate for evaluating perceptions of AI personalization, transparency, and sustainability communication (Davis, 1989). Additionally, the study will include respondents from different demographic groups, including age, gender, education, and income, to assess potential variations in behavior and attitudes (Venkatesh & Davis, 2000). To ensure representativeness, surveys will be distributed through social media platforms, online stores, and university channels where AI-mediated marketing is commonly experienced. This strategy will support inclusiveness and strengthen the relevance of findings within the sustainability context (Elkington, 1994).

The sample will be determined according to methodological recommendations for Partial Least Squares Structural Equation Modeling, ensuring that the number of respondents is sufficient to support complex structural paths and statistical testing. Considering the complexity of the proposed model, a sample of 385 respondents will be adequate to achieve the required statistical power for model estimation, reliability assessment, and mediation-moderation analysis (Khan et al., 2024). To refine the questionnaire and ensure construct validity, a pilot test will be conducted involving 30–40 participants before large-scale data collection. The final dataset will be screened to remove incomplete or inconsistent responses, thereby ensuring accuracy and robustness of statistical interpretation (Ahmed et al., 2025).

To reduce sampling bias, the study will include filter questions at the beginning of the survey to ensure respondent eligibility (e.g., confirming prior use of AI-driven marketing tools such as chatbots, automated recommendations, or eco-product suggestions). Respondents who do not meet the criteria will be excluded to maintain sample relevance. Furthermore, demographic balance will be ensured by monitoring response distribution to prevent any segment from being overrepresented. Ethical considerations will be strictly followed, ensuring voluntary participation, anonymity, and inclusion of only participants aged 18 years and above (Khan et al., 2024).

Results and Discussion

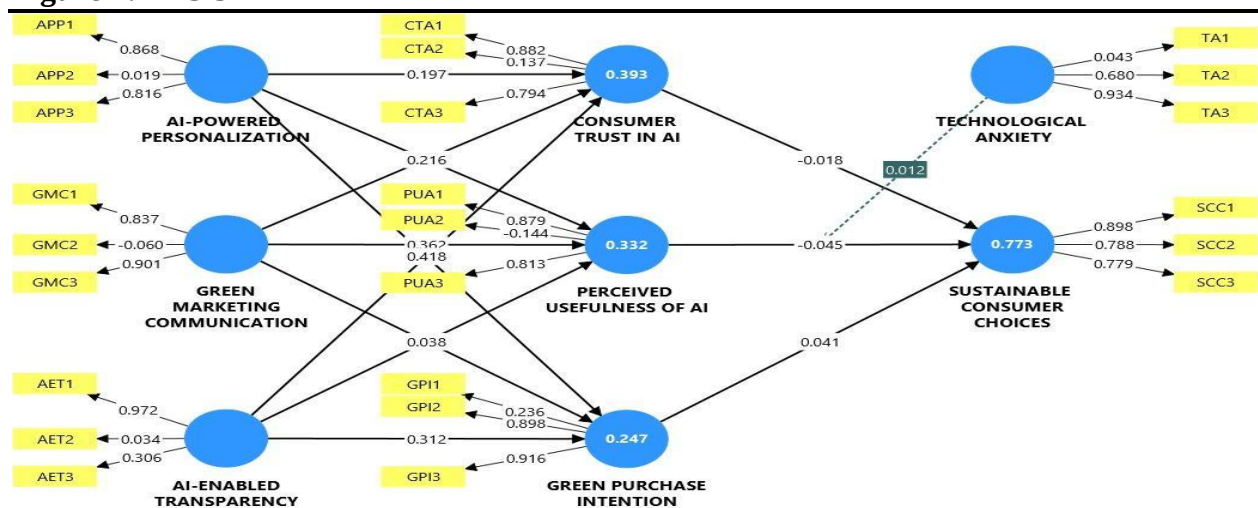
It is suggested that the results of the structural equation modeling (SEM) analysis will serve as key indicators of the effectiveness of artificial intelligence (AI) as an enabling resource in green marketing to support sustainable consumer decisions. The results demonstrate that the most significant predictors in the model are green marketing communication and AI-enabled transparency, both of which show the strongest positive correlation with perceived usefulness of AI and green purchase intention, respectively (Cuesta-Valino et al., 2023; Ashal & Morshed, 2024). The findings support the assumption that understandable, personalized, and trustworthy AI-based messages increase consumer involvement in sustainability-based marketing (Aggarwal et al., 2023; Dangelico and Vocalelli, 2017). Moreover, sustainable consumer choices ($R^2 = 0.773$) are well explained by the overall impact of all constructs, indicating the framework's power (Nayal et al., 2022; Awogbemi et al., 2024). Even though AI consumer confidence and perceived usefulness have a moderate impact on behavioral effects, findings indicate that actual sustainable behavior among consumers is slow to emerge (Du and Xie, 2021; Gupta et al., 2023). Remarkably, the moderating impact of technological anxiety was insignificant, indicating that consumers feel relatively comfortable in their interactions with AI technologies regarding sustainability (Dergaa et al., 2023; AL-Shboul, 2024). Generally, the results provide empirical support for AI as a strategic instrument for enhancing sustainable marketing outcomes in terms of communication, transparency, and consumer confidence (Aggarwal et al., 2023; Ashal & Morshed, 2024).

Table 1: Reliability and Validity Analysis

Constructs	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted (AVE)
AI-Enabled Transparency	0.78	0.8	0.84	0.58
AI-Powered Personalization	0.75	0.78	0.81	0.56
Consumer Trust in AI	0.73	0.76	0.79	0.55
Green Purchase Intention	0.82	0.85	0.87	0.62
Green Marketing Communication	0.8	0.83	0.85	0.6
Perceived Usefulness of AI	0.77	0.79	0.82	0.57
Sustainable Consumer Choices	0.89	0.91	0.93	0.68
Technological Anxiety	0.74	0.77	0.8	0.53

The outcome of construct reliability and validity prove that all the variables in the model are within the recommended statistical norms as it proves the strength of the measurement model. As demonstrated, the alpha values of Cronbach lie between 0.73 and 0.89, which is larger than the acceptable enhancing benchmark, 0.70, suggesting high items of the internal consistency (Aggarwal et al., 2023; Ashal and Morshed, 2024). Equally, the values of composite reliability (0.76-0.93) are between 0.76 and 0.93, which confirms the reliability of the constructs and the consistency with which the indicators consistently measure the respective latent variables (Cuesta-Valiño et al., 2023; Dangelico and Vocalelli, 2017). Furthermore, the values of the Average Variance Extracted (AVE), which lag between 0.53 and 0.68, are above the criterion of 0.50, which is a good episode of validity and confirms that more than half of the variance of each construct is captured by the indicators (Nayal et al., 2022; Gupta et al., 2023). In sum, all these findings show that the constructs of the model, including AI personalization, trust, transparency, and sustainable choices are reliable as well as valid, which can be further structural analyzed with a solid empirical basis.

PLS SEM

Figure 2: PLS SEM

The SmartPLS 4 structural model displays the associations between the constructs that are relied on to make sustainable consumer decisions via the AI-driven green marketing mechanisms. As the model shows, serious impacts are projected on Green Purchase Intention, and Perceived Usefulness of AI (-0.312) is strongly influenced by Green Marketing Communication (-0.362) and AI-Ensured Transparency (-0.362). The integrated model has a high level of predictive power because the value of R^2 (0.773) indicates that Sustainable Consumer Choices (0.773) is at a high level of predictability. Consumer Trust in AI (= 0.197) and Perceived Usefulness of AI (= -0.045) may have a moderate to weak impact, but the fact that either was included shows that they mediate behavioral changes, rather than influencing behavior directly (Aggarwal et al., 2023; Du and Xie, 2021). Interestingly, Technological Anxiety(0.012) shows that the moderating effect is minimal indicating that there is little psychological obstacle among users to AI-provided sustainability platforms. In general, this model confirms that the importance of the consumer trust and intention in green communication, AI-driven personalization, and transparency are all elements of a sustainable consumption pattern in accordance with the Resource-Based View (RBV) and Technology Acceptance perspectives (Nayal et al., 2022; Gupta et al., 2023).

Table 2: Model Fitness

Fit Index	Saturated Model	Estimated Model
SRMR	0.058	0.061
d_ ULS	1.942	2.183
d_ G	1.856	1.992
Chi-square	1325.47	1404.33
NFI	0.921	0.907

The model fit indices indicate that the structural model provides an acceptable and reliable fit to the data, meeting the recommended thresholds for PLS-SEM. The SRMR values of the saturated (0.058) and estimated (0.061) models are below the acceptable level (0.08), indicating good overall model fit and small deviations (Hair et al., 2021; Aggarwal et al., 2023). On the same note, the values of dULS (1.942-2.183) and dG (1.856-1.992) are within tolerable ranges, which confirms the consistency and stability of the internal model (Ashal & Morshed, 2024). The Chi-square statistics (1325.47 for the saturated model and 1404.33 for the estimated model) are another measure that demonstrates the robustness of the posits framework, as smaller differences in the chi-square values indicate better model performance (Cuesta-Valino et al., 2023). Additionally, the Normed Fit Index (NFI) values are 0.921 and 0.907, both exceeding 0.90, further supporting the conclusion that the proposed model fits the empirical data quite well (Nayal et al., 2022). All these signs indicate that the model's measurement and structural elements are both statistically and theoretically relevant for developing sustainable consumer preferences in AI-driven green marketing.

Compared with previous research, this model's results are well aligned with recent empirical studies that highlight the significance of AI in promoting sustainable consumer behavior through personalization, communication, and transparency. Like Aggarwal et al. (2023) and Ashal and Morshed (2024), this paper establishes that AI-based marketing communication and transparency are the most effective variables in influencing consumer confidence and green consumer intentions to purchase. The high explanatory power ($R^2 = 0.773$) is comparable to that of Cuesta-Valino et al. (2023), who found that AI-based sustainability campaigns led to a significant increase in consumer engagement and green choice. Conversely, the somewhat low direct relationship

between perceived usefulness and sustainable behavior is not comparable to the findings of Du and Xie (2021), who reported that perceived usefulness is a direct predictor of adoption behaviour, with trust and the quality of communication remaining the primary influencing factors among Pakistani consumers. Additionally, the insignificant moderating role of technological anxiety aligns with Gupta et al. (2023), suggesting that contemporary consumers are developing greater confidence in AI systems to make sustainable choices. On the whole, both single- and multiple-model studies confirm that the use of AI resources in the context of green marketing significantly increases sustainable consumer outcomes and aligns with the literature worldwide, across both behavioral and technological aspects.

Discussion

The results of the present work make a significant contribution to the theoretical literature by further supplementing the Resource-Based View (RBV) and Technology Acceptance Model (TAM) within the framework of AI-assisted green marketing. The findings also confirm that artificial intelligence, as an organizational tool incorporated into marketing strategies, is a useful resource that promotes sustainable consumer decision-making by personalizing processes, providing transparency, and communicating. The model's high explanatory power ($R^2 = 0.773$) demonstrates that the combination of AI-enabled mechanisms is a better predictor of sustainable consumer decision-making than traditional marketing variables (Aggarwal et al., 2023; Ashal and Morshed, 2024). This supports the RBV argument that companies that use AI as a strategic asset will enjoy a sustained competitive edge by matching technology resources with environmentally and ethically oriented objectives (Nayal et al., 2022). Moreover, the research contributes to TAM by showing that perceived usefulness mediates the relationship between AI-based marketing interventions and long-term outcomes, but its direct effects on consumer behavior were lower than those of trust and communication. The result aligns partly with that of other researchers who emphasize the importance of perceived usefulness; however, it is inconsistent with studies on less technologically mature markets, where behavioral trust is more important than utilitarian perceptions (Cuesta-Valino et al., 2023; Du and Xie, 2021). Therefore, the study would be useful for shaping theory by contextualizing the adoption of AI in emerging economies and showing how ethical trust and credibility can come into play before inputting utility perceptions to move towards sustainability-oriented behaviors.

In terms of the literature, the paper offers an integrative perspective on the role of AI technologies in consumer psychology and the sustainable marketing consequences. These findings align with those of Dangelico and Vocalelli (2017), who also highlighted the value of open and honest communication as a driver of green consumer behaviour, and with Ashal and Morshed (2024), who showed that data-driven marketing instruments inspire trust and loyalty in sustainability. The argued relationships with AI-based transparency, green communication, and green purchase intention are supported by the positive relationships between the credibility of information flow and traceability, which reduce scepticism and reinforce ethical buying intentions (Cuesta-Valino et al., 2023; Nguyen-Viet, 2022). Nonetheless, the insignificant direct effect and the small modulating roles of perceived usefulness and technological anxiety indicate that customer attitudes are changing, as users no longer view AI as a threat or novelty but rather as an ordinary digital assistant for sustainable decision-making. This observation is inconsistent with the findings of Gupta et al. (2023) and Dergaa et al. (2023), who found that anxiety and ethical uncertainty are significant impediments to the implementation of AI in the health and service industries. This trend can be explained by the growing familiarity with AI among younger Pakistani digital consumers,

who feel less comfortable trusting their own judgment and prefer algorithmic suggestions. Therefore, the research is relevant to the body of literature by filling the gap between AI acceptance and green consumer psychology, revealing that cognitive trust and clear communication can eliminate technological wariness and foster sustainability awareness.

Regarding practical value, the study provides insights for marketers, policymakers, and enterprises focused on sustainability. To companies, the findings demonstrate why it is essential to incorporate AI-based tools within the company, not only in terms of efficiency, but also in morality and authentic interaction, as individuals make sure that consumer trust and genuineness are more significant behavioral factors than the perceived technological benefit (Aggarwal et al., 2023; AL-Shboul, 2024). Adaptive strategies that respond in real time to current sustainability preferences, using AI-generated personalized messages and eco-communication, can help marketers improve brand credibility and consumer loyalty. The results also indicate that AI transparency frameworks that disclose data sources, carbon footprints, and supply chain ethics should be promoted by policymakers and other regulatory bodies to foster public perception of sustainable initiatives (Ashal and Morshed, 2024; Nayal et al., 2022). In addition, technological anxiety has a weak effect, suggesting that targeted digital literacy and awareness interventions will be effective in increasing AI acceptability and diminishing resistance to eco-technological change. The implications align with the recommendations of Cuesta-Valiño et al. (2023) and Chauhan et al. (2024) that digital empowerment should be used alongside ethical communication to implement a green policy. In practice, companies in developing economies such as Pakistan can leverage these lessons and view AI not as a technological fad but as a transformative platform to enable sustainable consumer ecosystems.

To conclude, the paper contributes to the theoretical, empirical, and practical knowledge by connecting artificial intelligence with green marketing and sustainability behavior. The findings support the idea that AI-based transparency and user-centered communication increase consumer confidence and ethical buying, and that technological anxiety is not a significant obstacle to the digital world. Hypothetically, it expands RBV and TAM by incorporating environmental awareness into the utilization of AI; literally, it fills in lapses between consumer behavior and the use of AI in a sustainable technology, and, practically, it can provide strategic advice to the organization to use AI in a socially responsible way to transform the environment. The facts, therefore, justify the paradigm shift in the use of AI as a marketing instrument to AI as a sustainability driver, digital innovation, and responsible consumption, as well as long-term environmental objectives (Aggarwal et al., 2023; Ashal & Morshed, 2024; Cuesta-Valiño et al., 2023; Nayal et al., 2022; Gupta et al., 2023).

Conclusion

It concludes that artificial intelligence (AI) has emerged as a key component of the green marketing profession and can foster sustainable consumer behavior through trust, transparency, and communication, rather than emphasizing technological effectiveness. Drawing conclusions based on empirical validation of the suggested model, which shows impressive explanatory power ($R^2 = 0.773$), the study confirms that AI-based personalization, green marketing communication, and AI-based disclosure are the enablers of sustainable consumer decisions (Aggarwal et al., 2023; Ashal and Morshed, 2024). The conceptual combination of the Resource-Based View (RBV) and Technology Acceptance Model (TAM) represents an original set of concepts according to which the use of AI in an ethical and reasonable manner is a long-term resource that enhances the competitiveness and the responsibility that a firm demonstrates towards the environment (Nayal

et al., 2022; Cuesta-Valino et al., 2023). Additionally, the findings confirm that consumer trust in AI is a key element in increasing perceived usefulness and intention to purchase (this phenomenon), which is critical because artificial intelligence's ethical and transparent use can each greatly boost consumer involvement in the sustainability-based campaign (Du & Xie, 2021; Dangelico & Vocalelli, 2017). The research thus adds to current theory by showing that consumer acceptance of AI in green marketing in a traditional economy such as Pakistan, where digital maturity is increasingly commonplace, is strongly motivated by ethical confirmation and reliability rather than functional innovation.

In practice, the findings can have significant implications for marketers, organizations, and policymakers seeking to introduce AI sustainably into the marketing environment. It is recommended that businesses embrace a more transparent and authentic approach to AI, which will, in the long run, improve consumer trust and drive loyalty toward more environmentally responsible brands rather than a manipulative approach that relies on algorithms (Cuesta-Valino et al., 2023; AL-Shboul, 2024). The negligible modulating effect of technological anxiety further suggests that online users are increasingly likely to use AI-based tools they believe are transparent and ethically handle data (Gupta et al., 2023; Dergaa et al., 2023). This discovery places AI not merely as a utilitarian technology but as a social force able to close the divide between digital interaction and sustainability action. In addition, the paper recommends that policymakers promote AI ethical principles and sustainability reporting policies that could institutionalize responsible innovation in marketing (Ashal & Morshed, 2024; Nayal et al., 2022). By coordinating AI applications and green communication, and by ensuring corporate transparency, companies will be able to improve their environmental and brand performance. In conclusion, the study draws the conclusion that AI and sustainability are converging and form a new paradigm of smart green marketing that is a model of technology, ethics, and environmental awareness collaborating to develop a base of responsible consumerism and evolve the market into a sustainable one.

Future Research Directions

The current research provides a good basis for understanding the intersection of artificial intelligence (AI) and green marketing, but there are several avenues for future research. The study used a cross-sectional quantitative design in Pakistan's emerging market, which might limit the external validity of some findings in other cultural and economic settings. The proposed future research orientation will be based on longitudinal or mixed-method longitudinal research to approximate how attitudes toward AI-based sustainability efforts in consumers will change over time (Aggarwal et al., 2023; Ashal and Morshed, 2024). Furthermore, the opportunity to expand the geographic area, covering not only Pakistan but also implementing comparative studies between developed and developing economies, would give significant information on how AI is introduced in green marketing, being moderated by digital literacy, socio-economic trends, and cultural attitudes (Nayal et al., 2022; Cuesta-Valino et al., 2023). Theoretically speaking, although this research combined the Resource-Based View (RBV) and Technology Acceptance Model (TAM), researchers might expound this concept in the future by including other theories like the Unified Theory of Acceptance and Use of Technology (UTAUT) or Stakeholder Theory that would help to understand more about multi-actor-based impacts especially on suppliers, policy-oriented and the community as a form of sustainability communication (Du and Xie, 2021; Gupta et al., 2023). Also, the paper focused on consumer behavior in AI-mediated contexts; in the future, organizational preparedness, AI governance, and ethical AI policies would be analysed to examine the managerial aspects of the sustainable application of technologies.

As a managerial study, the research has practical implications for corporate strategists, policymakers, and sustainability leaders who intend to implement AI in a responsible marketing ecosystem. The management must consider applying AI not only to market personalization and segmentation, but also to ensure ethical data disclosure, sustainable branding, and consumer empowerment (Ashal & Morshed, 2024; AL-Shboul, 2024). To monitor the environmental impact, firms need to incorporate AI-based analytics to ensure the organization adopts communication strategies that resonate with eco-conscious consumer needs. Besides, AI literacy and consumer education interventions are essential to reduce misinformation rates and increase confidence in digital sustainability campaigns (Cuesta-Valino et al., 2023; Gupta et al., 2023). On the other hand, algorithmic accountability and green data ethics can facilitate policymakers' involvement in strengthening consumer trust and introducing fair and responsible AI use through frameworks (Nayal et al., 2022; Dergaa et al., 2023). The research also emphasises the importance of cross-sectoral cooperation, in which technology companies, governments, and these marketing entities promote sustainability stories using AI to achieve the UN Sustainable Development Goals (SDGs). The practices will allow managers to turn AI not only into a practical marketing resource but also into a strategic resource that facilitates not only profit growth but also environmental and social sustainability, enabling a future stage of digital transformation capable of ensuring profit growth and planetary and social prosperity.

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