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RESEARCH ARTICLE

Statistical Modeling of Consumer Preferences for Eco-friendly Digital Products: A Data-driven Approach Toward Sustainable Consumption in India

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Abstract

As environmental concerns intensify globally, consumer behavior is undergoing a paradigm shift, particularly within rapidly digitizing economies like India. In this context, understanding and statistically modeling consumer preferences for eco-friendly digital products is both timely and essential. This study offers a data-driven approach to decoding sustainable consumption patterns, focusing on key behavioral and demographic indicators influencing green purchase intent. Drawing from structured survey responses of over 350 urban Indian consumers, the research employs a suite of advanced statistical tools-including multiple regression, principal component analysis (PCA), logistic regression, and chi-square tests-to examine correlations between sustainability-driven choices and variables like age-of-consumers, education-of-consumers, income, digital literacy with prior exposure to environmental campaigns. The analysis reveals that awareness of sustainability issues is significantly associated with behavioral outcomes like trust in eco-brands, willingness to pay a premium, and digital engagement with green content. PCA effectively distilled 14 observed behavioral metrics into three principal components, accounting for 78% of the variance in sustainable decision-making. These components reflect digital influence, socio-demographic consciousness, and psychological affinity toward sustainability. The study contributes a novel statistical modeling framework that bridges consumer psychology with sustainability science. Its interdisciplinary approach supports SDG-9 (industry-and-innovation), SDG-12 (responsible-consumption), and SDG-13 (climate-action), while offering practical insights for marketers, digital strategists, and policymakers. By harnessing empirical evidence, the research informs ESG-aligned and circular economy marketing strategies that resonate with India's digitally active and environmentally conscious consumer base.

Keywords: Sustainable consumption, consumer analytics, digital behavior, eco-friendly products, statistical modeling, circular economy, ESG marketing.

Introduction

There has been a growing worldwide transformation in sustainability efforts, as individuals, corporations, and policymakers adopt more conscious and strategic approaches. This change has been driven by worsening climate change indicators, environmental degradation, and increasing awareness of social inequalities-all of which demand an urgent recalibration of how economic and marketing systems operate (García-Sánchez et al., 2020; IPCC, 2021). Amid these challenges, the integration of sustainability into digital consumer behavior has developed into a significant subject of research interest and practice. Particularly in the Indian context, where rapid urbanization and digitalization intersect with environmental and social vulnerabilities, understanding and statistically modeling eco-friendly consumer behavior can offer essential insights for sustainable transformation.

India's digital economy is one of the fastest-growing globally, with over 850 million internet users expected by 2025 (Statista, 2023). The ubiquity of smartphones, widespread digital payments, and increasing e-commerce penetration have fundamentally altered how consumers interact with brands. These developments offer both

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opportunities and responsibilities for businesses aiming to align their digital strategies with SDG's, particularly SDG-9 (Industry-Innovation-and-Infrastructure), SDG-12 (Responsible-Consumption-and-Production), and SDG-13 (Climate-Action) (UNDP, 2022). Present study explores consumer preferences for eco-friendly digital products through advanced statistical modeling. It integrates insights from data science, behavioral economics, and environmental policy to aid marketers, business leaders, and policymakers in data-driven decision-making. Applying multivariate techniques like PCA, multiple-regression and chi-square testing, the study identifies latent variables and key predictors of sustainable choices in India's digital economy (Hair et al., 2019).

With the growing integration of Environmental, Social, and Governance (ESG) frameworks, businesses require reliable metrics and real-time behavioral insights (Kolk, 2016). This study responds by examining how socio-demographic indicators like consumer's age, income, education and geography-interact with psychographic traits like environmental concern, perceived sustainability, and digital trust (Peattie & Belz, 2010; Biswas & Roy, 2015). Sustainable digital behavior among consumers is not driven solely by altruistic motives. Price sensitivity, perceived efficacy, brand reputation, and peer influence also play critical roles in shaping eco-conscious decisions (Yadav & Pathak, 2017). Using regression analysis, this study evaluates the weight of each variable in influencing a consumer's willingness-to-pay (WTP) a premium for eco-labeled digital goods. Our findings contribute to a growing body of literature suggesting that sustainability marketing must be coupled with credible, data-backed, and culturally relevant messaging (Lim, 2022).

A particularly relevant dimension of this research is its attention to greenwashing-a practice where brands misrepresent their sustainability performance. This undermines trust and distorts markets, especially in countries like India where consumer protection laws around environmental claims are still evolving (Delmas & Burbano, 2011). Through the use of statistical analysis, including chi-square independence testing, the study examines how perceived greenwashing affects purchase intent and trust in digital platforms (Nguyen et al., 2020). Moreover, the rise of Gen Z and millennials as sustainability-conscious digital natives represents a paradigm shift in marketing and brand engagement. Such consumers tend to favor brands that openly share their practices and values, reflecting a strong preference for transparency, corporate accountability, and a genuine commitment to social justice and environmental stewardship (Fromm & Read, 2018). By clustering behavioral data, this study aims to model generational shifts in sustainable purchasing and offer predictive insights for future campaign planning.

Statistical modeling also allows for the integration of macroeconomic and cultural variables into the analysis. For instance, cultural values such as collectivism or uncertainty avoidance-common in Indian society-may mediate the relationship between digital trust and sustainable purchasing (Hofstede Insights, 2021). These nuances are often overlooked in qualitative assessments but can be quantified and interpreted using structured analytical frameworks.

From a policy perspective, this study offers practical insights for digital sustainability campaigns, ESG reporting, and inclusive marketing. By analyzing how different consumer segments respond to sustainability cues, it equips policymakers with behavioral tools to promote SDG-aligned practices (Thøgersen, 2005). The research also highlights broader implications for circular economy and inclusive innovation models, gaining momentum among Indian startups and global investors (Ellen MacArthur Foundation, 2020). As consumer demand for transparency rises, technologies like blockchain and AI-based product tracing can build trust-provided they are backed by statistically validated consumer insights, as addressed in this study.

In conclusion, the introduction lays the foundation for a comprehensive, data-driven exploration of sustainable digital consumerism in India. It connects statistical methodologies with real-world issues, from ESG integration and climate urgency to consumer trust and policy reform. In doing so, it meets and expands the goals of the conference-to explore innovative strategies, analyze the role of industries and academia in achieving SDGs, and inspire transformative change through evidence-based research.

Literature Review

A comprehensive understanding of sustainable digital consumer behavior requires reviewing interdisciplinary studies spanning environmental marketing, statistical modeling, behavioral economics, and digital trust. The following literature critically informs the theoretical foundation and methodological choices of this study, offering insights into eco-conscious consumption patterns and the tools necessary to analyze them.

Statista (2023)

Statista's projections of over 850 million internet users in India by 2025 highlight the country's digital transformation. This data underscores the urgent need to understand online consumer behavior and sustainable consumption patterns. It serves as the demographic and behavioral foundation for statistically modeling digital consumer preferences for eco-friendly products in this study.

UNDP (2022)

The UNDP (2022) emphasizes integrating digital innovation to achieve SDG-9 (Industry-and-Innovation), SDG-12 (Responsible-Consumption), and SDG-13 (Climate-Action). It

encourages data-driven decision-making to create inclusive, sustainable solutions. This aligns with the study's goal of using statistical modeling to generate insights supporting responsible consumption and environmental accountability.

Lim (2022)

Lim (2022) analyzes the role of digital-faith and brand-transparency in impelling sustainable consumer-behavior. Brands with high digital credibility gain more traction among conscious consumers. This finding supports one of the paper's hypotheses, suggesting digital trust as a statistically significant predictor of eco-friendly purchase intentions in online contexts.

Hofstede insights (2021)

Hofstede Insights (2021) presents cultural dimensions such as collectivism and strong-orientation that influence decision-making. In the Indian context, collectivist values moderate responses to sustainability messaging. This insight is statistically modeled in the study to reveal how culture affects digital consumer behavior and eco-consciousness in diverse demographics.

Pallant (2020)

Pallant's work on SPSS provides practical guidance for executing statistical tests such as chi-square, PCA, and regression analysis. This methodological foundation supports the study's design by ensuring statistical rigor in examining the relationship between socio-demographics, environmental awareness, and willingness to purchase sustainable digital products.

Field (2020)

Field (2020) offers advanced techniques for handling multivariate datasets, interpreting regression diagnostics, and conducting factor analysis. These tools are used in this paper to manage and analyze large behavioral datasets, improving the accuracy and credibility of the model predicting sustainable purchasing behavior in the digital-environment.

Nguyen et al. (2020)

Study conducted in 2020, investigates how consumer skepticism, especially toward greenwashing, affects sustainable purchase behavior. Their findings support the paper's third hypothesis that perceived greenwashing reduces trust and purchase intent. Statistical testing validates this relationship in the Indian digital market context.

García-Sánchez et al. (2020)

This study links transparent ESG disclosures with stronger brand reputation and customer loyalty. The paper utilizes this insight to show how statistically modeling ESG-aligned behaviors among Indian consumers can support strategic sustainability communication and enhance digital consumer engagement.

Ellen-MacArthur-Foundation (2020)

The Ellen-MacArthur-Foundation advocates for circular-economy models, emphasizing product lifecycle transparency and data integration. These principles are adopted in the study's design to statistically identify consumer preferences that align with lifecycle sustainability, supporting digital transformation with minimal environmental impact.

Hair et al. (2019)

Hair et al. provide a robust framework for applying multiple regression and PCA in behavioral research. This methodology enables the study to extract latent variables and statistically assess the impact of environmental awareness, digital trust, and greenwashing on consumer decisions.

Tabachnick & Fidell (2018)

Their work explains the practical application of PCA, logistic regression, and multivariate testing. This paper follows their guidelines to clean, reduce, and interpret consumer behavior data, identifying key factors influencing sustainable digital purchasing patterns in the Indian market.

Fromm & Read (2018)

Fromm and Read examine generational preferences and conclude that millennials and Gen Z are more responsive to brands with strong sustainability commitments. Their behavioral tendencies justify the paper's demographic segmentation and statistical modeling focused on younger consumers' WTP for eco-friendly digital products.

Peattie & Belz (2010)

This foundational text promotes integrating ecological and ethical values into marketing strategy. It aligns with this study's objective of understanding how consumers evaluate sustainability claims and provides theoretical grounding for constructing and testing sustainability-driven consumer behavior models.

Delmas & Burbano (2011)

Delmas and Burbano critique greenwashing, showing how inconsistent messaging erodes consumer trust. Their conclusions reinforce the study's hypothesis that perceived greenwashing is statistically linked to reduced trust and lower purchase intent, particularly among informed digital consumers.

Thøgersen (2005)

Thøgersen's work links sustainable consumer behavior to policy support and social norms. It forms the behavioral backbone of this paper's statistical approach, justifying the inclusion of variables like environmental concern and peer influence in modeling eco-conscious purchasing in the digital space.

Objectives of the Study

- To investigate key demographic and behavioral predictors of sustainable digital consumer behavior in

India using advanced statistical modeling methods like multiple-regression and principal-component-analysis (PCA).
- To evaluate the influence of environmental awareness, digital trust, and perceived product sustainability on consumer WTP a premium for eco-friendly-digital-products.
- To statistically assess the influence of greenwashing, peer influence, and digital engagement on brand trust and sustainable purchase intentions.
- To support policymaking and strategic ESG initiatives by generating actionable insights from statistically validated consumer behavior trends, aligning with SDG 9, SDG 12, and SDG 13.

4.0 METHODOLOGY

4.1 Research Plan

Present research adopts a quantitative research design using a cross-sectional survey approach to statistically model consumer preferences toward eco-friendly digital products in India. The design supports hypothesis testing by analyzing structured datasets through multivariate statistical methods such as PCA, multiple-regression, and chi-square tests. A descriptive-exploratory framework was used to uncover patterns and predictors in sustainable digital behavior aligned with SDGs 9, 12, and 13 (UNDP, 2022; García-Sánchez et al., 2020).

4.2 Population and Sampling Method

The study-population includes digitally active Indian consumers aged 18–55 who frequently engage in e-commerce or use digital platforms to purchase electronics, services, or products. A stratified-random-sampling technique was employed to confirm diversity across consumer-age-groups, education levels, and income categories. The sampling frame included metro, semi-urban, and rural consumers from five Indian states. A total of 500 responses were collected, with 350 deemed valid after screening.

4.3 Data Collection and Instrumentation

Primary-data was obtained using well-organized questionnaire administered online engaging platforms like Google-forms and distributed via social media and email. The instrument comprised three sections:

Section A

Demographics (age, gender, income, education, location)

Section B

Behavioral constructs (digital trust, environmental awareness, perceived product sustainability, etc.)

Section C

Purchase intentions and brand perceptions related to eco-friendly products.

All items used a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). The instrument was pretested on 30 respondents and modified for clarity and reliability.

Validity and Reliability

Construct validity was ensured through literature-based item selection (Peattie & Belz, 2010; Nguyen et al., 2020). Content validity was verified by three academic experts in sustainability and statistics. Cronbach's Alpha was computed for each scale, achieving values >0.70, indicating acceptable reliability (Field, 2020). Kaiser-Meyer-Olkin (KMO) and Bartlett's test confirmed the suitability of the dataset for PCA.

4.5 Statistical Tools and Techniques

- IBM SPSS v26 employed for advanced data analysis.
- Descriptive Statistics: Frequencies and measures of central tendency for demographic distribution.
- Chi-square Tests: For association between categorical variables like age, gender, and purchase intent.
- Principal Component Analysis (PCA): Used to reduce 14 behavioral indicators viz. i) awareness of Sustainable Development Goals (SDGs), ii) interest in sustainable digital products, iii) willingness to reduce carbon footprint, iv) belief in eco-brand claims, v) trust in product reviews/ratings online, vi) trust in digital payment systems, vii) perception of greenwashing in advertising, viii) perception of brand credibility in sustainability, ix) environmental concern in purchase decisions, x) willingness to pay a premium for green products, xi) influence of eco-labels on buying behavior, xii) preference for brands with sustainability certifications, xiii)frequency of researching environmental impact before purchase, xiv) influence of social media on eco-friendly product awareness into latent variables representing eco-consciousness and trust dimensions (Hair et al., 2019).
- Multiple Linear Regression: Assessed the impact of independent variables (digital trust, awareness, greenwashing perception) on dependent-variables (WTP premium).
- Logistic Regression: Modeled purchase likelihood for sustainable products (dichotomized outcome).
- The models were tested for Multicollinearity (VIF < 2.0), normality of residuals, and homoscedasticity. Model fit indices and R^2 values were evaluated to validate statistical significance.

Ethical Considerations

Informed consent was obtained from all participants. Data was collected anonymously, stored securely, and used solely for academic research purposes. The study complied with the ethical guidelines of the Indian Council of Social Science

Research (ICSSR).

Limitations of Methodology

Though robust in design, the methodology may be constrained by:

- Self-reported data, which can be biased.
- Cross-sectional nature, limiting causal inference.
- Digital-only survey, potentially excluding non-digital consumers.

Future research can explore longitudinal methods and mixed-mode sampling for improved generalizability.

Research Hypotheses

Hypothesis 1

H01: There is no association between consumers' environmental awareness and their willingness to pay a premium for eco-friendly digital products. Vs

H11: Environmental awareness has a statistically significant positive effect on the willingness to pay more for sustainable digital products

Hypothesis 2

H02: There is no association between digital trust and purchase intent for products marketed as sustainable. Vs

H12: Digital trust is a statistically significant positive predictor of sustainable product purchase intention.

Hypothesis 3

H03: There is no association between Perceived greenwashing and lower brand trust and reduced purchase behavior. Vs

H13: Perceived greenwashing is statistically significantly associated with lower brand trust and reduced purchase behavior.

Results and Analysis

This section presents descriptive statistics, factor reduction using Principal Component Analysis (PCA), regression outputs, chi-square tests, and interpretive analyses aligned with the study's objectives and hypotheses. Results are linked to SDGs 9, 12, and 13, focusing on sustainable digital consumption behavior in India.

Table 1: Demographic Profile of Respondents

Demographic-Variable	Categories	Frequency	Percentage
Gender	Male	180	51.40%
	Female	170	48.60%
Age Group	18–25	96	27.40%
	26–35	130	37.10%
	36–45	82	23.40%
	46+	42	12.00%
Education Level	UG	140	40.00%
	PG	170	48.60%
	Doctoral/Other	40	11.40%
Monthly Household Income	< ₹25,000	84	24.00%
	₹25,000–₹50,000	100	28.60%
	₹50,000–₹100,000	96	27.40%
	> ₹100,000	70	20.00%

Descriptive Statistics

A summary of respondent demographics (N = 350) is presented in Table 1.

Interpretation

Gender distribution within the sample appears to be balanced and includes a strong representation of digitally literate young adults (63% below age 35), who are typically more environmentally and digitally aware (Fromm & Read, 2018; Lim, 2022).

Principal-Component-Analysis (PCA)

PCA was used to reduce 14 behavioral variables to key latent factors. KMO = 0.832, Bartlett's Test = significant ($p < 0.001$), indicating sampling adequacy.

Table 2: Rotated Component Matrix (Varimax-Rotation)

Variables	*Component 1 (Eco-Awareness)*	*Component 2 (Digital Trust)*	*Component 3 (Perceived Authenticity)*
Awareness of SDGs	0.764		
Interest in sustainable products	0.729		
Willingness to reduce carbon footprint	0.711		
Belief in eco-brand claims		0.781	
Online trust in product ratings		0.745	
Trust in digital payment systems		0.722	
Perception of greenwashing in advertising			-0.803
Brand credibility in sustainability			0.766

Table 3: Regression Output (Model Summary)

Variable	B	*Std. Error*	*Beta*	*t-value*	*p-value*
Constant.	1.211	0.331		3.658	0.001
Eco-awareness (C1)	0.384	0.056	0.402	6.857	<0.001
Digital Trust (C2)	0.265	0.051	0.299	5.196	<0.001
Authenticity (C3)	0.178	0.048	0.221	3.708	<0.001
Education	0.089	0.035	0.117	2.543	0.012
Income	0.063	0.041	0.078	1.537	0.126

$R^2 = 0.684$, Adjusted $R^2 = 0.671$, F-statistic = 48.96 ($p < 0.001$)

Interpretation

Principal-Component-Analysis (PCA) was employed to classify key behavioral-patterns from 14 variables related to sustainable digital consumption. With a KMO value of 0.832 and a Significant-Bartlett's-Test ($p < 0.001$), this data was suitable for factor analysis. *Three components emerged, explaining 78.4% of total variance*: Eco-Awareness (concern for sustainability-and-climate), Digital-Trust (confidence in online platforms and eco-claims), and Perceived Authenticity (sensitivity to greenwashing and trust in brand credibility). These factors were later used in regression models to assess their influence on eco-product preferences.

Multiple Linear Regression

Dependent variable

WTP Premium for Eco-Friendly-Products

Independent variables

Eco-awareness (C1), Digital trust (C2), Perceived authenticity (C3), Income, Education

Interpretation

All behavioral predictors are statistically significant. Eco-awareness and digital trust show the strongest effects, validating H1 and H2. Income is not significant, suggesting behavioral drivers outweigh economic constraints.

Chi-Square Tests

To examine associations between demographics and Willingness to Pay (WTP) premium:

Interpretation

Interpretation of Chi-square Results: Our study explores the association between demographic factors and WTP-a-premium:

Gender × WTP ($\chi^2 = 3.96$, $p = 0.047$)

A significant association suggests that gender influences WTP. While specifics aren't provided, earlier studies suggest that female-consumers tend to show a greater WTP-a-premium for eco-friendly items.

Table 4: Chi-Square Tests

Variable	*χ^2 Value*	*df*	*p-value*
Gender × WTP	3.96	1	0.047*
Age × WTP	18.24	3	0.001**
Education × WTP	16.77	2	0.002**
Income × WTP	5.98	3	0.112

**Statistically-significant at $p < 0.05$;*
** Statistically-significant at $p < 0.01$**

Age × WTP ($\chi^2 = 18.24$, $p = 0.001$)

A strong significant-relationship indicates that possibilities of younger individuals to pay a premium is more, likely due to better environmental awareness and value alignment.

Education × WTP ($\chi^2 = 16.77$, $p = 0.002$)

A clear association exists, with more educated individuals showing higher WTP, reflecting greater awareness and concern for ethical consumption.

Income × WTP ($\chi^2 = 5.98$, $p = 0.112$)

Our analysis shows, this result is not significant statistically ($p > 0.05$), suggesting that income level does not significantly influence WTP-a-premium. Therefore, it shows that Individuals with greater-earning-capacity can afford premium products. However, this suggests that WTP is more value-driven than affordability-driven, especially when it comes to ethical, environmental, or sustainability-based decisions.

In conclusion, Younger, more educated individuals are significantly more likely to pay a premium. No significant difference in WTP across income levels.

Logistic Regression: Brand Trust

Dependent Variable: High Brand Trust (1 = Yes, 0 = No)

Key predictors

Greenwashing perception (negative), Social media influence (positive)

Table 5: Logistic-Regression-Results

Predictor	*B*	*S.E.*	*Wald*	*Exp(B)*	*p-value*
Greenwashing Score	-0.528	0.111	22.56	0.59	<0.001
Social Media Score	0.414	0.087	21.69	1.512	<0.001
Constant	-0.731	0.201	13.25	0.481	<0.001

Interpretation

The logistic regression findings highlight the crucial role of digital perceptions in shaping consumer trust, particularly in the context of promoting sustainable consumption patterns aligned with the SDGs, notably SDG-12 (*Responsible-Consumption-and-Production*) and SDG-13 (*Climate-Action*). A higher perception of greenwashing significantly decreases the likelihood of brand trust by 41% (Exp(B) = 0.59, $p < 0.001$), revealing that misleading environmental claims erode consumer confidence in digital eco-friendly offerings. Conversely, positive engagement through social media increases the probability of trust by 51% (Exp(B) = 1.512, $p < 0.001$), emphasizing the influence of digital communication in reinforcing brand credibility. These insights reinforce the need for transparent environmental messaging and active digital engagement strategies as part of sustainable marketing practices. For brands committed to environmentally responsible innovation, digital reputation management emerges as a key enabler of consumer trust and loyalty- critical components in advancing sustainable lifestyles and supporting India's broader transition toward a green, digitally empowered economy.

Generational Comparison of Eco-Behavior

Interpretation

Younger generations show statistically higher eco-awareness. Marketing strategies must thus target these groups for greater impact on sustainable adoption.

Key Observations

H11: Supported – Eco-awareness strongly predicts premium purchase behavior.

H12: Supported – Digital trust is a significant positive predictor of sustainable purchase intent.

H13: Supported – Perceived greenwashing negatively affects trust and purchase likelihood.

Table 6: Eco-Consciousness Index by Age Group

Age group	*Mean score*	*Std. Dev*	*Anova p-value*
18–25	4.21	0.55	
26–35	4.09	0.61	
36–45	3.78	0.64	
46+	3.51	0.71	0.003**

Discussion

The results obtained in our research gives robust-insights into the behavioral, demographic, and perceptual determinants of sustainable digital consumerism in India. The statistically significant role of eco-awareness, digital trust, and perceived brand authenticity as predictors of consumers' WTP-a-premium for eco-friendly digital-goods validates the conceptual framework adopted. It is consistent with emerging scholarship emphasizing the intersection of digital consumer behavior and sustainability, especially in rapidly digitizing economies like India (Lim, 2022; García-Sánchez et al., 2020).

Eco-Awareness and Sustainable Intentions

The identification of eco-awareness as the strongest predictor of willingness to pay ($\beta = 0.402$, $p < 0.001$) underscores the growing importance of environmental values in determining purchase-decisions. This finding is aligned with Yadav and Pathak (2017), who argued that green concern decides the association between consumer-values and green-purchasing-behavior. As digital platforms continue to scale in India, targeted awareness campaigns promoting SDG-aligned choices can significantly influence consumer sentiment. Moreover, such results benefit the growing literature on sustainability marketing by reinforcing the need for emotional and informational appeals in communication strategies (White et al., 2019). From a policy lens, this result substantiates the potential of eco-literacy programs integrated into public digital infrastructure (e.g., the MyGov app or UPI platforms), promoting sustainable behavior at scale. Eco-awareness being a statistically significant driver of behavior supports SDG 12, which emphasizes responsible consumption and production.

Digital Trust as a Behavioral Enabler

Digital trust-measured through trust in digital payment systems and online reviews-emerged as another statistically significant predictor of sustainable purchasing intentions ($\beta = 0.299$, $p < 0.001$). This line up with the findings of Lim (2022), who observed that digital transparency, data privacy, and user interface design influence consumers' willingness to engage with eco-labeled digital products. The role of digital trust is especially critical in markets like India, where online misinformation and data breaches can erode consumer confidence. According to Lissitsa and Kol (2021), higher levels of digital trust correlate with increased engagement in e-commerce and digital services. Thus, digital trust serves as a behavioral enabler that can amplify the effectiveness of sustainability-driven messaging in the digital ecosystem. This also reflects a shift in how consumers evaluate brands-transparency and technical reliability are now part of sustainability perception, as reflected in studies like Hasan et al. (2020), which link digital interface experiences with perceived brand responsibility.

Greenwashing and Declining Brand Trust

The negative correlation between perceived greenwashing and brand trust, as confirmed by logistic regression ($B = -0.528$, $p < 0.001$), offers critical insights into consumer skepticism regarding sustainability claims. This affirms the hypothesis (H3) that consumers penalize brands that are perceived as disingenuous. These findings are consistent with the conclusions drawn by Delmas and Burbano (2011) and further supported by Nguyen et al. (2020), who found that overstated or unverified sustainability messaging can backfire, leading to a significant decline in consumer engagement and loyalty. For firms integrating ESG strategies, these findings underscore the need for credible, verifiable, and third-party validated sustainability certifications. In the absence of authentic engagement, brands risk losing trust and long-term value, which undermines the very goals of SDG-12 (Responsible-Consumption) and SDG 13 (Climate-Action). This insight resonates with Luchs et al. (2020), who emphasized the role of perceived honesty and ethical signaling in sustainable brand positioning. Furthermore, transparency in digital communication-through blockchain-enabled product tracing or AI-verified sustainability labels-has been recommended by authors like Sun and Lin (2021) as effective strategies for mitigating consumer concerns around greenwashing. This approach not only safeguards brand equity but also empowers consumers with informed decision-making capabilities.

Generational Insights and Behavioral Shifts

Another key observation from the ANOVA results is the generational gradient in eco-consciousness, with younger respondents (18–35 years) reporting significantly higher eco-behavior scores. This generational divide is in line with studies by Fromm and Read (2018) and de Jong et al. (2020), who highlighted that Gen Z and millennials are more likely to align their consumption with ethical and environmental values. Their preferences are shaped by digital literacy, peer influence, and social identity-making them crucial stakeholders for sustainable business transformation. This behavioral trend validates Objective 3 of present research and highlights the role-of-social-media and peer networks in catalyzing awareness. Social influence, when mediated through credible digital platforms, can reinforce social norms around eco-responsibility. According to Akbar and Hoffmann (2021), peer-led interventions are particularly effective in the digital economy due to their trust-based propagation and emotional resonance. Additionally, this age-group preference shift supports the growing case for age-specific ESG strategies. Brands that co-create sustainability initiatives with young consumers not only enhance engagement but also build long-term brand loyalty. This finding is aligned with SDG 13's emphasis on youth engagement in climate action and sustainability advocacy.

Statistical Model Implications for Practice

By employing Principal Component Analysis, this study successfully extracted three critical latent variables-eco-awareness, digital trust, and brand authenticity-explaining over 78% of behavioral variance. These constructs are statistically stable and contextually relevant, as affirmed by Hair et al. (2019) and Tabachnick and Fidell (2018), who advocated for PCA in behavioral modeling. This statistical structure provides businesses and policymakers with a validated behavioral segmentation model. For instance, digital marketing campaigns can be customized using this model to identify high-impact consumer segments, thus enhancing targeting efficiency and minimizing resource waste-contributing to SDG 9 (Innovation & Infrastructure).

Synthesis with Sustainable-Development-Goals (SDG's)

The empirical results of this study strongly support three key Sustainable Development Goals:

SDG-9 (Industry-Innovation-and-Infrastructure)

The integration of digital trust and data-driven branding models highlights how digital infrastructure and smart technologies can foster sustainable behavior. Findings suggest that trust in digital tools (e.g., payment systems, product ratings) directly influences eco-friendly purchase intent. As Sharma and Jha (2023) explain, digital consumer trust not only affects commercial outcomes but also the success of infrastructure-led sustainability campaigns.

SDG-12 (Responsible-Consumption-and-Production)

This study's validation of eco-awareness as a behavioral predictor underlines the importance of consumer responsibility. Aligning with White et al. (2019), our findings imply that digital education, labelling, and influencer-driven campaigns can shift public behavior toward eco-friendly options. Chi-square and ANOVA results further stress the demographic segmentation potential for responsible consumption policies.

SDG-13 (Climate-Action)

Consumers' perception of authenticity and their rejection of greenwashing illustrate a demand for credible climate responsibility. As highlighted by UNDP (2022), climate action begins with informed individual choices, and our statistical model offers a practical roadmap to assess and encourage those choices. This multi-SDG alignment positions the statistical model not only as a predictive tool but also as a policy-support framework that enhances corporate accountability and public behavior under national climate strategies like India's LiFE initiative (Lifestyle for Environment).

Practical Implications for Industry and Policymakers

This research provides critical implications across the ecosystem:

For marketers

The identified behavioral components can be used to build sustainable segmentation models. Eco-aware, digitally trusting, and authenticity-seeking consumers represent high-value targets for premium, purpose-driven branding strategies (Kotler et al., 2021). Campaigns should highlight transparency, verified certifications, and long-term environmental impacts rather than one-off claims.

For ESG strategists

The rejection of greenwashing shown in the data provides a strong rationale for incorporating measurable, traceable sustainability KPIs in ESG disclosures. As Moser and Gonzalez (2021) suggest, ESG performance should reflect not just internal efficiency but also consumer perception and trust.

For policymakers and digital platforms

Incentivizing platforms to incorporate verified eco-labels, digital sustainability scores, and peer-rated credibility systems could foster responsible consumption. Regulation to penalize greenwashing, when combined with digital literacy programs, can improve alignment with SDG 12 and SDG 13.

For startups and tech innovators

The behavioral clusters identified through PCA provide a strong base for developing AI-powered recommendation engines for eco-products. As noted by Kumar and Patel (2023), such tools are pivotal in scaling sustainable business models in digital ecosystems.

Theoretical contributions and innovation

This paper contributes to the growing-body of interdisciplinary-sustainability-research by integrating statistical modeling, consumer behavior, and digital trust into a single framework. Few studies have used PCA and regression tools simultaneously to identify actionable behavioral components in the Indian context. The originality lies in contextualizing statistical tools in support of real-world SDG outcomes. As Field (2020) notes, combining quantitative models with socio-psychological constructs provides a robust mechanism for scaling behavioral insights. Our model not only confirms this proposition but adapts it to a dynamic, digitally evolving society with strong sustainability mandates.

Summary

The increasing urgency for sustainable development has prompted organizations, policymakers, and researchers to examine the role of digital consumer behavior in promoting environmental and social responsibility. This study adopts a data-driven statistical modeling approach to investigate the behavioral determinants of consumer preferences for eco-friendly digital products in the Indian context. By applying robust multivariate-techniques including Principal-Component-Analysis (PCA), multiple-regression, and logistic-regression to data collected from 350 respondents, the research identifies three core behavioral constructs: eco-awareness, digital trust, and brand authenticity. These constructs not only capture the psychological and perceptual dimensions of sustainability-oriented behavior but also serve as significant predictors of two key outcomes willingness-to-pay (WTP) a premium and brand trust.

Our study reveals that younger consumers, particularly those under 35 years of age, along with individuals possessing higher educational qualifications, demonstrate greater eco-consciousness and digital engagement. ANOVA tests confirmed that this demographic segment consistently reported higher scores on eco-awareness and were more responsive to sustainability messaging. These findings are in line with a generational shift toward value-based consumption, where environmental concerns and ethical brand behavior take precedence over price sensitivity. Interestingly, income levels did not show a statistically significant impact on willingness to pay, suggesting that sustainable consumer behavior in digital markets is increasingly driven by internalized values rather than purchasing power.

PCA effectively reduced 14 behavioral indicators into three interpretable components, which explained over 78% of the total variance. Regression analyses further validated that eco-awareness had the strongest influence on sustainable behavior, followed by digital trust and brand authenticity-all statistically significant. These findings support Hypotheses H1 and H2, demonstrating that consumers with higher environmental awareness and confidence in digital platforms are more inclined to engage in eco-responsible purchasing. The logistic regression model adds further depth to the analysis by exploring predictors of brand trust. Results indicate that perceived greenwashing negatively affects brand trust, reducing the odds by 41% ($Exp(B) = 0.59$, $p < 0.001$), while positive social media engagement increases trust likelihood by 51% ($Exp(B) = 1.512$, $p < 0.001$). These insights validate Hypothesis H3 and underscore the critical role of digital ecosystems in shaping consumer trust-either positively, through peer-driven validation and transparent brand communication, or negatively, through skepticism and misinformation. This duality highlights the importance of digital reputation management, especially for brands committed to ESG (Environmental, Social, and Governance) principles.

From a policy and strategic perspective, the study offers several actionable insights. For brands and marketers, the findings highlight the necessity of investing in transparent, verifiable sustainability practices and leveraging social media platforms to build trust through authentic engagement. For policymakers, the evidence supports the design of targeted awareness campaigns that appeal to value-

driven consumers, especially within digitally literate and environmentally conscious demographics. Moreover, the study offers a replicable statistical framework for modeling sustainable digital consumer behavior, combining rigorous empirical analysis with theoretical relevance. Aligned with SDG-9 (Industry-Innovation-and-Infrastructure), SDG-12 (Responsible-Consumption-and-Production), and SDG-13 (Climate-Action), the study contributes to the global discourse on sustainable development by showcasing how data analytics and behavioral modeling can drive more effective ESG strategies in emerging digital markets like India. The evidence underscores that fostering eco-awareness and digital trust through transparent branding and strategic communication can significantly enhance sustainable consumption. In doing so, this research not only promotes academic-understanding but also gives meaningful direction for industry stakeholders seeking to align with global sustainability objectives.

Conclusion

This study demonstrates that eco-awareness, digital trust, and brand authenticity significantly influence sustainable digital consumer behavior in India, offering a robust statistical framework for understanding and promoting responsible consumption. By validating three core behavioral drivers through PCA, regression, and chi-square analysis, the research confirms that younger, eco-conscious consumers demand transparency and authenticity and are willing to support sustainable brands-especially when digital trust is established. These insights align with SDG-9 (Industry-Innovation-and-Infrastructure), SDG-12 (Responsible-Consumption-and-Production), and SDG-13 (Climate-Action), and underscore the risks of greenwashing in eroding consumer trust. By bridging statistical modeling with marketing strategy and policy, the study provides actionable pathways for ESG-aligned innovation, reinforcing that data-driven inclusion and impact are essential to advancing sustainability in the digital age.

Limitations

The present study has following limitations:

Sample representation

Although our research used robust sample size of 350 respondents, the sample was skewed toward urban and digitally literate consumers, particularly Gen Z and millennials. This limits the generalizability of findings to rural or less digitally active populations.

Self-Reported Data Bias

The reliance on self-reported-survey responses might have introduced social-desirability-bias, particularly in questions related to sustainability preferences and green consumption, potentially affecting the accuracy of behavioral indicators.

Temporal-limitation

Our analysis reflects consumer-behavior as observed during a single time-frame. Given the dynamic nature of digital platforms and evolving environmental awareness, longitudinal studies are needed to validate the consistency of these behavioral patterns over time.

Future Scope

Longitudinal-studies

Subsequent studies may adopt a longitudinal approach to evaluate how eco-conscious behaviors evolve over time, especially in response to changing policy environments or sustainability campaigns.

Inclusion of rural and semi-urban populations

Expanding the sample to include rural and semi-urban consumers will provide a more holistic view of sustainable digital behavior across socioeconomic strata in India.

Cross-country comparative analysis

Comparing similar behavioral models across other emerging economies (e.g., Brazil, South Africa, Indonesia) would help contextualize India's sustainability progress and global alignment with the SDGs.

Experimental designs

Incorporating experimental research or randomized controlled trials could strengthen causal inference, particularly for variables like greenwashing perception or digital trust.

Technology-enabled behavioral tracking

Leveraging digital analytics, AI tools, or blockchain tracing in future studies can offer more objective, real-time behavioral data-enriching insights on actual (not just intended) sustainable consumption.

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References

Akbar, P., & Hoffmann, S. (2021). Under which circumstances do consumers choose sustainable options? The role of message framing and perceived consumer effectiveness. *Journal of Business Research*, 132, 475–485. https://doi.org/10.1016/j.jbusres.2021.04.070

Ahmad, W., & Zhang, Q. (2020). Green purchase intention: Effects of electronic word-of-mouth and green brand knowledge. *Corporate Social Responsibility and Environmental Management*, 27(1), 74–84.

Ali, A., & Ahmad, I. (2021). Consumer trust in e-commerce: The role of digital privacy and security in sustainable consumption. *Sustainable Development*, 29(4), 672–683.

Balasubramanian, S., & Mahajan, R. (2021). Consumer behavior and

greenwashing: A multivariate approach. *Business Strategy and the Environment*, 30(2), 986–996.

Bhatia, M., & Jain, A. (2018). Green marketing framework: Empirical validation using Indian data. *Journal of Global Marketing*, 31(4), 236–252.

Bhattacharya, A., & Sen, S. (2022). Brand authenticity and environmental communication: Evidence from India. *Journal of Marketing Management*, 38(7–8), 603–623.

Biswas, A., & Roy, M. (2015). Green products: An exploratory study on the consumer behavior in emerging economies of the East. *Journal of Cleaner Production*, 87(1), 463–468.

Buerke, A., & Straube, F. (2020). Understanding green marketing orientation and green purchase behavior: A data-driven approach. *Journal of Cleaner Production*, 275, 123113.

Chaturvedi, A., & Shrivastava, S. (2019). Cultural influences on sustainability practices in Indian digital markets. *South Asian Journal of Business and Management Cases*, 8(3), 330–342.

Chi, T., & Chi, H. (2020). The impacts of green brand authenticity on customer–brand relationships and purchase behavior. Sustainability, 12(19), 8012. https://doi.org/10.3390/su12198012

D'Souza, C., & Taghian, M. (2019). CSR communication and green marketing: A consumer-centric model. *Corporate Communications: An International Journal*, 24(1), 32–48.

Delmas, M. A., & Burbano, V. C. (2011). The drivers of greenwashing. *California Management Review*, 54(1), 64–87.

Ellen MacArthur Foundation. (2020). The Circular Economy in Detail. Retrieved from https://ellenmacarthurfoundation.org

Field, A. (2020). Discovering Statistics Using IBM SPSS Statistics (5th ed.). SAGE Publications.

Fromm, J., & Read, A. (2018). Marketing to Gen Z: The rules for reaching this vast and very different generation of influencers. AMACOM.

García-Sánchez, I. M., Rodríguez-Ariza, L., & Frías-Aceituno, J. V. (2020). The cultural system and integrated reporting. *International Business Review*, 29(3), 101667.

Ghosh, A., & Shah, M. (2019). Sustainable consumer behavior and the role of digital platforms. *Journal of Retailing and Consumer Services*, 51, 220–230.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). Multivariate Data Analysis (8th ed.). Cengage.

Hasan, R., Lowe, B., Petrovici, D., & Huhmann, B. A. (2020). The role of digital trust in marketing: A framework and research agenda. *Journal of Interactive Marketing*, 50, 71–88.

Hofstede Insights. (2021). Country Comparison: India. https://www.hofstede-insights.com/country-comparison/india/

IPCC. (2021). Climate Change 2021: The Physical Science Basis. https://www.ipcc.ch/report/ar6/wg1/

Joshi, Y., & Rahman, Z. (2019). Sustainable consumption behavior and green marketing strategies: A framework for fostering green consumerism. *Journal of Cleaner Production*, 206, 732–744.

Kalafatis, S. P., Pollard, M., East, R., & Tsogas, M. H. (2020). Green marketing and behavioral research: A review. *European Journal of Marketing*, 54(7), 1571–1597.

Kanchanapibul, M., Lacka, E., Wang, X., & Chan, H. K. (2022). Sustainability and consumption: A review of literature on the role of the digital economy. *Journal of Business Research*, 140, 449–462.

Kang, J., & Kim, H. J. (2021). Building a sustainable brand through social media: The role of consumer–brand engagement. Sustainability, 13(3), 1264. https://doi.org/10.3390/su13031264

Kotler, P., Kartajaya, H., & Setiawan, I. (2021). Marketing 5.0: Technology for Humanity. Wiley.

Kumar, B., & Joshi, M. (2022). Perceived value and trust in sustainable product marketing. *Journal of Business Research*, 147, 105–117.

Kumar, S., & Patel, A. (2023). AI and the sustainable consumer: Predictive analytics in green marketing. *Sustainable Computing: Informatics and Systems*, 38, 100726.

Li, G., & Wu, H. (2023). Smart retail and AI in green consumption: Machine learning applications in customer insights. *Journal of Retailing and Consumer Services*, 70, 103162.

Lim, W. M. (2022). Digital trust and eco-conscious buying: Antecedents and outcomes. *Journal of Retailing and Consumer Services*, 67, 102974.

Lissitsa, S., & Kol, O. (2021). Digital divides in eco-purchasing across generations. *Technology in Society*, 64, 101468.

Luchs, M. G., Walker Naylor, R., Irwin, J. R., & Raghunathan, R. (2020). Promoting sustainability through product design: Consumer responses to sustainability and aesthetics. *Journal of Marketing Research*, 57(4), 716–738.

Luo, X., & Bhattacharya, C. B. (2019). Corporate social responsibility and consumer behavior: The mediating role of trust. *Journal of Marketing*, 83(1), 50–68.

Mehta, P., & Sharma, R. (2022). Exploring the digital-sustainability nexus: Trust, authenticity, and eco-branding. *Information Systems Frontiers*, 24, 659–674.

Mishra, A., & Singh, R. (2020). Statistical modeling of green behavior using SEM: An empirical study. *International Journal of Consumer Studies*, 44(5), 445–457.

Moser, R., & Gonzalez, C. (2021). ESG disclosures and consumer trust: The mediating role of perceived responsibility. *Journal of Sustainable Finance & Investment*, 11(1), 1–16.

Narang, S., & Bansal, N. (2023). Machine learning for green consumer segmentation in Indian e-commerce. Sustainable Computing, 40, 100795.

Nguyen, T. N., Lobo, A., & Greenland, S. (2020). Pro-environmental purchase behavior: The role of green marketing communications. *Journal of Retailing and Consumer Services*, 57, 102229.

Pallant, J. (2020). SPSS Survival Manual (7th ed.). McGraw-Hill Education.

Peattie, K., & Belz, F. M. (2010). Sustainability marketing: An innovative conception of marketing. Marketing Review St. Gallen, 27(5), 8–15.

Rahman, S. (2021). The role of eco-labeling in sustainable product choices. *Environmental Research Letters,* 16(9), 094010.

Rana, J., & Paul, J. (2020). Health motive and the purchase of organic food: A meta-analytic review. *International Journal of Consumer Studies*, 44(2), 162–171.

Raza, S. A., & Umer, A. (2020). The influence of peer recommendations on sustainable buying behavior in online environments. Internet Research, 30(5), 1459–1478.

Sharma, A., & Jha, D. (2023). Building digital trust for sustainable consumption in India. *Technological Forecasting and Social Change*, 188, 122272.

Sharma, P., & Kumar, A. (2020). Integrating circular economy in online retail: An Indian perspective. *Journal of Cleaner Production*, 268, 122243.

Singh, A., & Verma, R. (2019). Role of environmental concern and perceived consumer effectiveness in green purchase behavior. *International Journal of Environmental Research*, 13(4), 645–658.

Statista. (2023). Digital users in India by 2025. Retrieved from https://www.statista.com

Sun, Y., & Lin, J. (2021). Blockchain and supply chain transparency: Impact on sustainable consumer trust. *Journal of Cleaner Production*, 298, 126870.

Tabachnick, B. G., & Fidell, L. S. (2018). Using Multivariate Statistics (7th ed.). Pearson.

Tandon, A., & Dhir, A. (2021). Sustainable e-commerce adoption in India: Consumer behavior and policy implications. *Technological Forecasting and Social Change*, 168, 120776.

Taufique, K. M. R., & Vaithianathan, S. (2018). Green advertising appeals and consumer purchase intention: Evidence from the emerging markets. *International Journal of Emerging Markets*, 13(1), 95–113.

Thøgersen, J. (2005). How may consumer policy empower consumers for sustainable lifestyles? *Journal of Consumer Policy*, 28(2), 143–178.

Trivedi, R., & Patel, J. (2021). Awareness and attitude toward sustainable consumption among Indian youth. *Social Responsibility Journal*, 17(6), 795–812.

UNCTAD. (2023). Sustainable Consumption and Production: Global Digital Markets. Retrieved from https://unctad.org

UNDP. (2022). Digital Innovation and SDGs: Pathways to Progress. United Nations Development Programme. https://www.undp.org

Wang, H., & Lin, C. (2021). How perceived CSR and sustainability innovation affect green purchase intentions: A consumer perspective. *Journal of Business Ethics*, 174, 135–152.

White, K., Habib, R., & Hardisty, D. J. (2019). How to shift consumer behaviors to be more sustainable: A review. Nature Sustainability, 2(11), 981–989.

Yadav, R., & Pathak, G. S. (2017). Determinants of consumers' green purchase behavior in a developing nation. *Journal of Cleaner Production*, 142, 385–393.

Zaharia, C., & Zaharia, A. (2020). Statistical evaluation of consumer perceptions of digital green labeling. *International Journal of Environmental Research and Public Health*, 17(6), 2003.

Zhang, Y., & Wang, X. (2021). Social media influencers and green behavior: Evidence from Instagram users. Sustainability, 13(14), 7933.