# Factors Influencing the Adoption of Bio-Plastics among Consumers

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**Abstract**

The increasing environmental concerns associated with conventional petroleum-based plastics have accelerated interest in sustainable alternatives such as bio-plastics. Bio-plastics, derived from renewable biomass sources and often biodegradable in nature, are considered a promising solution to reduce plastic waste and carbon emissions. However, consumer adoption remains uneven due to various economic, psychological, and informational barriers. The present study examines the factors influencing the adoption of bio-plastics among consumers using factor analysis as the primary statistical tool. Data will be collected from consumers through a structured questionnaire to identify the underlying dimensions affecting purchase intention and usage behaviour. Variables such as environmental awareness, perceived quality, price sensitivity, product availability, social influence, and trust in eco-labels are expected to play significant roles. The findings will help manufacturers, marketers, and policymakers understand consumer preferences and develop strategies to enhance the acceptance and market penetration of bio-plastic products in emerging and developed markets alike.

**Key Words**

Bio-plastics, Consumer Adoption, Environmental Awareness, Factor Analysis, Sustainable Consumption, Purchase Intention

## Introduction

Plastic products have become an inseparable part of modern life due to their convenience, durability, low cost, and versatility. They are widely used in packaging, healthcare, agriculture, construction, electronics, and household applications. However, the extensive use of conventional plastics has created severe environmental challenges, including non-biodegradable waste accumulation, marine pollution, greenhouse gas emissions, and dependence on fossil fuel resources. These concerns have intensified the search for sustainable alternatives, among which bio-plastics have emerged as one of the most promising solutions.

Bio-plastics refer to materials that are bio-based, biodegradable, or possess both characteristics. Bio-based plastics are manufactured wholly or partially from renewable resources such as corn starch, sugarcane, cellulose, or vegetable oils. Biodegradable plastics can decompose naturally under specific environmental conditions through microbial activity. Popular forms of bio-plastics include polylactic acid (PLA), polyhydroxyalkanoates (PHA), starch blends, and bio-polyethylene. These materials are increasingly used in packaging, disposable cutlery, shopping bags, food containers, and textile products.

The growing awareness regarding climate change, plastic pollution, and sustainable living has positively influenced consumer attitudes toward eco-friendly products. Many consumers now prefer products that reduce environmental harm and support green practices. Bio-plastics align with these preferences because they are perceived as environmentally responsible alternatives to traditional plastics. Governments across the world are also promoting sustainable packaging through bans on single-use plastics, recycling targets, and incentives for green innovation. Such developments have created favourable conditions for the growth of the bio-plastics market.

Despite these advantages, the adoption of bio-plastics among consumers remains limited in many markets. Several challenges hinder widespread acceptance. Firstly, bio-plastic products are often more expensive than conventional plastic alternatives due to higher production costs and limited economies of scale. Price-sensitive consumers may hesitate to switch unless they perceive additional value. Secondly, many consumers lack awareness about the meaning, benefits, and disposal methods of bio-plastics. Confusion between terms such as biodegradable, compostable, recyclable, and bio-based can reduce trust and purchase intention.

Thirdly, product quality and performance perceptions significantly influence consumer decisions. Some consumers believe eco-friendly alternatives may be weaker, less durable, or less practical than conventional

plastics. Fourthly, availability and accessibility of bio-plastic products are still limited in certain regions, reducing convenience for consumers. Social influence, peer behaviour, media campaigns, and environmental education also shape adoption behaviour. If consumers observe others choosing sustainable products, they may be more willing to adopt similar behaviour.

Understanding the determinants of consumer adoption is essential for businesses and policymakers. Manufacturers need insights into consumer expectations to improve product design, pricing, communication, and distribution strategies. Retailers can use such knowledge to position bio-plastic products effectively. Governments can formulate awareness campaigns, subsidies, and regulatory policies that encourage sustainable consumption.

The present study titled "Factors Influencing the Adoption of Bio-Plastics among Consumers" seeks to identify the major dimensions that affect consumer willingness to purchase and use bio-plastic products. Since multiple variables may influence behaviour simultaneously, factor analysis will be employed as an appropriate statistical technique. Factor analysis helps reduce a large number of observed variables into smaller meaningful factors representing consumer attitudes and motivations.

Possible factors may include environmental consciousness, economic considerations, perceived product performance, social norms, knowledge level, and trust in eco-certifications. Identifying these factors will provide a clearer understanding of consumer behaviour and guide strategic interventions.

As sustainability becomes a global priority, consumer acceptance of bio-plastics will play a crucial role in reducing dependence on conventional plastics and promoting a circular economy. Therefore, examining the drivers and barriers to adoption is timely, relevant, and valuable for both academic research and practical decision-making.

**Review of Literature**

**Cruz and Portugal (2025)** conducted an umbrella review on consumer demand for bio-plastics and summarized the major barriers affecting market acceptance. The study found that limited awareness, unclear labelling, low product recognition, insufficient knowledge, and uncertainty regarding disposal methods significantly reduce adoption behaviour. Price premiums and limited product availability were also identified as obstacles. The authors emphasized the importance of transparent communication, educational campaigns, and standardised eco-labelling to build trust among consumers. They further noted that consumers are more willing to adopt bio-plastics when they understand environmental benefits and perceive functional equivalence with conventional plastics. The study provides a comprehensive synthesis of evidence-based recommendations for policymakers and marketers. It concluded that successful adoption depends not only on technological advancement but also on consumer education and confidence-building measures. This review is highly relevant because it consolidates global findings and offers practical insights into the behavioural factors driving or restricting consumer demand for bio-plastic products.

**Fletcher et al. (2024)** examined how environmental sustainability orientation influences consumer acceptance of bio-based and biodegradable plastics. The study revealed that consumers with stronger environmental values showed higher willingness to purchase bio-plastic products. Perceived environmental benefits, ethical responsibility, and concern for plastic waste were major motivational drivers. However, scepticism regarding actual sustainability performance and product cost reduced adoption intention. The research highlighted that positive consumer orientation toward green lifestyles enhances market opportunities for bio-plastics. It also found that consumers expect transparency regarding raw materials, lifecycle impact, and end-of-life disposal. The authors recommended targeted communication strategies and stronger sustainability claims supported by evidence. Businesses that align product branding with environmental values may improve adoption rates. This study contributes significantly to understanding how personal ecological values shape consumer choices in sustainable packaging and materials markets. It confirms that psychological commitment to sustainability is an essential predictor of bio-plastic adoption behaviour among modern consumers.

**Siddiqui et al. (2023)** studied the factors influencing consumers' intention to reduce plastic packaging across fast-moving consumer goods in Germany. Although focused on packaging reduction, the findings strongly relate to bio-plastic adoption because both involve sustainable consumption behaviour. The study found environmental concern, awareness of plastic pollution, and perceived personal responsibility to be strong determinants of eco-friendly purchase intention. Consumers preferred alternatives that reduced waste while maintaining convenience and product quality. Price sensitivity remained an important constraint, especially for low-involvement goods. The authors suggested that sustainable packaging solutions such as bio-plastics can gain acceptance when consumers perceive convenience and environmental value simultaneously. They also noted that education and visibility at the point of purchase improve behavioural intention. The research demonstrates that environmental attitudes alone are insufficient unless supported by practical and affordable alternatives. Therefore, marketers must

combine sustainability messaging with functional benefits to encourage consumers to switch from conventional plastics to bio-plastic products.

**Filho et al. (2022)** explored international consumer attitudes and concerns regarding bio-plastics across multiple countries. The study reported generally positive perceptions toward bio-plastics as substitutes for conventional plastics, especially in packaging applications. Consumers believed bio-plastics could reduce pollution and dependence on fossil fuels. However, respondents expressed concerns about higher prices, limited availability, uncertain durability, and lack of knowledge about disposal methods. Low cost and greater market accessibility were found to be critical for mass adoption. The study also indicated that consumers prefer bio-plastic products when supported by government regulation and corporate environmental responsibility. Cross-country analysis revealed variations in awareness levels depending on education and environmental culture. The findings suggest that consumer trust and convenience are central to adoption decisions. This research is important because it provides global evidence that adoption depends on balancing sustainability benefits with affordability, accessibility, and product reliability in everyday purchasing decisions.

**Prakash and Pathak (2021)** studied on sustainable product adoption examined the behavioural intention of consumers toward biodegradable alternatives and green packaging solutions. The researchers identified perceived usefulness, environmental concern, subjective norms, and consumer awareness as significant predictors of adoption. Consumers were more likely to choose eco-friendly plastic substitutes when they believed their actions contributed to environmental protection. Social influence from peers, family, and media campaigns also played an important role. However, concerns regarding price and performance quality negatively affected willingness to buy. The study emphasized the relevance of behavioural theories such as the Theory of Planned Behaviour in explaining green product choices. It suggested that businesses should improve communication regarding durability, safety, and value-for-money to encourage adoption. Although not limited exclusively to bio-plastics, the study offers useful insights into the psychological and economic factors influencing consumer acceptance of biodegradable products and sustainable packaging innovations.

**Klein, Emberger-Klein, and Menrad (2020)** analysed consumer preferences for bio-based apparel using a functional rain jacket made from bio-plastic material in Germany. The study found that prior product experience, green consumer values, and favourable attitudes toward bio-plastics significantly influenced purchase preferences. Consumers who had previous exposure to eco-friendly products showed greater readiness to adopt innovative bio-based goods. Functional performance remained highly important, indicating that sustainability alone cannot guarantee purchase decisions. Price and product quality were still major considerations. The authors concluded that successful marketing of bio-plastic products requires combining environmental messaging with attractive design and reliable functionality. This study is particularly valuable because it demonstrates that consumer acceptance of bio-plastics extends beyond packaging into lifestyle products such as apparel. It highlights the importance of psychographic characteristics in shaping demand for bio-based consumer goods and offers insights for expanding bio-plastic adoption across product categories.

**Objective of the Study**

- To identify the factors influencing the adoption of bio-plastics among consumers.

**Research Methodology**

The present study titled **"Factors Influencing the Adoption of Bio-Plastics among Consumers"** was descriptive and analytical in nature. The study aimed to identify the major factors influencing consumer adoption of bio-plastic products. Primary data were collected from consumers residing in Haryana through a structured questionnaire designed on a five-point Likert scale ranging from strongly agree to strongly disagree. The questionnaire included statements related to environmental awareness, price sensitivity, product quality, availability, social influence, and purchase intention toward bio-plastics.

A sample size of 275 respondents from different districts of Haryana was selected using convenience sampling technique. Both male and female consumers of different age groups, educational backgrounds, and occupations were included to ensure diversity in responses. Secondary data were also collected from journals, research papers, websites, and published reports related to bio-plastics and consumer behaviour.

For data analysis, descriptive statistics and Factor Analysis were applied to identify the underlying dimensions influencing the adoption of bio-plastics among consumers. The findings of the study helped marketers and policymakers promote sustainable consumer behaviour effectively.

**Data Analysis**

Factor Analysis were applied to identify the underlying dimensions influencing the adoption of bio-plastics among consumers.

| **Reliability Statistics** | |
|---|---|
| Cronbach's Alpha | N of Items |
| .908 | 12 |

| **KMO and Bartlett's Test** | | |
|---|---|---|
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy. | | .843 |
| Bartlett's Test of Sphericity | Approx. Chi-Square | 5279.354 |
| | df | 69 |
| | Sig. | .000 |

*Source: Primary Data*

The reliability analysis showed a **Cronbach's Alpha value of 0.908** for 12 items, indicating excellent internal consistency and high reliability of the scale. The **Kaiser-Meyer-Olkin (KMO) value of 0.843** confirmed that the sample was adequate for factor analysis. Bartlett's Test of Sphericity was significant (**Chi-square = 5279.354, df = 69, p = 0.000**), showing sufficient correlation among variables. Therefore, the data were considered suitable for applying factor analysis successfully.

| **Communalities** | Initial | Extraction |
|---|---|---|
| I prefer products that are environmentally friendly. | 1.000 | .714 |
| Bio-plastics help in reducing plastic pollution. | 1.000 | .821 |
| I am concerned about the harmful effects of conventional plastics on nature. | 1.000 | .807 |
| I am willing to support products made from renewable resources. | 1.000 | .681 |
| I will buy bio-plastic products if their price is reasonable. | 1.000 | .695 |
| Bio-plastic products should have the same quality as regular plastic products. | 1.000 | .765 |
| High prices discourage me from purchasing bio-plastic products. | 1.000 | .822 |
| Durability and strength influence my decision to buy bio-plastics. | 1.000 | .753 |
| I purchase bio-plastic products when they are easily available in the market. | 1.000 | .628 |
| Recommendations from family and friends influence my purchase decision. | 1.000 | .483 |

| | | |
|---|---|---|
| Advertisements increase my interest in bio-plastic products. | 1.000 | .651 |
| I prefer stores that offer eco-friendly product options. | 1.000 | .691 |

*Source: Primary Data*

The communalities table shows the proportion of variance in each variable explained by the extracted factors. All variables had initial communalities of **1.000**, as principal component analysis was used. The extraction values ranged from **0.483 to 0.822**, indicating that the factors explained a satisfactory amount of variance in most statements. The highest communality was found for **"High prices discourage me from purchasing bio-plastic products" (0.822)**, followed by **"Bio-plastics help in reducing plastic pollution" (0.821)** and **"I am concerned about the harmful effects of conventional plastics on nature" (0.807)**. This indicates that these variables were strongly represented by the extracted factors. The lowest communality was for **"Recommendations from family and friends influence my purchase decision" (0.483)**, showing relatively weaker representation. Overall, all items had acceptable communalities above 0.40, confirming that the selected variables were relevant and contributed meaningfully to identifying the factors influencing the adoption of bio-plastics among consumers.

**Total Variance Explained**

| Component | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | | Rotation Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|---|---|---|
| | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 4.592 | 38.268 | 38.268 | 4.592 | 38.268 | 38.268 | 3.213 | 26.776 | 26.776 |
| 2 | 2.464 | 20.531 | 58.799 | 2.464 | 20.531 | 58.799 | 3.184 | 26.530 | 53.305 |
| 3 | 1.455 | 12.127 | 70.926 | 1.455 | 12.127 | 70.926 | 2.115 | 17.621 | 70.926 |
| 4 | .775 | 6.461 | 77.387 | | | | | | |
| 5 | .515 | 4.290 | 81.677 | | | | | | |
| 6 | .428 | 3.565 | 85.243 | | | | | | |
| 7 | .392 | 3.268 | 88.510 | | | | | | |
| 8 | .378 | 3.151 | 91.661 | | | | | | |
| 9 | .334 | 2.785 | 94.446 | | | | | | |
| 10 | .297 | 2.476 | 96.922 | | | | | | |
| 11 | .193 | 1.609 | 98.531 | | | | | | |
| 12 | .176 | 1.469 | 100.000 | | | | | | |

*Source: Primary Data*

The Total Variance Explained table indicates that three factors were extracted with eigenvalues greater than 1, confirming their significance in explaining consumer adoption of bio-plastics. The first factor had an eigenvalue of **4.592** and explained **38.268%** of the total variance. The second factor had an eigenvalue of **2.464**, contributing

**20.531%** variance. The third factor had an eigenvalue of **1.455**, explaining **12.127%** variance. Together, these three factors accounted for a cumulative variance of **70.926%**, which is considered satisfactory in social science research. After rotation, the variance was more evenly distributed among the three factors, with contributions of **26.776%**, **26.530%**, and **17.621%** respectively. This suggests that the extracted factors adequately represented the original variables and provided a meaningful structure for understanding the major dimensions influencing the adoption of bio-plastics among consumers.

| **Rotated Component Matrix** | **Component** | | |
|---|---|---|---|
| | **1** | **2** | **3** |
| **1. Environmental Awareness** | | | |
| I prefer products that are environmentally friendly. | .883 | | |
| Bio-plastics help in reducing plastic pollution. | .860 | | |
| I am concerned about the harmful effects of conventional plastics on nature. | .818 | | |
| I am willing to support products made from renewable resources. | .804 | | |
| **2. Price and Product Quality** | | | |
| I will buy bio-plastic products if their price is reasonable. | | .892 | |
| Bio-plastic products should have the same quality as regular plastic products. | | .888 | |
| High prices discourage me from purchasing bio-plastic products. | | .831 | |
| Durability and strength influence my decision to buy bio-plastics. | | .800 | |
| **3. Availability and Social Influence** | | | |
| I purchase bio-plastic products when they are easily available in the market. | | | .762 |
| Recommendations from family and friends influence my purchase decision. | | | .758 |
| Advertisements increase my interest in bio-plastic products. | | | .626 |
| I prefer stores that offer eco-friendly product options. | | | .623 |

*Source: Primary Data*

The Rotated Component Matrix revealed three distinct factors influencing the adoption of bio-plastics among consumers. **Factor 1: Environmental Awareness** included statements such as preference for environmentally friendly products, reducing plastic pollution, concern for harmful effects of conventional plastics, and support for renewable resources, with strong loadings ranging from **0.804 to 0.883**. This indicates that environmental consciousness is a major driver of adoption. **Factor 2: Price and Product Quality** consisted of reasonable price, quality comparable to regular plastics, effect of high prices, and durability, with loadings between **0.800 and 0.892**. This shows that economic value and product performance significantly influence consumer decisions. **Factor 3: Availability and Social Influence** included market availability, recommendations from family and

friends, advertisements, and preference for eco-friendly stores, with loadings from **0.623 to 0.762**. Thus, accessibility and external influence also play an important role in encouraging consumers to adopt bio-plastic products.

| **Component Transformation Matrix** | | | |
|---|---|---|---|
| Component | 1 | 2 | 3 |
| 1 | .645 | .612 | .458 |
| 2 | -.669 | .742 | -.048 |
| 3 | -.369 | -.275 | .888 |

*Source: Primary Data*

The Component Transformation Matrix presents the correlation between the initial and rotated factor solutions. It indicates how the original components were transformed during the rotation process to achieve a clearer and more interpretable factor structure. The values show that **Component 1** was strongly associated with the rotated first and second factors, while **Component 2** had a high positive loading on the second rotated factor (**0.742**). **Component 3** showed the strongest relationship with the third rotated factor (**0.888**), indicating a clear representation of that dimension. The presence of positive and negative values reflects the directional adjustment made during rotation. Overall, the matrix confirms that the Varimax rotation successfully redistributed the variance among the three extracted factors, resulting in a simpler and more meaningful structure for interpreting the factors influencing the adoption of bio-plastics among consumers.

**Findings**

The study identified three major factors influencing the adoption of bio-plastics among consumers. The reliability test showed a Cronbach's Alpha value of 0.908, indicating excellent internal consistency of the 12 statements used in the questionnaire. The KMO value of 0.843 and significant Bartlett's Test confirmed that the data were suitable for factor analysis.

Factor analysis extracted three significant factors explaining 70.926% of the total variance, which indicates a strong representation of consumer behaviour. The first and most important factor was Environmental Awareness, contributing the highest variance. Consumers preferred environmentally friendly products, believed bio-plastics reduce plastic pollution, were concerned about harmful effects of conventional plastics, and supported products made from renewable resources.

The second factor was Price and Product Quality. Consumers were more willing to adopt bio-plastics when prices were reasonable and product quality matched conventional plastics. High prices acted as a major barrier, while durability and strength positively influenced purchase decisions.

The third factor was Availability and Social Influence. Easy market availability, recommendations from family and friends, advertisements, and preference for stores offering eco-friendly options encouraged adoption.

Overall, the findings revealed that environmental concern, economic value, and market accessibility are the key determinants driving consumer acceptance of bio-plastic products.

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