



# Impact of Business Analytics to Predict Consumer Adoption of Sustainable Products

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## Abstract

*The growing awareness of environmental sustainability has prompted businesses to develop eco-friendly products, yet consumer adoption of such products remains inconsistent. This research investigates the role of business analytics in predicting consumer behavior toward sustainable products. By leveraging data-driven techniques such as predictive modeling, machine learning algorithms, and sentiment analysis, the study aims to identify key factors influencing consumer preferences, purchasing decisions, and adoption patterns. The findings highlight how businesses can optimize marketing strategies, personalize product offerings, and enhance decision-making processes to increase the acceptance of sustainable products. Furthermore, the study emphasizes the strategic importance of integrating business analytics into sustainability initiatives, demonstrating that actionable insights derived from consumer data can significantly influence both market success and environmental impact. This research provides a framework for organizations to harness analytics not only as a tool for operational efficiency but also as a catalyst for promoting sustainable consumption.*

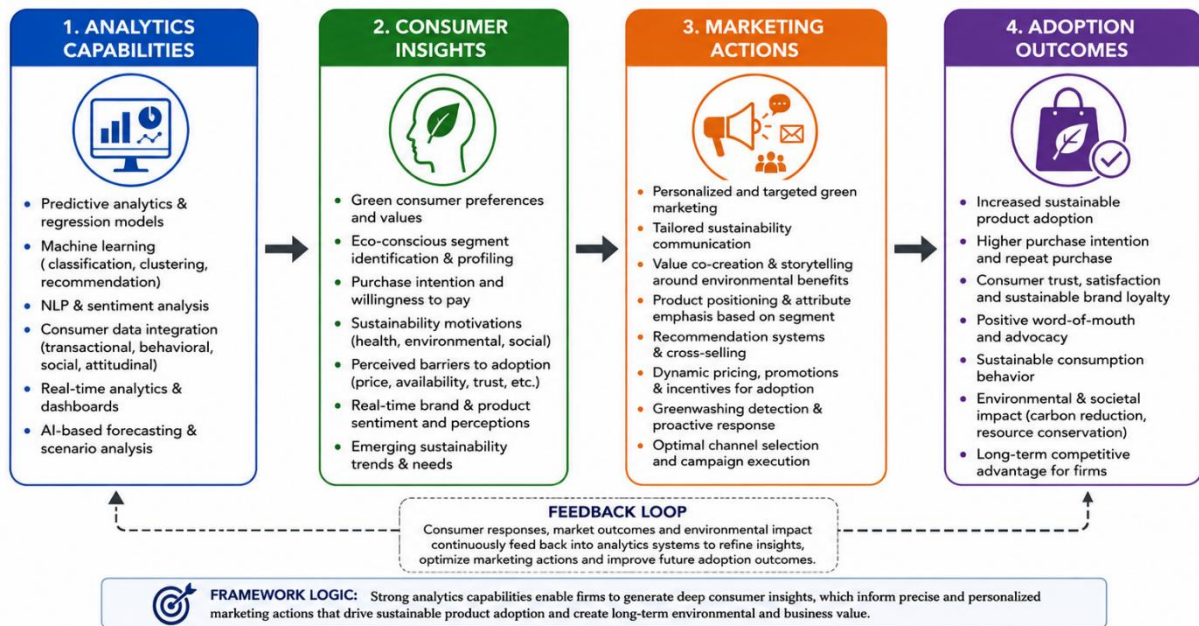
**Keywords:** Business Analytics, Consumer Adoption, Sustainable Products, Predictive Modeling, Machine Learning, Consumer Behavior, Eco-friendly Products, Data-driven Decision Making, Sustainability Marketing, Sentiment Analysis

## 1. Introduction

The growing urgency of climate change and resource scarcity has led firms to develop sustainable products – goods designed to minimize environmental impact throughout their lifecycle. Consumers increasingly express interest in eco-friendly products (a 2020 survey found 78% of U.S. shoppers consider sustainability important), yet actual adoption often lags. For example, one study found that while ~65% of consumers say they want to buy purpose-driven brands, only about 26% actually do. Similarly, many companies struggle to convert stated “green” preferences into sales despite high consumer interest. This gap suggests a need for more effective marketing strategies that resonate with consumer values. In recent years, business analytics – the use of statistical analysis, predictive modeling, and machine learning to extract insights from data has emerged as a key tool for understanding and influencing consumer behavior. Analytics can help firms forecast which segments are most likely to adopt sustainable products, personalize offerings and messages, and monitor market trends in real time. This paper reviews the literature on business analytics and green consumer behavior, and proposes a conceptual framework linking analytics capabilities to sustainable product adoption. Specifically, we

examine how predictive models, machine learning, and sentiment analysis can be applied in sustainability marketing, and how these tools generate insights that guide strategic marketing actions (Figure 1). We also identify implications for theory and practice in this domain.

**Figure 1. Conceptual framework linking analytics to sustainable product adoption**  
(Analytics Capabilities → Consumer Insights → Marketing Actions → Adoption Outcomes)



## 2. Research Objectives

- Explore applications of business analytics tools (predictive modelling, ML, sentiment analysis) in sustainability marketing.
- Develop a conceptual framework linking analytics capabilities with consumer adoption of sustainable products.
- Examine the concept and significance of business analytics in understanding consumer behaviour toward sustainable products.
- Review literature on factors influencing adoption of sustainable products and the role of data-driven marketing strategies.

These objectives guide a literature-based, conceptual investigation. For example, Garg *et al.* (2025) demonstrate the utility of an ADO (Antecedents–Decisions–Outcomes) framework in aligning analytics tools (antecedents) with marketing outcomes, informing our approach.

## 3. Review of literature

### Consumer Adoption of Sustainable Products

**Definition and importance:** Sustainable products are typically defined as goods that “protect or enhance the natural environment by conserving energy and resources while reducing or eliminating toxic agents, pollution, and waste throughout their lifecycle”. Such products – from eco-friendly food and clothing to energy-efficient appliances – aim to meet consumer needs without depleting natural resources. They are increasingly recognized as essential for meeting global sustainability goals (e.g. the UN Sustainable Development Goals) and for mitigating climate change.

**Attitudes vs. behavior:** Numerous studies document a persistent gap between pro-environmental attitudes and actual purchase behavior. For instance, White *et al.* (2019) note that while a majority of consumers report wanting sustainable brands, only a small fraction follow through at the point of purchase. This “elusive green consumer” phenomenon is well-known: consumers face barriers such as higher prices, lack of information, convenience, or skepticism about claims. Yet the latent demand is significant. In the U.S., NielsenIQ found 78% of consumers say a sustainable lifestyle is important to them and 66% are willing to pay more for products from companies committed to sustainability. Empirical analyses confirm the

business potential: McKinsey & Company reports that CPG products labeled with ESG (environmental/social) claims grew 28% over five years (2017–2022), significantly outpacing the 20% growth of comparable non-ESG products. In short, consumer preferences are shifting towards sustainability, but purchasing behavior depends on many factors (e.g. price, quality, trust in claims). To bridge this gap, companies must understand the drivers of sustainable purchase behavior – an area where data analytics can play a transformative role.

**Theoretical perspectives:** Classic consumer-behavior models have been adapted to green contexts. For example, the Theory of Planned Behavior posits that purchase intention is shaped by attitudes (toward the behavior), subjective norms, and perceived control. In sustainability, positive attitudes toward eco-products and social norms about environmentalism are known to increase intention to buy green. However, intentions often fail to translate into action due to situational barriers (e.g. cost) or lack of knowledge. Other theories (e.g. Value-Belief-Norm, motivation–opportunity–ability) highlight the role of values, beliefs, and external enablers in sustainable consumption. In practice, this means firms need to identify which values (e.g. health, ecological concern), product attributes (e.g. quality, features), and social influences drive a given consumer segment. Unfortunately, these factors are complex and vary widely across markets. As Jaman (2023) notes, sustainable decision-making is “inherently complex” due to diverse motivations, attitudes and socio-economic factors. Predictive analytics can help manage this complexity by uncovering the key behavioral drivers in large consumer datasets.

### **Business Analytics in Marketing**

Business analytics is the systematic use of data analysis techniques – including descriptive reporting, predictive modeling, and prescriptive optimization – to inform decisions. As UC Online explains, BA uses statistical methods, data mining and predictive models to identify trends and forecast future events. In marketing, BA has become essential for turning raw data (from sales, CRM, social media, etc.) into actionable insights. For example, companies use analytics for customer segmentation, campaign analysis, and demand forecasting.

**Applications:** Studies across industries show that analytics can transform marketing. Chukwu (2024) finds that analytics can “revolutionize customer segmentation, demand forecasting, personalized marketing, and channel optimization” in the food industry. Specifically, clustering and prediction models allow firms to identify niche consumer segments and tailor their campaigns, while sophisticated forecasting (e.g. machine learning for perishable goods) can reduce waste and improve profitability. Analytics also enables *customized marketing*: by analyzing individual-level data, companies can recommend products and offers that match each consumer’s unique preferences. Moreover, analytics-driven **campaign analysis** (via real-time dashboards and KPI tracking) helps measure the effectiveness of sustainability initiatives and adjust strategies on the fly. In short, integrating BA into marketing is not just a technical upgrade but a strategic shift: firms must build data infrastructure and a data-driven culture to fully leverage these capabilities.

**Data-driven sustainability marketing:** In the context of green products, analytics is now being applied to both understand consumer eco-behavior and to design sustainability-focused campaigns. For example, predictive analytics can be used to forecast demand specifically for eco-friendly items, helping manage green supply chains more efficiently. Boozary et al. (2025) demonstrate how regression and classification models can identify the most important determinants of sustainable purchases (such as demographic traits, advertising activities, and product features). They show that even relatively simple models (linear regression, decision trees) can achieve high predictive accuracy – average accuracy over 90% – in forecasting green purchasing behavior. Feature-importance analysis in such models highlights which factors (e.g. price, eco-label, personal values) matter most for different customers, underscoring the value of customer-specific data. In practice, this means data scientists can train models on historical purchase and survey data to predict which consumers are likely to buy a new sustainable product or to respond to a green marketing campaign.

### **Sentiment Analysis and Consumer Insights**

**Sentiment analysis:** Beyond structured data, firms increasingly turn to **sentiment analysis** (a subfield of natural language processing) to gauge consumer attitudes toward sustainability. By mining text from social media, online reviews, and survey responses, sentiment analysis algorithms can quantify how positively consumers talk about a brand’s environmental efforts or product attributes. For example, Nguyen et al. (2024) apply sentiment

analysis to social media chatter on sustainable food brands, finding that positive sentiment correlates with higher purchase intentions. In the food-and-beverage context, Yassir et al. (2024) show that consumer **sentiment toward sustainable branding** (measured via a survey index) has a strong positive influence on purchase decisions. In regression models, every unit increase in the sustainable branding sentiment score significantly raised consumers' purchase intention. In other words, when customers feel positively about a brand's eco-friendly image, they are much more likely to buy its products. This illustrates how analytics can quantify and leverage intangible factors like brand sentiment.

**Applications in marketing:** Sentiment analysis can be used in multiple ways. First, it provides *market intelligence* on how consumers perceive sustainable products and advertising. By tracking trends in public sentiment, firms can adapt their messaging or address misconceptions (e.g. fears about "greenwashing"). Second, analytics-driven insights can personalize communication. For instance, if sentiment analysis reveals that one segment is primarily motivated by health concerns and another by ethical values, a company can tailor its advertising themes accordingly. Booshan et al. (2025) argue that AI tools like NLP and sentiment analysis enable highly **customized green messaging**, which builds consumer trust and loyalty [21]. Indeed, their framework suggests that companies should "utilize AI solutions like machine learning and NLP to develop customized green messaging" for environmentally-conscious consumers. Similarly, they note that managers should use technology not just for efficiency, but to personalize eco-friendly campaigns in ways that align with consumer values (e.g. highlighting health or environmental benefits). In practice, a brand might use sentiment analysis to inform the tone and content of social media posts or product descriptions, ensuring they resonate with target audiences.

Collectively, these studies indicate that advanced analytics predictive modeling, machine learning, sentiment analysis and related AI techniques are powerful tools for understanding green consumer behavior. They complement traditional marketing by enabling evidence-based, data-driven decision-making. In the next section, we develop a conceptual framework that illustrates how these analytics capabilities link to consumer adoption of sustainable products.

## 4. Research Methodology

- **Qualitative Conceptual Study:** Following Booshan *et al.* (2025), we use a qualitative, conceptual methodology with a systematic literature review. No primary data are collected.
- **Data Sources:** We surveyed open-access journals, conference papers, and industry reports (2022–2025) on business analytics, digital marketing, and sustainable consumption. Keywords included "predictive analytics," "machine learning," "sentiment analysis," "sustainable marketing," and "consumer behavior."
- **Thematic Synthesis:** Using thematic analysis, we extracted information on analytical methods (e.g. model types, accuracy metrics) and consumer adoption drivers (e.g. values, price sensitivity). Consistent with Garg *et al.* (2025), we organized insights into the ADO scheme: analytics tools (A) → marketing strategies (D) → consumer adoption outcomes (O).
- **Framework Development:** We iteratively built a conceptual model linking analytics to adoption. This draws on established models (e.g. Techno–Organization–Environment, TPB) and recent AI-sustainability studies. For example, Booshan *et al.* provide a framework for AI in sustainable marketing, which we adapt to our objectives.
- **Metrics and Methods Extraction:** We specifically extracted methods (e.g. linear regression, random forests, deep learning) and performance metrics (accuracy, RMSE, F1-scores) used in reviewed studies. This allows us to compare approaches: for instance, Vijayaragavan *et al.* (2024) report near-99% **accuracy** using a deep learning sentiment model on e-commerce data.

### Conceptual Framework

The proposed framework (Figure 1) links **Analytics Capabilities** (predictive models, ML classifiers, NLP sentiment analysis) to **Consumer Adoption Drivers** (attitudes, awareness, trust) through **Marketing Strategy**. In detail:

- **Analytics Capabilities:** Tools such as predictive regression models and classification algorithms analyze historical sales and customer data. For example, Boozary *et al.* (2025) used regression and classification algorithms to analyze sustainable purchase behavior, finding that models could "**accurately predict clients' preferences**". Sentiment analysis (via NLP)

gauges public opinion from reviews and social media. Modern deep models achieve very high accuracy in sentiment classification (e.g. ~98.8%), enabling reliable sentiment scoring.

- **Consumer Insights:** Analytics outputs reveal key adoption factors. For instance, sentiment scores indicate how positively consumers view a brand's sustainability, which Yassir *et al.* (2024) found to have a strong effect on purchase intent. Feature-importance results from ML highlight demographic or attitudinal predictors; Boozary *et al.* identified demographics and product features as top drivers. These insights shape understanding of consumer motivations (e.g. environmental concern, value).
- **Marketing Strategy (Decisions):** Insights inform targeted actions: personalized advertisements, tailored pricing, or sustainable product design. The ADO model illustrates this chain: analytics (antecedents) guide decisions (e.g. "target eco-conscious young adults with a green ad"), leading to outcomes (actual purchase of the sustainable product). For example, Garg *et al.* (2025) note that AI-enabled personalized messaging enhances consumer trust and loyalty towards green brands.
- **Outcomes (Adoption):** Improved consumer adoption metrics—such as increased market share for eco-products, repeat purchase rates, and brand equity—are the results. Analytical strategies are expected to narrow the attitude-behavior gap: as McKinsey reports, a majority of consumers express sustainability concern, but only a minority act on it (e.g. 78% vs. ~28% adoption). By using analytics-driven tactics, firms can move more consumers from intent to action.

This framework encapsulates how data-driven analytics can transform sustainability marketing from guesswork to evidence-based strategy. It builds on the insight that analytics can simultaneously boost ROI and sustainability: targeted campaigns, as Booshan *et al.* observe, can **"improve marketing ROI while reducing environmental impact"**.

## 5. Findings

From the reviewed literature, we synthesize the following core insights:

- **High Accuracy of Predictive Models:** Advanced models can reliably predict green purchases. Boozary *et al.* (2025) report that random-forest classifiers reached about 91% accuracy on unseen data. Their linear regression models had RMSE  $\approx 23.7$  (in context of purchase scores). This suggests firms can forecast demand for sustainable products with reasonable precision.
- **Sentiment Analysis as a Strong Predictor:** NLP-based sentiment features strongly correlate with adoption. Yassir *et al.* (2024) found that consumer sentiment toward sustainable branding had a positive, significant influence on purchase decisions. Modern deep sentiment models achieve nearly 99% classification accuracy, meaning firms can trust these scores to gauge consumer attitudes effectively.
- **Personalization Drives Trust & Adoption:** Analytics enables personalization, which in turn builds trust. Garg *et al.* (2025) highlight that AI-driven personalization of green messages increases consumer loyalty to eco-brands. Similarly, segmenting consumers by values (e.g. health vs. environmental concern) allows targeted appeals. This matches Booshan *et al.*'s observation that personalized AI campaigns can both improve ROI and advance sustainability.
- **Consumer Factors Identified:** The literature identifies key adoption drivers beyond attitude. Analytical studies emphasize factors such as price and perceived quality. The Nielsen–McKinsey study notes that consumers care about price, yet products with ESG claims still outperform others. Analytics helps quantify how much each factor matters (via feature-importance or regression coefficients).
- **Dynamic Feedback Loop:** A continuous analytics-driven feedback cycle emerges: firms analyze behavior, adjust strategy, and re-evaluate outcomes. For instance, analyzing post-campaign sentiment can inform next steps. This dynamic process was implicit in multiple studies (e.g., Garg *et al.*'s ADO framework) and suggests a virtuous cycle for sustainable marketing.

These findings collectively show that business analytics provides actionable insights to boost adoption of sustainable products, validating our framework. All insights remain at a conceptual level; empirical testing is recommended for future research.

## 6. Implications

By synthesizing research on analytics and green marketing, this paper contributes a conceptual bridge between two domains. The framework connects theories of consumer behavior with data-driven marketing practice. It suggests testable propositions: for example, that predictive analytics capability will be positively associated with green product

adoption (mediated by personalization), and that sentiment analysis will strengthen the effect of marketing campaigns on purchase intention. Future empirical research could validate these links. Our work also highlights gaps: while many studies apply analytics, few explicitly examine how analytics capabilities translate into sustainability outcomes, indicating a need for more interdisciplinary research at this nexus.

### **Managerial implications:**

- **Adopt Analytics Tools:** Marketing leaders should invest in predictive and NLP tools. The high predictive accuracy reported by Boozary *et al.* justifies dedicating resources to analytics infrastructure. Using ML to segment customers or forecast demand can significantly improve targeting of sustainable products.
- **Personalize Sustainability Messaging:** Use data-driven personalization in campaigns. As Booshan *et al.* suggest, campaigns should emphasize consumer values like environmental awareness. For example, if analytics indicate a segment values organic ingredients, tailor messaging to highlight that aspect. Personalized green messages (created via ML/NLP) have been shown to build trust.
- **Integrate Sustainability into Brand Equity:** Frame analytics outputs into branding. The concept of “green branding” – linking all product elements to sustainability – is supported by research (Nielsen–McKinsey found strong growth for products with ESG claims). Analytics can help identify which ESG attributes (organic, eco-label, social claims) resonate most with consumers in each category.
- **Monitor and Iterate:** Establish metrics for both adoption and sustainability impact. Continuously track sales of green products and consumer sentiment on social platforms. Adjust strategies using real-time data. For instance, if sentiment analysis shows a spike in negative discussion about a claim, revise messaging promptly. This iterative approach maximizes both market and environmental outcomes, aligning with Booshan *et al.*’s notion of ethical, results-oriented AI use.
- **Consider Ethical/Privacy Issues:** With heavy data use, ensure compliance and transparency. Several sources caution about data privacy and bias. Managers should adhere to regulations (GDPR, etc.) and be transparent about using consumer data in sustainability initiatives to maintain trust.

### **7. Limitations**

- **Conceptual Approach:** This study is based entirely on secondary sources and theoretical synthesis, without new empirical data. As Booshan *et al.* (2025) note, conceptual studies (e.g. literature reviews) are valuable for framework development but inherently lack empirical validation. The absence of primary data means our findings should be interpreted as *theoretical insights*, not confirmed effects.
- **Scope of Sources:** We relied on published literature (2022–2025), which may omit relevant findings not yet in the public domain. Conceptual researchers often face “theoretical gaps” when not all relevant work is included. It’s possible we missed studies (especially non-English or industry reports) that could add nuance to the framework.
- **Generalizability:** Our framework highlights many factors but does not guarantee universal applicability. Different product categories, cultures, or market conditions might involve additional dynamics not captured here. Since this is a conceptual model, it should be tested and refined in specific organizational or cultural contexts.
- **Rapidly Evolving Technology:** Analytics tools and consumer behavior evolve quickly. New methods (e.g. advanced generative models) or shifting consumer trends may emerge after our review period. Thus, the study provides a snapshot up to early 2025; future developments in AI or sustainability standards could modify the relationships we propose.
- **Focus on Marketing:** We concentrated on the marketing side (consumer data, campaigns), so operational factors (e.g. green supply chain analytics) are not addressed. This focus keeps the study tractable but omits some elements (like production analytics) that also affect sustainable product success.

### **8. Future Research Directions**

- **Empirical Validation:** The proposed framework and insights call for empirical testing (e.g. field experiments measuring the impact of analytics-driven campaigns on green purchases).
- **Cross-Cultural Studies:** Given varied sustainability norms, research should explore how analytics effectiveness differs internationally.
- **Integration with Emerging Tech:** Future work could examine how IoT data (e.g. product traceability) or blockchain can feed into analytics for sustainability.

- **Longitudinal Consumer Studies:** Tracking consumers over time would reveal how analytics-driven marketing affects long-term green behavior change.
- **Ethical AI and Bias:** Deep studies on algorithmic fairness in sustainability contexts are needed, as highlighted by Booshan *et al.*

## 9. Conclusion

This research has examined how business analytics can serve as a transformative force in promoting sustainable consumption. By synthesizing the existing literature and proposing a structured conceptual framework, the study addresses one of the most persistent challenges in sustainability marketing: the gap between what consumers say they value and what they actually purchase. While surveys consistently show that a large majority of consumers care about environmental impact, actual adoption of sustainable products remains disproportionately low. Closing this gap is not merely a commercial problem, it is an environmental and social one, and business analytics offers a rigorous, data-driven path toward solving it.

The framework proposed here traces a clear pathway from analytics capabilities through consumer insights to marketing strategy and, ultimately, to improved adoption outcomes. Tools such as predictive regression models, machine learning classifiers, and NLP-based sentiment analysis allow organizations to move beyond intuition and guesswork. They can identify which consumer segments are most primed for sustainable products, which product attributes drive purchase decisions, and how public sentiment toward a brand's environmental claims shifts in real time. Studies reviewed in this paper confirm that these methods are not experimental luxuries, random forest classifiers have demonstrated over 91% predictive accuracy, and deep learning sentiment models have approached 99% classification performance, making them reliable and deployable in real marketing contexts.

Critically, the value of analytics lies not just in prediction but in personalization. When firms understand that one segment responds to health-focused messaging while another is motivated by ecological values, they can tailor their communication with precision. This kind of targeted, resonant messaging builds genuine consumer trust — the foundation on which sustainable brand loyalty is constructed. Furthermore, real-time sentiment monitoring enables companies to detect and respond to greenwashing perceptions before they damage credibility, turning analytics into a tool for both offense and defense in sustainability marketing.

It is also important to be transparent about the study's boundaries. This is a conceptual, literature-based investigation, which means the framework's propositions have not yet been empirically validated. Future research should test these relationships through field experiments, longitudinal consumer studies, and cross-cultural comparisons, since sustainable consumption dynamics differ meaningfully across markets and demographics. The ethical dimensions of data use — algorithmic bias, consumer privacy, and transparency — also demand sustained scholarly and managerial attention as these analytics systems grow more powerful.

Looking forward, the convergence of AI, IoT, and blockchain with a growing base of eco-conscious consumers will only increase the strategic importance of this research area. Organizations that treat analytics as a core pillar of their sustainability strategy — rather than a supplementary function — will be better positioned to convert consumer interest into action and market share into environmental impact. Ultimately, business analytics and sustainability are not competing priorities; they are complementary ones. Data-driven insight, applied thoughtfully and ethically, offers the clearest route toward a marketplace where choosing sustainably becomes the easiest, most natural choice for consumers worldwide.

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