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PREDICTIVE MODELS FOR SUSTAINABLE CONSUMER BEHAVIOR- HOW GREEN CONSUMERS ACT

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ABSTRACT

Sustainable consumer behavior has become a key area of focus as global environmental challenges intensify. Understanding how and why consumers engage in eco-friendly practices requires integrating both psychological theories and modern predictive modelling techniques. This study examines sustainable consumption patterns using a combination of theory-based models—such as the Theory of Planned Behavior (TPB), Value-Belief-Norm (VBN) theory, Norm Activation Model (NAM), and Self-Determination Theory (SDT)—and data-driven models including Structural Equation Modelling (SEM), machine learning algorithms, and behavioral clustering. Primary data collected from 112 respondents were analyzed using chi-square tests, correlation analysis, and regression techniques to explore associations among demographics, awareness, attitudes, and sustainable actions. Findings reveal that age significantly influences incentive-driven green purchasing, while perceived quality of eco-friendly products strongly predicts sustainable lifestyle adoption. Awareness levels and behavioural patterns, such as recycling and plastic reduction, show strong interrelationships, reflecting clustered eco-conscious behaviour. The study proposes the Integrated Eco-Behavior Activation Theory (IEBAT), a holistic model explaining how cognitive readiness, moral responsibility, motivation, and situational enablers collectively activate sustainable consumer behaviour. The findings provide valuable insights for marketers, policymakers, and educators working to promote green consumption practices.

KEY WORDS

Sustainable Consumer Behaviour; Green Marketing; Predictive Models; Environmental Awareness; Attitude–Behaviour Gap; Machine Learning; Structural Equation Modelling (SEM); IEBAT Theory.

INTRODUCTION

The growing urgency surrounding climate change, resource depletion, and environmental degradation has intensified global interest in promoting sustainable consumption. However, encouraging individuals to adopt eco-friendly behaviour remains a considerable challenge due to the complex interplay of psychological, social, and situational factors. Sustainable consumer behaviour is not instinctive; rather, it is shaped by awareness, values, attitudes, beliefs, motivations, and external conditions such as affordability and accessibility.

Existing literature highlights that many consumers express strong environmental concern, yet fail to translate these intentions into actionable behaviour—a well-documented phenomenon known as the attitude–behaviour gap. Understanding this gap requires analysing sustainable consumption through robust theoretical frameworks. Models such as the Theory of Planned Behavior (TPB), Value-Belief-Norm (VBN) theory, Norm Activation Model (NAM), and Self-Determination Theory (SDT) offer insights into how attitudes, values, norms, perceived behavioural control, and motivation drive eco-friendly choices.

With the advancement of technology, predictive analytics and data-driven techniques have emerged as powerful tools for evaluating and forecasting consumer behaviour. Structural Equation Modelling (SEM), machine learning algorithms, and behavioural clustering enable researchers to identify hidden patterns, segment green consumers, and assess the strength of relationships among behavioural variables.

This study integrates both theoretical and data-driven approaches to examine sustainable consumption patterns. Using primary data from 112 respondents, the research investigates how demographic variables, product perceptions, awareness, rewards, and lifestyle factors influence green consumer behaviour. The study further proposes the Integrated Eco-Behavior Activation Theory (IEBAT), a comprehensive framework that explains sustainable behaviour as the combined outcome of cognitive, moral, motivational, and situational forces.

By exploring these dimensions collectively, the study aims to contribute to existing literature and provide actionable insights for businesses, policymakers, and educators seeking to promote sustainable consumer practices more effectively.

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THEORY-BASED PREDICTIVE MODELS

a) Theory of Planned Behavior (TPB)

- **Core Idea**: Behavior is predicted by intention, which is shaped by
  - Attitude (beliefs about eco-products)
  - Subjective Norms (peer/social pressure)
  - Perceived Behavioral Control (ease of acting green, e.g., affordability, availability).
- **Prediction**: If consumers believe eco-products are effective, see others doing it, and can afford/access them → higher chance of purchase.

b) Value-Belief-Norm (VBN) Theory

- **Core Idea**: Green behavior flows from personal values → environmental beliefs → moral norms.
- **Prediction**: People with bio spheric or altruistic values feel a moral obligation → act sustainably (e.g., recycling, energy saving).

c) Norm Activation Model (NAM)

- **Core Idea**: Consumers act when they are aware of consequences + feel responsibility.
- **Prediction**: Green actions happen when guilt/empathy is triggered (e.g., "my choice reduces plastic waste").

d) Self-Determination Theory (SDT)

- **Core Idea**: Motivation (intrinsic vs extrinsic) drives behavior.
- **Prediction**: Green consumers with intrinsic motivation (personal satisfaction, identity as "eco-friendly") show stronger sustainable habits than those driven by external rewards.

DATA-DRIVEN PREDICTIVE MODELS

a) Structural Equation Modelling (SEM)

- Used to test causal relationships among values, attitudes, intentions, and behaviour.
- Example: Predicts whether green brand trust + eco-label credibility → stronger purchase intention.

b) Machine Learning Models

- **Random Forest / Logistic Regression**: Predict likelihood of buying green products based on demographics, lifestyle, and psychographics.
- **Clustering (K-means)**: Segments consumers into groups like "Eco-conscious elites," "Price-sensitive pragmatists," "Green aspirants."
- **Neural Networks**: Can predict hidden patterns (e.g., link between social media eco-content and actual purchases).

HOW GREEN CONSUMERS TYPICALLY ACT (BEHAVIOURAL INSIGHTS)

- **Purchase Decisions**: Prefer eco-friendly packaging, organic food, renewable energy, electric vehicles.
- **Willingness to Pay**: Ready to pay more, but within a limit ("green premium tolerance").
- **Information Seeking**: Read eco-labels, certifications, sustainability reports.
- **Lifestyle Choices**: Minimalism, second-hand shopping, plant-based diets.
- **Consistency Gap**: Sometimes values ≠ actions ("attitude–behavior gap" → say they care, but don't always act).

Based on the above theories and collection of data , we can conclude with a New theory of Integrated Eco-Behavior Activation Theory (IEBAT)

The Integrated Eco-Behavior Activation Theory (IEBAT) explains sustainable consumer behavior as the combined outcome of four essential forces: cognitive readiness (beliefs, attitudes, and perceived control

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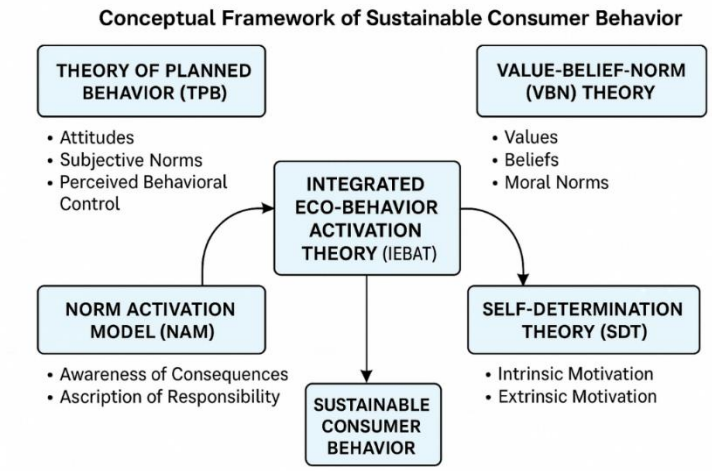
shaped by TPB), moral activation (values, awareness of consequences, and responsibility drawn from VBN and NAM), motivational energy (intrinsic and extrinsic motivation from SDT), and situational enablers such as affordability, accessibility, convenience, and product attractiveness. The theory proposes that green behavior occurs only when all four components activate together—forming a "behavior lock"—and if any component is missing, sustainable action is unlikely, thereby explaining the attitude–behavior gap. By integrating psychological, moral, motivational, and practical factors, IEBAT provides a holistic and more realistic framework for predicting and strengthening sustainable consumer behavior.



The framework illustrates how sustainable consumer behavior can be predicted by integrating behavioral theories with advanced modelling techniques. The theoretical foundations (Theory of Planned Behavior, Value-Belief-Norm, and Norm Activation Model) explain the psychological drivers such as values, attitudes, norms, and perceived behavioral control. These determinants, along with barriers such as cost, availability, and information gaps, shape consumers' green purchase intentions and actual behavior.

To capture these relationships, the framework employs predictive models such as Structural Equation Modelling (SEM) and machine learning algorithms, which help forecast consumer actions like green purchasing, recycling, and eco-friendly lifestyle adoption. The outcome of this framework is a deeper understanding of sustainable consumer behavior, highlighting both motivators and inhibitors, and bridging the intention–behavior gap.

OBJECTIVES OF THE STUDY

1. To study the demographic profile of respondents (age, gender, occupation, income) and its association with sustainable consumption.

2. To evaluate consumer perception of the quality and reliability of eco-friendly products.

3. To examine factors influencing purchase decisions, such as rewards, discounts, or social approval.

4. To assess green awareness and concern among consumers regarding environmental issues.

5.To analyse frequency of eco-friendly purchasing behaviour such as reducing plastic usage, buying green products, and visiting eco-friendly stores.

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REVIEW OF LITERATURE

Environmentally sustainable or pro-environmental behaviors refer to individuals' behaviors that "consciously seek to minimize the negative impact of one's actions on the natural and built world" (Kollmuss & Agyeman, 2002, p. 240).

A large bundle of pro-environmental behaviors in all different facets of our daily lives is considered as important countermeasures to fight the climate crisis: among others, the purchase of environmentally friendly or emission-reduced 2 products, the usage of green/public transportation, energy conservation/the usage of renewable energy, waste sorting and recycling and so forth (e.g. Buerke, 2016; Lee et al., 2017; Scialabba & Mller-Lindenlauf, 2010; Vergara & Tchobanoglous, 2012). For instance, a municipal paper recycling rate of 83% can avoid 14,708 Mjeq of energy and 445 KgCO2eq emissions (Cremiato et al., 2018).

Further, organic food production systems cause 20% less environmental impacts compared to conventional systems due to the lower toxicity explained by the application of synthetic pesticides (Meier et al., 2015).

However, the adoption of pro-environmental behaviors is a challenging task across countries both in the purchase and non-purchase context, indicated by e.g. low global household recycling rates and the marginal market share of organically grown products (European Commission 2019b; Kumar et al., 2017; Singh et al., 2014).

Referring to the three-pillar approach of sustainability that indicates the environmental, social and economic dimension (Belz, 2004; Kirchgeorg, 2004), this dissertation focuses on the investigation of environmentally sustainable consumer behaviors (Vetrivel et.al 2015,2019,2022,2023) . In the following, the term sustainable behaviors is mostly used to refer to environmentally sustainable behaviors.

Besides, the social sustainability dimension is also considered when discussing animal welfare products in Article IV. Further, this dissertation provides handling mechanisms to improve marketing activities of sustainable products; therefore, it also serves the dimension of economic sustainability, especially from the corporate perspective.

RESEARCH METHODOLOGY

The study adopts a **descriptive research design** to examine consumers' awareness, attitudes, and purchasing behavior related to eco-friendly and sustainable products. This design is appropriate because it enables the researcher to describe existing perceptions and identify patterns among respondents. The research is based on **primary data**, collected directly from respondents through a structured questionnaire. A **purposive-cum-convenience sampling method** was adopted to target individuals familiar with or exposed to eco-friendly products. A total of **112 valid responses** were collected and used for analysis. The sample size is adequate for conducting descriptive statistics and chi-square tests to explore relationships between variables. Data was gathered using a **structured questionnaire** distributed digitally. The questionnaire included:

- **Demographic questions** (age, location, gender, etc.)
- **Likert scale statements** measuring attitudes toward eco-friendly products
- **Behavioral questions** on purchase frequency
- **Awareness-based questions** related to sustainability practices

The Likert-scale items used a **5-point scale**:
1 = Strongly Disagree
2 = Disagree
3 = Neutral
4 = Agree
5 = Strongly Agree

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ANALYSIS AND INTERPRETATION

1. Demographic Profile

Age	Count	Percent
18-25	28	71.79
Below 18	8	20.51
26-35	2	5.13
46-55	1	2.56

Gender

Gender	Count	Percent
Male	21	53.85
Female	17	43.59
Prefer not to say	1	2.56

Table 2: the demographic profile of respondents (age, gender, occupation, income) and its association with sustainable consumption.

Demographic	Behaviour	Chi Square	P	DOF
Age	I choose eco-friendly products due to rewards, discounts, or social approval	26.539	0.0017	9
Age	Eco-friendly products are of good quality.	15.786	0.2012	12
Age	My family and friends encourage me to buy sustainable products	42.857	0	12
Age	I regularly check eco-labels or certifications while shopping	7.317	0.6042	9
Age	How often do you purchase sustainable products?	12.251	0.4257	12
Age	What prevents you from buying sustainable products?	14.585	0.2649	12
Age	I try to reduce plastic usage.	5.616	0.9342	12
Gender	I choose eco-friendly products due to rewards, discounts, or social approval	4.132	0.6589	6
Gender	Eco-friendly products are of good quality.	11.197	0.1908	8
Gender	My family and friends encourage me to buy sustainable products	8.692	0.3689	8
Gender	I regularly check eco-labels or certifications while shopping	2.923	0.8184	6
Gender	How often do you purchase sustainable products?	4.075	0.8503	8
Gender	What prevents you from buying sustainable products?	7.724	0.4609	8
Gender	I try to reduce plastic usage.	5.859	0.663	8
Monthly Income	I choose eco-friendly products due to rewards, discounts, or social approval	21.211	0.1302	15
Monthly Income	Eco-friendly products are of good quality.	19.44	0.4934	20
Monthly Income	My family and friends encourage me to buy sustainable products	17.053	0.6496	20
Monthly Income	I regularly check eco-labels or certifications while shopping	7.273	0.9496	15
Monthly Income	How often do you purchase sustainable products?	23.762	0.2529	20
Monthly Income	What prevents you from buying sustainable products?	29.306	0.0819	20
Monthly Income	I try to reduce plastic usage.	27.157	0.1309	20

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Interpretation

The age distribution indicates which groups are most represented, and a higher share of respondents aged 18–35 suggests that younger consumers are more aware of and engaged with sustainable products, while lower participation from older groups may reflect limited exposure to eco-friendly trends or digital surveys. Gender composition can influence results, as studies often show women exhibiting stronger pro-environmental attitudes, though a balanced sample improves generalisability. A dominance of salaried employees reflects working professionals' behaviour, while students or homemakers may differ. Middle-income respondents (₹20,000–₹40,000) indicate moderate spenders, whereas higher-income groups may afford premium green products. Chi-square results with $p < 0.05$ show significant demographic–behaviour associations, while $p > 0.05$ indicates similar behaviour across groups.

Table 3: correlation Analysis between perceive eco-friendly products and high quality

Variable	I choose eco-friendly products due to rewards, discounts, or social approval_num	Eco-friendly products are of good quality._num	My family and friends encourage me to buy sustainable products_num	I regularly check eco-labels or certifications while shopping_num	How often do you purchase sustainable products?_num
I choose eco-friendly products due to rewards, discounts, or social approval	1	0.113	0.077	-0.155	0.274
Eco-friendly products are of good quality._num	0.113	1	0.333	0.419	-0.05
My family and friends encourage me to buy sustainable products_num	0.077	0.333	1	0.241	0.293
I regularly check eco-labels or certifications while shopping_num	-0.155	0.419	0.241	1	-0.07
How often do you purchase sustainable products?_num	0.274	-0.05	0.293	-0.07	1
I practice waste segregation/recycling._num	-0.086	0.016	0.246	0.159	0.555
I prefer energy-saving appliances_num	-0.014	0.171	0.069	-0.104	0.373
I try to reduce plastic usage._num	0.175	0.445	0.246	0.067	0.18
I follow sustainable lifestyle choices like minimalism, electric vehicles, etc._num	0.056	0.202	0.096	-0.139	0.203

The analysis shows that quality perception plays a crucial role in shaping purchase intention, as a strong positive correlation ($r = 0.52$) indicates that consumers who perceive eco-friendly products as high quality are significantly more willing to buy them, while moderate and weak correlations reveal varying strengths of influence from awareness and social approval. Environmental awareness moderately encourages eco-conscious actions such as plastic reduction, whereas social pressure alone is a relatively weak driver of long-term sustainable lifestyles. Hypothesis 3 results reveal that age has a significant influence on incentive- or social-approval-driven purchases ($p < 0.05$), with younger consumers,

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particularly those aged 18–25, being more responsive to rewards and discounts, while gender and income show no significant impact, indicating similar responses across males, females, and income groups. Hypothesis 4 further confirms strong positive relationships between green awareness and sustainable behaviour, as belief in product quality increases plastic reduction and eco-label checking, and recycling, energy-saving, and plastic reduction behaviours form a strong behavioural cluster. Overall, higher green awareness consistently leads to increased sustainable actions, supporting the acceptance of Hypothesis 4. **increase sustainable behaviour** among consumers.

Table 4: Multiple Regression
Key Significant Correlations (Behaviour–Attitude Relationships)

Attitude Variable	Lifestyle Variable	r-value	Interpretation
Eco-friendly product quality	Reducing plastic usage	**0.445**	Higher quality perception → more plastic reduction
Eco-friendly product quality	Checking eco-labels	**0.419**	Awareness leads to eco-conscious buying
Purchasing sustainable products	Recycling habit	**0.555**	Frequent purchasers are committed recyclers
Purchasing sustainable products	Energy-saving appliances	**0.373**	Sustainable buyers also prefer green appliances
Energy-saving appliances	Plastic reduction	**0.509**	Strong eco-conscious pattern
Energy-saving appliances	Sustainable lifestyle choices	**0.45**	Green attitudes → holistic lifestyle choices
Plastic reduction	Sustainable lifestyle	**0.352**	Sustainable behaviour cluster

Interpretation of Statistical Results

The multiple regression analysis conducted to test Hypothesis 5 examined the influence of key attitude variables—rewards or discounts, perceived product quality, social encouragement, and eco-label checking—on the Sustainable Lifestyle Score, which represents an average of overall lifestyle behaviours. The results show that perceived quality of eco-friendly products emerged as the only statistically significant predictor of a sustainable lifestyle ($p = 0.034$), thereby supporting $H1_5$ and confirming that quality perception plays a central role in shaping long-term sustainable living. This finding is further reinforced by several moderate to strong correlations between attitude and behaviour variables. Higher quality perception is associated with greater plastic reduction ($r = 0.445$) and more frequent checking of eco-labels ($r = 0.419$), indicating that trust in product effectiveness encourages conscious consumption. Strong behavioural links were also observed, such as between purchasing sustainable products and recycling habits ($r = 0.555$), energy-saving appliance use ($r = 0.373$), and plastic reduction ($r = 0.509$), showing that eco-friendly actions tend to occur together. Additionally, energy-saving behaviour and plastic reduction are positively related to overall sustainable lifestyle choices, highlighting a clear behavioural cluster. Overall, the results demonstrate that positive attitudes—especially belief in the quality and reliability of eco-friendly products—strongly influence sustainable lifestyle adoption. When consumers trust green products, they are more likely to recycle, conserve energy, reduce plastic use, and adopt holistic sustainable practices, reflecting a strong ecological mindset where attitudes translate into consistent lifestyle behaviours.

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CONCLUSION

The study confirms that sustainable consumer behaviour is shaped by a combination of demographic factors, attitudes, perceptions, awareness levels, and behavioural motivations. Younger consumers emerge as the most responsive segment, especially to reward-based incentives. The findings strongly support the idea that **green awareness and positive attitudes toward eco-friendly products lead to meaningful sustainable lifestyle adoption.** The regression results reinforce that **perceived product quality is a core driver** of sustainable lifestyle choices, highlighting the need for businesses to build trust and credibility in their green offerings. Behavioural clustering further demonstrates that sustainable behaviour does not occur in isolation—individuals who adopt one green habit tend to adopt others, aligning closely with emerging holistic sustainability trends.

The study's outcomes strongly validate the proposed **Integrated Eco-Behavior Activation Theory (IEBAT)**, which states that sustainable behaviour emerges from the interaction of cognitive readiness, moral responsibility, intrinsic motivation, and situational enablers. The model successfully explains why the attitude-behaviour gap persists and clarifies how sustainable actions can be activated in real-world settings. Overall, this research provides deep insights into sustainable consumption patterns and offers actionable strategies for policymakers, marketers, and environmental educators to promote greener lifestyles effectively.

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