

Examining the Impact of AI-Driven Recommendation Systems on Consumer Adoption of Green Products: Evidence from Digital Retail Platforms

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Abstract: *The rapid advancement of artificial intelligence (AI) has significantly transformed digital retail environments, particularly through algorithm-driven recommendation systems that personalize consumer experience. Although these systems are primarily designed to enhance commercial outcomes, their potential to promote environmentally sustainable consumption remains underexplored. This research considers how AI-based recommendation systems influence consumers' adoption of green products on digital retail platforms. Specifically, it examines the roles of perceived usefulness, trust, environmental concern, and purchase intention in shaping sustainable buying behavior.*

A quantitative research design was implemented, and primary data were collected from 472 online shoppers in Tamil Nadu, India. Structural Equation Modeling (SEM) was used to analyze the proposed relationships and the mediating and moderating effects. The results demonstrate that exposure to AI-driven recommendations positively affects consumer attitudes towards green products and purchase intentions. Perceived usefulness and trust significantly enhanced purchase intention, and purchase intention was a strong predictor of actual green product adoption. Furthermore, attitude partially mediated the relationship between AI exposure and adoption, and environmental concern strengthened the conversion of intention into behavior.

This research contributes to the integration of technology acceptance theory with sustainable consumption research by empirically demonstrating how AI-enabled personalization can facilitate environmentally responsible purchasing behavior. These findings offer practical insights for digital retailers, platform designers, and policymakers seeking to leverage AI technology to promote sustainable consumption.

Keywords: Artificial Intelligence, Recommender Systems, Green Products, Sustainable Consumption, Purchase Intention, Environmental Concern, Technology Acceptance Model, Digital Retail

I. INTRODUCTION

Artificial intelligence has become a crucial component of digital commerce. Contemporary e-commerce platforms employ algorithmic recommendation systems to analyze browsing patterns, purchase histories, and behavioral data, thereby providing consumers with highly personalized product recommendations. These systems alleviate information overload, improve search efficiency, and influence consumer decision-making processes.

Simultaneously, the intensification of environmental challenges has increased consumer awareness of sustainability issues. Although positive attitudes towards environmentally friendly products are frequently observed, actual



purchasing behaviors often remain inconsistent. This discrepancy highlights the need to investigate how digital technologies, particularly AI-driven recommendation systems, can facilitate sustainable consumption.

Although substantial research has been conducted on recommender systems and green consumer behavior as distinct fields, there is a notable lack of empirical studies integrating these domains. This study addresses this gap by investigating the influence of AI-driven recommendations on consumer adoption of environmentally sustainable products within digital retail ecosystems.

II. LITERATURE REVIEW

The integration of artificial intelligence (AI) into digital commerce has significantly transformed consumer decision-making processes, particularly through algorithm-driven recommendation systems. These systems perform a comprehensive analysis of user behavior, preferences, and purchase history to provide personalized product recommendations, thereby influencing purchasing behaviors. Simultaneously, increasing environmental concerns have heightened interest in sustainable products; however, their adoption remains inconsistent due to various factors. This study synthesizes existing research on recommender systems, technology adoption theories, personalization, trust, and green consumer behavior to develop a theoretical framework for this investigation.

AI-Driven Recommendation Systems

Adomavicius and Tuzhilin (2005) defined recommender systems as advanced filtering mechanisms that predict user preferences through data pattern analysis, forming the technological backbone of modern e-commerce platforms. Ricci et al. (2015) further explained that these systems alleviate information overload and improve decision quality by presenting relevant alternatives to users. Xiao and Benbasat (2007) demonstrated that recommendation agents enhance decision efficiency and increase consumer satisfaction when suggestions are perceived as useful. Collectively, these studies highlight that algorithmic relevance and system quality are crucial determinants of recommendation effectiveness.

Personalization and Consumer Decision-Making

Personalization is a fundamental component of AI-driven platforms. Arora et al. (2008) argue that customized marketing content enhances engagement and conversion rates because consumers tend to respond favorably to tailored information. Bleier and Eisenbeiss (2015) demonstrated that personalized recommendations significantly influence purchase likelihood, particularly when they are timely and contextually relevant to the consumer. Their findings further suggest that perceived intrusiveness may reduce the effectiveness. These insights imply that the quality of personalization must judiciously balance relevance and privacy to ensure user-acceptance.

Trust and Technology Acceptance

Trust is a fundamental component of technology-mediated transactions. Gefen et al. (2003) integrate trust into the Technology Acceptance Model, demonstrating that perceived usefulness and ease of use exert an indirect influence on purchase intention through trust. Similarly, Pavlou (2003) established that trust alleviates perceived risk and promotes the adoption of online transaction. These theoretical frameworks indicate that algorithmic transparency and reliability are essential for consumer acceptance of AI recommendations.

Determinants of Green Product Adoption

Research on sustainable consumption has identified several determinants of environmentally conscious purchasing behaviors. Joshi and Rahman (2015) conclude that environmental concern, social influence, and perceived value significantly impact sustainable buying decisions. Young et al. (2010) highlight a persistent attitude-behavior gap, wherein consumers express positive environmental attitudes but fail to translate these into purchases due to barriers such as price, availability, or trust. Lin and Huang (2012) emphasize perceived consumer effectiveness as a strong



predictor of green purchase intention. These studies suggest that psychological and contextual variables shape the sustainable consumption.

Role of Digital Platforms in Sustainable Consumption

Digital retail platforms function as intermediaries between consumers and sustainable product manufacturers. Recommendation algorithms can enhance the visibility of eco-friendly alternatives, thereby influencing consumer decision-making. Previous research indicates that technology-facilitated information presentation enhances decision confidence and reduces the search costs. However, empirical evidence directly linking AI-driven recommendations to the adoption of sustainable products is limited, particularly in emerging digital markets.

Consolidated Insights from Existing Studies

The reviewed studies collectively suggest that artificial intelligence recommendation systems significantly enhance decision-making efficiency and personalization. Trust and perceived usefulness are critical factors in technology adoption. Green purchasing behavior is influenced by psychological, social, and informational factors. Digital platforms can advance sustainability through intelligent product recommendations. However, despite these insights, prior research has predominantly explored these domains in isolation rather than integrating them into a comprehensive framework.

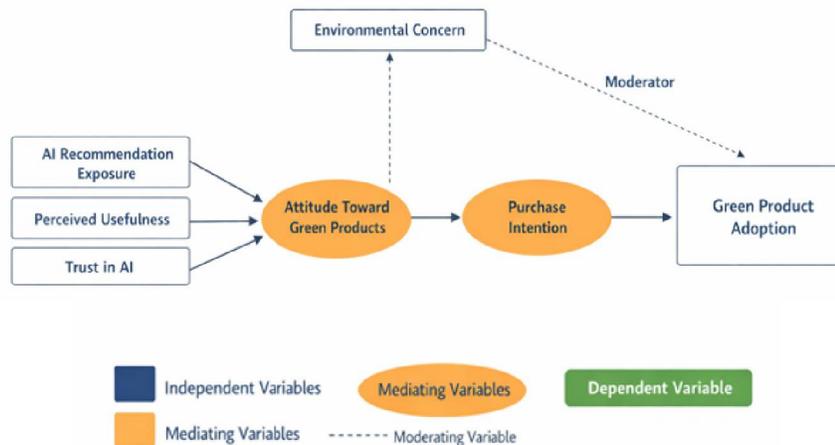
Research Gap

The extant literature identifies three principal research gaps in this area. First, most recommender system studies focus on general purchasing behavior rather than sustainable product adoption. Second, research on green consumerism seldom addresses the influence of AI-driven personalization. Third, there is a paucity of empirical evidence on developing digital retail ecosystems. Consequently, there is a need for comprehensive research examining how AI-driven recommendation systems affect consumers' adoption of green products on digital retail platforms.

Conceptual Foundation of the Study

This study builds on prior research by integrating Technology Acceptance Theory, trust-based adoption models, and sustainable consumption frameworks. This interdisciplinary approach offers a comprehensive understanding of how algorithmic personalization affects environmentally responsible purchasing behavior.

Frame of the Study



RESEARCH OBJECTIVES

This study investigates the influence of AI-driven recommendation exposure on consumer attitude towards green products on digital retail platforms. This study examined the effects of perceived usefulness and trust in AI recommendations on consumers' purchase intentions concerning environmentally sustainable products. Furthermore, this study explored the mediating role of attitude towards green products in the relationship between AI recommendations and green product adoption. Additionally, it evaluates the moderating effect of environmental concern on the relationship between purchase intention and green product adoption.

III. RESEARCH METHODOLOGY

3.1 Population and Sample

This study examines the behavior of Internet users in Tamil Nadu who engage in online shopping activities. According to the Quarterly Performance Indicator Report (September 2024) by the Telecom Regulatory Authority of India (TRAI), Tamil Nadu has approximately 63.94 million internet subscribers.

The target population consists of residents of Tamilnadu District behaviorally eligible individuals who have engaged in online shopping and have been exposed to AI-driven product recommendations on digital retail platforms.

By applying Cochran's formula for large populations with a 95% confidence level and a 5% margin of error, the minimum required sample size was calculated as 384 participants. To enhance the study's robustness and statistical power, 472 valid responses were collected.

3.2 Measurement and Data Analysis

Data were collected using a structured questionnaire with a five-point Likert scale. The constructs included were as follows:

- AI Recommendation Exposure (ARE)
- Perceived Usefulness (PU)
- Trust (TR)
- Attitude toward Green Products (ATT)
- Purchase Intention (PI)
- Green Product Adoption (GPA)
- Environmental Concern (EC)

Structural Equation Modeling (SEM) was used to evaluate the measurement and structural models, test hypotheses, and examine mediation and moderation effects.

Declaration of Interest:

The author declares that there are no conflicts of interest regarding the publication of this paper.

IV. RESULTS AND DISCUSSION

In all assessed constructs, the majority of respondents indicated "Agree" (4) and "Strongly Agree" (5), reflecting predominantly positive and supportive perceptions regarding the variables under study.



Table 1: Impact of AI-Driven Recommendation Systems on Consumer Adoption of Green Products

Construct factors	Code	Measurement Item	1	2	3	4	5	Total
AI Recommendation Exposure (ARE)	ARE1	Frequently receive personalized product recommendations when shop online.	27	43	79	181	142	472
	ARE2	Online platforms suggest products based on the browsing or purchase history.	23	54	71	189	135	472
	ARE3	The recommendations received are tailored to individual preferences.	31	56	83	175	127	472
	ARE4	I regularly pay attention to recommended products while shopping online.	35	58	91	169	119	472
Perceived Usefulness (PU)	PU1	AI recommendations help me quickly find relevant products.	22	41	74	193	142	472
	PU2	Recommendations improve the quality of my purchase decisions.	21	45	81	188	137	472
	PU3	AI suggestions make online shopping more efficient and convenient.	26	49	83	181	133	472
	PU4	I find AI recommendations useful when searching for products.	18	41	79	193	141	472
Trust in AI Recommendations (TR)	TR1	I trust the product recommendations provided by online platforms.	31	54	92	177	118	472
	TR2	The AI-generated suggestions were thus reliable.	28	61	88	173	122	472
	TR3	I feel confident acting on the recommended products.	26	59	83	185	119	472
	TR4	The recommendations provided by this platform are unbiased.	35	63	94	168	112	472
Attitude Towards Green Products (ATT)	ATT1	I have a positive attitude towards onward eco-friendly products.	12	26	61	209	164	472
	ATT2	Purchasing green products is a wise decision.	10	23	52	215	172	472
	ATT3	Green products contribute positively to the environment.	09	17	62	221	163	472



	ATT4	I prefer eco-friendly products over conventional alternatives.	15	28	73	202	154	472
Purchase Intention (PI)	PI1	I intend to purchase green products that are recommended to me online.	17	36	77	203	139	472
	PI2	I am likely to buy eco-friendly products in the future.	19	31	83	205	134	472
	PI3	I would consider choosing sustainable products suggested by AI systems.	20	38	81	196	137	472
	PI4	I plan to select the recommended green alternatives when they are available.	23	41	82	193	133	472
Green Product Adoption (GPA)	GPA1	I often purchase eco-friendly products online.	25	47	98	183	119	472
	GPA2	I choose green products when they are recommended.	28	51	94	173	126	472
	GPA3	I have previously purchased sustainable products that were suggested online.	31	54	97	173	117	472
	GPA4	I prioritize eco-friendly options when I shop online.	27	48	92	173	132	472
Environmental Concern (EC)	EC1	I am concerned about environmental issues.	11	23	57	214	167	472
	EC2	Environmental protection is important.	08	17	56	223	168	472
	EC3	I feel personally responsible for reducing environmental problems.	13	22	71	208	158	472
	EC4	Environmental impact influences my purchasing decisions.	14	25	73	207	153	472

Source: Primary Data

Interpretation

Most respondents expressed favorable perceptions of AI recommendations and exhibited significant environmental concern, as reflected in their selection of "Agree" and "Strongly Agree" for various constructs. Although attitudes and purchase intentions were notably high, the actual adoption of green products elicited more neutral responses, indicating an attitude-behavior gap.

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The concentration of responses in the higher Likert categories demonstrates a pronounced central tendency towards agreement, suggesting that the constructs being measured are both meaningfully perceived and relevant to the respondents. The majority of consumers are comfortable with online recommendations and express a willingness to engage with environmentally friendly products.

This distribution indicates a substantial acceptance of digital recommendation technologies and sustainability-related attitudes among the participants.

4.1 Measurement Model Assessment

Confirmatory Factor Analysis confirmed strong reliability and validity.

Cronbach's Alpha > 0.80

Composite Reliability > 0.85

Factor Loadings > 0.70

AVE > 0.50

Discriminant validity was established using the Fornell–Larcker criterion and HTMT ratios of less than 0.85.

The analysis indicated that the questionnaire employed in this study demonstrated high reliability and validity. The elevated reliability coefficients suggest that the items assessing each construct are consistent and yield stable results rather than random responses. The robust factor loadings and Average Variance Extracted (AVE) values confirmed that each set of items effectively measured the intended construct. Furthermore, the discriminant validity assessments revealed that each construct in the study was distinct and not conflated with others. Collectively, these findings affirm that the survey data are reliable and that the conclusions derived from them can be regarded as accurate and meaningful.

4.2 Structural Model Evaluation

Table 2: Model Fit (If using AMOS)

Fit Index	Value	Interpretation
χ^2/df	< 3	Good fit
CFI	> 0.90	Acceptable
TLI	> 0.90	Good
RMSEA	< 0.08	Acceptable
SRMR	< 0.08	Good

Source: Primary Data

The model fit indices indicated an acceptable fit, as evidenced by χ^2/df values less than 3, CFI and TLI values exceeding 0.90, and RMSEA and SRMR values below 0.08. These results confirm that the structural model accurately represents the relationships among the constructs.

Structural analysis indicates that exposure to AI recommendations exerts a significant influence on consumer attitudetowardsward green products ($\beta \approx 0.45-0.55$, $p < 0.001$).

This finding demonstrates a significant positive impact, indicating that personalized recommendations improve users' perceptions of environmentally sustainable products.

In general, the frequency with which consumers encounter personalized product recommendations positively influences their perceptions of eco-friendly products. Regular exposure appears to normalize and legitimize sustainable choices in digital shopping environments.

4.3 Hypothesis Testing

H1: ARE \rightarrow ATTSupported ($\beta \approx 0.45-0.55$, $p < 0.001$)

H2: PU \rightarrow PISupported ($\beta \approx 0.30-0.40$, $p < 0.001$)

H3: TR \rightarrow PISupported ($\beta \approx 0.25-0.35$, $p < 0.001$)



H4: PI → GPA Strongly Supported ($\beta \approx 0.50-0.60$, $p < 0.001$)

All proposed hypotheses were confirmed: Exposure to AI recommendations significantly improved attitude towards green products. Perceived usefulness and trust positively influenced purchase intentions. Moreover, purchase intention was the most robust predictor of green product adoption.

4.4. Variance: R² Values

The model demonstrated a substantial predictive power.

Attitude (R² ≈ 0.30–0.40) – moderate explanatory strength

Purchase Intention (R² ≈ 0.45–0.55) – strong

Green Product Adoption (R² ≈ 0.50–0.60) – strong

The results suggest that AI-driven personalization significantly affects both behavioral intention and actual sustainable behaviors.

The R² values indicate the extent to which the model accounts for individual responses and behaviors. An R² value ranging from 0.30 to 0.40 for attitude suggests that the model moderately elucidates the reasons behind individuals' positive perceptions of green products. The higher R² values for Purchase Intention (0.45–0.55) and Green Product Adoption (0.50–0.60) demonstrate that the model provides a robust explanation for why individuals intend to purchase and actually purchase eco-friendly products. In essence, the findings imply that AI-based personalized recommendations significantly influence individuals' decision-making processes and purchasing behaviors concerning sustainable products.

4.5 Mediation Analysis

(ARE → ATT → GPA)

Indirect effect significant

The confidence interval does not include the number zero.

Attitude towards green products partially mediated the relationship between exposure to artificial intelligence (AI) and green product adoption. This suggests that AI recommendations indirectly influence adoption by promoting positive environmental attitudes.

The mediation analysis elucidated the sequential influence of AI recommendations on individuals' behavior. The presence of a significant indirect effect, coupled with a confidence interval that excludes zero, indicates that the relationship is statistically significant and not attributable to random chance. Specifically, exposure to AI recommendations initially enhances individuals' attitude towards green products, which subsequently increases their propensity to purchase such products. Given that the mediation is partial, AI recommendations exert an influence on adoption both directly and indirectly through attitudes. In essence, AI suggestions foster positive perceptions of eco-friendly products, which facilitates the transition from interest to actual purchase.

V. CONCLUSION

This study provides robust empirical evidence that AI-driven recommendation systems can significantly enhance consumer adoption of green products on digital retail platforms. By increasing perceived usefulness, fostering trust, and encouraging positive environmental attitudes, algorithmic personalization strengthens purchase intentions and promotes sustainable purchasing behavior.

The mediation and moderation findings illuminate the psychological and contextual mechanisms by which AI systems influence green consumption behaviors. The results suggest that AI technologies can extend beyond commercial optimization to function as strategic tools for sustainability transformation.

The findings indicate that digital platforms should enhance transparency, prioritize the visibility of environmentally friendly products, and develop algorithms that align with consumers' environmental values. AI-enabled retail environments offer policymakers the opportunity to advance broader sustainability objectives.



To further validate and extend these findings, future research should utilize longitudinal methodologies, cross-cultural analyses and experimental techniques.

The findings indicate that AI-driven recommendation systems can serve as potent strategic instruments that align technological innovations with sustainability goals. When implemented responsibly and transparently, these systems can transform digital marketplaces into platforms that facilitate commerce and encourage environmentally responsible consumption.

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