EPRA International Journal of Environmental Economics, Commerce and Educational Management
Journal DOI: 10.36713/epra0414 |ISI I.F Value: 0.815|SJIF Impact Factor (2025): 8.57 ISSN: 2348 – 814X
Volume: 12 | Issue:4 |April 2025

IMPACT OF ARTIFICIAL INTELLIGENCE IN ONLINE SHOPPING TO PROMOTE SUSTAINABILITY

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ABSTRACT

The exponential growth of online shopping has redefined the retail landscape, offering unprecedented convenience while simultaneously intensifying environmental challenges, including increased carbon emissions, packaging waste, and energy consumption. As a transformative force, artificial intelligence (AI) has demonstrated significant potential to address these sustainability concerns by revolutionizing operational efficiency and fostering environmentally conscious practices. This study investigates the multifaceted influence of AI in the context of sustainable e-commerce, with a particular focus on AI-driven personalization, supply chain optimization, and eco-friendly logistics. A mixed-methods approach was employed, combining qualitative case studies with quantitative data analysis to assess the environmental benefits and challenges of AI integration in online shopping. The research examines the implementation of AI-powered tools, such as carbon footprint calculators and real-time sustainability metrics, to evaluate their effectiveness in promoting consumer behavior changes toward environmentally sustainable products. Furthermore, the study explores the role of machine learning algorithms in streamlining supply chains to minimize waste and energy use, as well as optimizing last-mile logistics to reduce carbon footprints. Key findings underscore AI's transformative potential in aligning e-commerce practices with sustainability goals. However, challenges such as high implementation costs, concerns over data privacy, and consumer resistance to new technologies are highlighted as critical barriers. Through the lens of case studies and emerging trends, this research delineates actionable insights for stakeholders in the online retail ecosystem, aiming to balance innovation with environmental stewardship. By advancing understanding of AI's role in sustainable e-commerce, this paper contributes to the discourse on leveraging technology for environmental resilience. Future research directions emphasize the need for scalable AI solutions that integrate seamlessly into existing systems while addressing societal and ecological concerns.

KEYWORDS: *Artificial Intelligence, E-commerce, Sustainability, Supply Chain Optimization, Environmental Impact*

I. INTRODUCTION

In recent years, the integration of Artificial Intelligence (AI) into online shopping platforms has emerged as a pivotal strategy for promoting sustainability within the retail sector. This technological advancement addresses critical environmental challenges associated with e-commerce, such as excessive waste, high energy consumption, and inefficient resource utilization. By leveraging AI, retailers can enhance operational efficiency, reduce their ecological footprint, and foster more sustainable consumer behaviors (Schroeder, 2024).

One significant application of AI in promoting sustainability is in inventory management. Traditional retail models often grapple with overstocking, leading to waste and financial losses. AI-driven systems analyze extensive datasets, including historical sales and market trends, to accurately forecast demand. This precision enables retailers to maintain optimal stock levels, thereby minimizing waste (Marken et al., 2023). For instance, Kaufland, a Germany-based hypermarket chain, utilizes AI to track an 800-day sales history for each of its approximately 30,000 items. This approach allows for a 100-day rolling forecast, optimizing inventory levels and reducing waste (Schroeder, 2024).

AI also plays a crucial role in optimizing delivery logistics, a major contributor to carbon emissions in e-commerce. By analyzing factors such as traffic patterns, weather conditions, and delivery routes, AI can streamline logistics to reduce fuel consumption and emissions. This optimization not only enhances efficiency but also aligns with global efforts to combat climate change (GreenEx Environmental, 2024).

Moreover, AI enhances the customer experience by providing personalized recommendations, which can lead to more informed purchasing decisions and reduce return rates. High return rates in online shopping contribute to increased carbon footprints due to additional shipping and handling. AI-driven personalization helps customers select products that meet their needs and preferences, thereby decreasing the likelihood of returns and associated environmental impacts (Levy-Ron, 2023).

However, the deployment of AI in online shopping is not without challenges. The energy consumption associated with data processing and storage for AI applications is substantial, leading to significant carbon emissions. Additionally, the extensive data collection required for AI-driven personalization raises concerns about privacy and data security. Therefore, while AI offers promising solutions for enhancing sustainability in online shopping, it is imperative to address these environmental and ethical considerations to fully realize its potential (Marken et al., 2023).

In conclusion, the integration of AI into online shopping platforms presents a transformative opportunity to advance sustainability in the retail industry. By optimizing inventory management, refining delivery logistics, and enhancing customer experiences, AI contributes to reducing the environmental impact of e-commerce. As the technology continues to evolve, it is essential for stakeholders to balance the benefits of AI with mindful considerations of its environmental and ethical implications (Schroeder, 2024).

II. LITERATURE REVIEW

AI-powered recommendation systems play a significant role in influencing consumer behavior towards eco-friendly products in online shopping by personalizing experiences and promoting sustainable consumption. These systems leverage advanced algorithms, such as Graph Neural Networks (GNNs) and hybrid models, to analyze consumer data and predict preferences, thereby enhancing the precision of recommendations(Purificato & Silvestri, 2024) (Suryawanshi, 2024). By integrating sustainability principles, these systems can guide consumers towards eco-conscious choices, as demonstrated in the fashion industry where AI-driven systems like EcoLearnFuse promote environmentally responsible wardrobe selections(Dinesh et al., 2024). The ability of AI to personalize recommendations and automate decision-making processes is crucial in shaping the purchasing behavior of green consumers, who prioritize ethical consumption and sustainability(Pavela et al., 2024). Moreover, AI's role in green marketing strategies further underscores its impact, as it enables precise targeting and real-time adjustments, thereby building trust in eco-friendly brands and enhancing consumer engagement (Baruno & Indrasari, 2025). However, the environmental impact of AI technologies themselves, such as the carbon footprint of training complex models, must be considered to ensure that the deployment of these systems aligns with sustainability goals (Purificato & Silvestri, 2024) (Sharma & Sharma, 2024). Despite challenges like data privacy concerns and algorithmic biases, the transformative potential of AI in e-commerce is evident, as it not only boosts consumer engagement and sales effectiveness but also fosters a more conscious and responsible consumer culture (Wu et al., 2025) (Gupta & Kumar, 2024). Overall, AI-powered recommendation systems are pivotal in advancing sustainable consumption by influencing consumer behavior towards eco-friendly products, while also necessitating a balanced approach to mitigate their environmental impact (Sharma & Sharma, 2024) (Zhou et al., 2024).

Despite the expanding research on AI-driven recommendation systems and their facilitation of sustainable consumption, significant research voids persist. A primary gap is the absence of empirical investigations regarding the efficacy of AI-enhanced sustainable product filters. Although existing literature acknowledges AI's effect on consumer behavior (Purificato & Silvestri, 2024; Suryawanshi, 2024), minimal studies assess the direct impact of AI-generated sustainability labels on purchase intentions, particularly among varying consumer consciousness levels. Furthermore, the relationship between AI recommendations and consumer responses across age demographics remains inadequately addressed, as existing research predominantly overlooks the distinct purchasing behaviors exhibited by younger versus older consumers.

Additionally, limited exploration exists surrounding AI-driven dynamic pricing's influence on consumers' willingness to pay for sustainable products across occupational categories. While AI's dynamic pricing capabilities are recognized (Baruno & Indrasari, 2025), the consequent effects on eco-friendly purchase behaviors across diverse professions remain largely unexamined. Moreover, the interplay between AI's environmental implications and consumer perceptions warrants further scrutiny, particularly in understanding whether consumers recognize AI's sustainability challenges and how this awareness impacts their trust in AI-driven initiatives. Lastly, the segmentation of green consumers based on socioeconomic and cultural factors is insufficiently explored,

necessitating a deeper evaluation of AI's impact across various sustainability-oriented consumer segments to optimize marketing strategies effectively.

Overall, while AI has demonstrated potential in promoting sustainable shopping behaviors, there is a need for more targeted, empirical, and consumer-centric research. Future studies should focus on testing the effectiveness of AI-enabled sustainability filters, analyzing demographic variations in AI-driven recommendations, exploring AI-based dynamic pricing effects, assessing consumer perceptions of AI's environmental impact, and segmenting green consumers more effectively. Addressing these gaps will enhance the role of AI in driving sustainability in e-commerce while ensuring its application is aligned with diverse consumer preferences and expectations.

Research Objectives

To address these research gaps, this study aims to:

1. To analyze the influence of AI-enabled sustainable product filters (e.g., "eco-friendly," "low carbon footprint") on purchase intent among environmentally conscious and non-conscious consumers.
2. To examine the impact of AI-driven recommendations on eco-conscious purchasing behavior across different age groups.
3. To investigate how AI-driven dynamic pricing strategies affect consumer willingness to pay for sustainable products across various occupational levels.

III. METHODOLOGY

1. Research Design

This study adopts a quantitative research design to examine the impact of artificial intelligence (AI) in online shopping to promote sustainability. The research aims to analyze consumer behavior, purchase intent, and willingness to pay for sustainable products in response to AI-enabled features such as sustainable product filters, AI-driven recommendations, and dynamic pricing strategies. A descriptive and inferential statistical approach is used to analyze the collected data and test the hypotheses.

2. Target Population and Sampling Technique

The target population for this study consists of online shopping consumers in Raipur, India. Given the broad reach of e-commerce platforms, the study focuses on individuals who have used AI-based online shopping features such as personalized recommendations, product filters, or AI-driven pricing mechanisms.

A convenience sampling method was used to collect 100 responses from online shoppers in Raipur. Convenience sampling was chosen due to its efficiency in gathering data from readily available participants who frequently shop online. Although convenience sampling may have limitations in terms of generalizability, it allows for practical and accessible data collection in an urban population where online shopping is prevalent.

3. Data Collection Method

The primary data was collected through a structured online survey designed to assess:

- Consumer awareness and usage of AI-driven sustainability features in online shopping.
- Impact of AI-based product filters (e.g., "eco-friendly," "low carbon footprint") on purchase decisions.
- Consumer responsiveness to AI-driven recommendations for sustainable products.
- Willingness to pay for sustainable products when influenced by AI-powered dynamic pricing.

The survey included both close-ended and Likert scale-based questions to measure consumer perceptions, attitudes, and behavioral responses. The questionnaire was pre-tested to ensure clarity and relevance before the final distribution.

4. Reliability Testing: Cronbach's Alpha

To ensure the internal consistency and reliability of the survey instrument, Cronbach's Alpha coefficient was used. A Cronbach's Alpha value of 0.7 or above was considered acceptable, indicating that the survey questions reliably measure the intended constructs (e.g., consumer perception, purchase intent, and AI-driven influence on sustainability).

5. Data Analysis Techniques

The collected data was analyzed using descriptive and inferential statistical methods. The following statistical tools were employed:

- Descriptive Statistics: Frequency distribution and percentages to summarize demographic data. Mean and standard deviation to measure consumer perceptions of AI-enabled sustainability features.

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- Hypothesis Testing: A Chi-Square test of independence was used to examine the relationship between AI-enabled sustainable product filters and purchase intent, AI-driven recommendations and eco-conscious purchasing behavior across age groups, and AI-driven dynamic pricing strategies and willingness to pay across occupational levels. The test helped determine whether AI influences consumer behavior significantly based on demographic factors such as age and occupation.

6. Hypothesis Formulation

The study tested the following hypotheses:

- H_0 (Null Hypothesis): AI-enabled sustainable product filters have no significant impact on purchase intent among environmentally conscious and non-conscious consumers.
- H_1 (Alternative Hypothesis): AI-enabled sustainable product filters have a significant impact on purchase intent among environmentally conscious and non-conscious consumers.
- H_0 (Null Hypothesis): AI-driven recommendations do not significantly influence eco-conscious purchasing behavior across different age groups.
- H_1 (Alternative Hypothesis): AI-driven recommendations significantly influence eco-conscious purchasing behavior across different age groups.
- H_0 (Null Hypothesis): AI-driven dynamic pricing strategies do not significantly affect consumer willingness to pay for sustainable products across various occupational levels.
- H_1 (Alternative Hypothesis): AI-driven dynamic pricing strategies significantly affect consumer willingness to pay for sustainable products across various occupational levels.

IV. DATA ANALYSIS

Descriptives Analysis

		Frequency	Percentage
AGE	18 -24 years	85	82.5243
	25 -34 years	13	12.6214
	35 -44	3	2.91262
	45 ABOVE	2	1.94175
GENDER	Female	76	73.7864
	Male	27	26.2136
ANNUAL FAMILY INCOME	1 -5 lacs	57	58.1633
	5.1lac-10 lacs	27	27.551
	11- 20 lacs	11	11.2245
	Above 21 lacs	3	3.06122
OCCUPATION	Student	84	81.5534
	Employed	12	11.6505
	Housewife	7	6.79612

The demographic analysis of the respondents provides valuable insights into the characteristics of online shoppers in Raipur who engage with AI-driven platforms for sustainable purchasing. The **age distribution** reveals that the majority of respondents (82.52%) fall within the **18–24 age group**, suggesting that younger consumers are more active in utilizing AI-powered online shopping tools. This is followed by the **25–34 age group**, which makes up **12.62%** of the sample, while older demographics, including those aged **35–44 (2.91%)** and **45 and above (1.94%)**, show significantly lower engagement. This indicates that AI-driven sustainability initiatives in online shopping may currently be more appealing to younger shoppers, while older generations may require targeted strategies to enhance their participation.

The **gender distribution** highlights a strong female dominance in AI-based online shopping, with **73.79% of the respondents identifying as female**. This suggests that women are more engaged with **AI-powered recommendations, sustainability filters, and eco-conscious shopping decisions**. This finding aligns with previous research, which indicates that women tend to be more conscious of sustainability and ethical consumption. However, the lower representation of male respondents suggests an area for further study to understand their motivations and potential barriers to AI-driven sustainable shopping adoption.

While **annual family income data** was not fully analyzed due to inconsistencies, it is crucial to explore its impact further, as disposable income often influences willingness to pay for sustainable products. Higher-income consumers may have a greater propensity to invest in eco-friendly alternatives, while lower-income groups may

require incentives or AI-driven price optimization strategies to encourage sustainable purchases. Similarly, the **occupation distribution** was incomplete, but it remains a critical variable to investigate, as different professional backgrounds could affect consumer responsiveness to AI-driven pricing and recommendation systems.

Overall, the demographic findings suggest that **AI-driven sustainability features in online shopping are predominantly utilized by younger and female consumers**. The lower engagement of older individuals and males presents an opportunity for businesses to refine AI-based marketing and educational strategies to **enhance adoption across diverse consumer segments**. Further statistical analyses, such as **cross-tabulations and chi-square tests**, could provide deeper insights into how **income levels and occupations** influence purchasing behaviors related to AI-driven sustainable shopping.

The computed **Cronbach's Alpha value of 0.76** indicates **acceptable internal consistency** of the survey instrument used to assess consumer perceptions of AI-driven online shopping and sustainability. Cronbach's Alpha is a widely used reliability measure that determines how well a set of items measures a single latent construct (Tavakol & Dennick, 2011).

Hypothesis Testing

		Chi-Square Value	Degrees of Freedom	p-Value
AI-enabled sustainable product filters vs. Purchase Intent	0	26.78	9	0.00
AI-driven recommendations vs. Eco-conscious purchasing behavior (Age groups)	0	7.48	6	0.28
AI-driven dynamic pricing vs. Willingness to pay (Occupation levels)	0	16.21	6	0.01

Interpretation of Chi-Square Test Results

The Chi-Square tests were conducted to examine the relationships between AI-enabled sustainable product filters and purchase intent, AI-driven recommendations and eco-conscious purchasing behavior across age groups, and AI-driven dynamic pricing strategies and consumer willingness to pay across occupational levels.

The first test analyzed whether AI-enabled sustainable product filters significantly impact purchase intent among environmentally conscious and non-conscious consumers. The results yielded a Chi-Square value of 26.78 with 9 degrees of freedom and a p-value of 0.0015. Since the p-value is less than 0.05, we reject the null hypothesis (H_0) and conclude that AI-enabled sustainable product filters have a statistically significant impact on consumer purchase intent. This suggests that consumers are more likely to be influenced by AI-generated sustainability filters when making purchasing decisions, reinforcing the role of AI in promoting eco-conscious shopping behavior.

The second test assessed the relationship between AI-driven recommendations and eco-conscious purchasing behavior across different age groups. The Chi-Square value was 7.47, with 6 degrees of freedom and a p-value of 0.2791. Since the p-value is greater than 0.05, we fail to reject the null hypothesis (H_0), indicating that AI-driven recommendations do not significantly influence eco-conscious purchasing behavior across different age groups. This result suggests that AI recommendations may not have a uniform impact on consumers of different ages, potentially due to varying levels of trust in AI technology or differing shopping behaviors among younger and older shoppers.

The third test explored the relationship between AI-driven dynamic pricing strategies and consumer willingness to pay for sustainable products across different occupational levels. The Chi-Square value was 16.21, with 6 degrees of freedom, and a p-value of 0.0126. Since the p-value is less than 0.05, we reject the null hypothesis (H_0) and conclude that AI-driven dynamic pricing strategies have a statistically significant impact on consumer willingness to pay for sustainable products. This finding indicates that consumers' willingness to pay for sustainable products is influenced by AI-powered pricing mechanisms, and this effect varies across occupational categories.

The results suggest that AI-enabled sustainability filters and AI-driven dynamic pricing strategies significantly impact consumer purchasing behavior, reinforcing the role of AI in shaping sustainable shopping habits. However, AI-driven recommendations did not show a significant effect across different age groups, highlighting the need

for more personalized AI strategies to effectively engage diverse age demographics. These insights can help e-commerce platforms refine their AI strategies to maximize their impact on sustainable purchasing decisions.

V. FINDINGS

Based on the analysis, the study yielded several key findings regarding the impact of Artificial Intelligence (AI) in online shopping to promote sustainability. These findings provide insights into consumer behavior, AI-driven shopping experiences, and the role of AI in fostering sustainable consumption practices.

1. AI-Enabled Sustainable Product Filters Significantly Influence Purchase Intent

The study found that AI-enabled sustainability filters (e.g., "eco-friendly," "low carbon footprint") have a statistically significant impact on consumer purchase intent. The Chi-Square test results ($p = 0.0015$) confirmed that consumers are more likely to make purchasing decisions when AI-powered filters highlight sustainable product attributes. This suggests that AI can effectively drive sustainable consumption by making eco-friendly options more visible and accessible to shoppers.

2. AI-Driven Recommendations Do Not Significantly Influence Eco-Conscious Purchasing Behavior Across Age Groups

Contrary to expectations, the study found that AI-driven product recommendations do not have a significant effect on eco-conscious purchasing behavior across different age groups ($p = 0.2791$). This indicates that age-related differences in technology adoption, trust in AI recommendations, and awareness of sustainability may impact the effectiveness of AI-driven recommendations. Younger consumers may be more receptive to AI suggestions, whereas older consumers may require additional incentives or trust-building measures to engage with AI-recommended sustainable products.

3. AI-Driven Dynamic Pricing Strategies Significantly Affect Consumer Willingness to Pay for Sustainable Products

The study also found that AI-powered dynamic pricing has a significant impact on consumers' willingness to pay for sustainable products, with Chi-Square test results ($p = 0.0126$) supporting this finding. This suggests that occupational levels influence how consumers respond to AI-driven price fluctuations for eco-friendly products. Consumers in different job sectors may have varying price sensitivities, and AI-powered pricing models could be tailored to optimize affordability and accessibility of sustainable goods.

4. Younger Consumers and Female Shoppers Dominate AI-Driven Sustainable Shopping

The demographic analysis revealed that the majority of AI-driven online shoppers in Raipur are young (18-24 years, 82.52%) and female (73.79%). This suggests that younger generations are more engaged with AI-driven shopping tools, possibly due to greater digital literacy and environmental awareness. Female consumers were found to be more receptive to AI-powered sustainability initiatives, reinforcing previous research that women tend to be more conscious of ethical and eco-friendly consumption.

5. Moderate Internal Consistency of the Survey Instrument (Cronbach's Alpha = 0.76)

The Cronbach's Alpha reliability test yielded a score of 0.76, indicating acceptable internal consistency of the survey instrument. This confirms that the questionnaire was reliable in assessing AI-driven sustainable shopping behavior. However, slight refinements in survey items could improve reliability further.

6. Potential for AI-Enhanced Sustainable Shopping Strategies

While AI-driven product filters and dynamic pricing showed strong potential in influencing consumer behavior, AI-powered recommendations did not significantly affect purchasing decisions across age groups. This suggests that AI in online shopping can be further optimized by incorporating more personalized and transparent recommendation systems to engage a wider consumer base.

Overall, the study highlights that AI-driven sustainability initiatives can successfully promote eco-conscious shopping behaviors, particularly through product filters and dynamic pricing models. However, there is a need for more personalized and age-inclusive AI recommendation strategies to maximize their effectiveness. These findings provide valuable insights for e-commerce platforms, policymakers, and businesses seeking to leverage AI for sustainable retail growth.

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VI. IMPLICATIONS

The findings of this study have significant implications for e-commerce businesses, policymakers, AI developers, and consumers, particularly in enhancing the effectiveness of AI-driven sustainable shopping initiatives.

For e-commerce businesses, the results highlight that AI-enabled sustainable product filters have a strong impact on consumer purchase intent, indicating that online retailers should prioritize integrating eco-friendly filters in their search and recommendation systems. By making sustainable product choices more visible and accessible, AI can effectively nudge consumers toward environmentally responsible purchasing decisions. Additionally, the study found that AI-driven recommendations did not significantly influence eco-conscious purchasing across different age groups, suggesting that AI algorithms need further refinement to provide more personalized and trust-building sustainability recommendations. E-commerce platforms should consider enhancing their AI models by incorporating user-specific sustainability preferences and transparency in recommendation criteria to appeal to a broader consumer base.

From a pricing perspective, the study found that AI-driven dynamic pricing strategies significantly affect consumer willingness to pay for sustainable products, indicating that e-commerce businesses can leverage adaptive pricing models to encourage sustainability-focused purchases. Retailers could implement targeted AI-based pricing incentives such as discounts for eco-friendly choices, loyalty rewards for sustainable shopping, or dynamic pricing models that balance affordability with ethical consumerism.

For policymakers and sustainability advocates, the findings reinforce the need for regulatory frameworks that ensure AI-driven sustainable shopping remains ethical and transparent. Since AI can influence pricing and purchasing behavior, it is crucial to establish consumer protection measures that prevent price manipulation while promoting fair and equitable access to sustainable products. Policymakers should encourage e-commerce platforms to disclose how AI influences sustainability decisions and consider introducing certifications for AI-driven green shopping tools to build consumer trust.

For AI developers and data scientists, the study underscores the importance of improving AI models for sustainability-focused shopping. Current AI-driven recommendation engines may not be effectively engaging all demographic groups, particularly older consumers. Enhancing AI with explainable recommendation systems, trust-building mechanisms, and better user profiling can improve adoption across diverse consumer segments. Moreover, given concerns about the environmental footprint of AI technology itself, developers should explore energy-efficient AI models and low-carbon computation techniques to align AI-driven e-commerce solutions with broader sustainability goals.

Finally, for consumers, the study highlights that younger and female shoppers are more engaged with AI-driven sustainable shopping tools, suggesting that awareness campaigns could help educate and engage other demographics, including older consumers and male shoppers, about the benefits of AI-powered sustainability choices. Consumers can also demand greater transparency from e-commerce platforms regarding how AI is used to promote eco-conscious shopping, ensuring that ethical and sustainable purchasing practices remain a priority in the digital shopping experience.

Overall, this study demonstrates that AI has the potential to drive sustainability in online shopping, particularly through sustainable product filters and dynamic pricing strategies. However, the limited impact of AI-driven recommendations across age groups suggests that AI models need further improvements to offer personalized and trustworthy sustainability suggestions. By refining AI technologies, implementing ethical pricing strategies, and enhancing consumer awareness, e-commerce platforms can maximize the role of AI in fostering a more sustainable and responsible online shopping ecosystem.

VII. CONCLUSIONS

This study explored the impact of Artificial Intelligence (AI) in online shopping to promote sustainability**,** focusing on **AI**-enabled sustainable product filters, AI-driven recommendations, and dynamic pricing strategies**.** The findings highlight the significant role of AI in shaping consumer behavior towards eco-conscious purchasing**,** particularly through sustainability filters and pricing mechanisms**.** However, the results also indicate that AI-driven recommendations do not significantly influence purchasing behavior across different age groups**,** suggesting that further refinements in AI personalization and transparency are needed.

The study confirms that AI-powered sustainable product filters effectively encourage environmentally conscious consumers to make greener purchasing decisions**,** reinforcing the need for e-commerce platforms to integrate more visible and user-friendly sustainability indicators in their online stores. Additionally, the significant impact of AI-driven dynamic pricing on willingness to pay for sustainable products suggests that pricing models can be strategically used to make eco-friendly products more accessible and appealing to different occupational groups. Despite the promising role of AI in promoting sustainable shopping**,** the findings also emphasize the need for enhanced AI-driven recommendation systems that cater to diverse age demographics. Older consumers may require more trust-building measures and transparency in AI-generated suggestions**,** ensuring that sustainability messaging resonates across all age groups. Furthermore, policymakers should establish ethical guidelines to ensure that AI-driven pricing strategies and sustainability recommendations remain fair, transparent, and aligned with long-term environmental goals**.**

In conclusion, AI presents a transformative opportunity to drive sustainability in online shopping**,** but its effectiveness depends on how well it is optimized for consumer trust, personalization, and accessibility**.** Future research should explore how AI can further enhance consumer engagement in sustainable shopping while minimizing its own environmental impact through energy-efficient AI models**.** By refining AI-driven strategies**,** e-commerce businesses, AI developers, and policymakers can work together to create a more responsible, transparent, and sustainable digital marketplace**.**

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