Market Research Term Project

Assessing the Impact Adoption of Biodegradable Packaging Among E-commerce Businesses

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1. Introduction

1.1 Background and Context

The need for packing materials has grown dramatically due to the e-commerce sector's explosive growth, raising environmental concerns. Despite being economical and practical, conventional plastic packaging has drawn much criticism for its detrimental effects on the environment, such as carbon emissions and plastic pollution. Companies, consumers, and governments are looking for sustainable substitutes, and biodegradable packaging is promising (Prakash & Pathak, 2017).

Plant-based plastics, compostable paper, and starch-based materials are biodegradable packaging materials that break down organically without endangering the environment. Consumer knowledge, worries about product quality, and cost perception all play a role in the limited adoption of biodegradable packaging in e-commerce despite its environmental benefits. Given the increasing regulatory pressure and shifts in consumer preferences, understanding the determinants of consumer adoption is crucial for businesses aiming to integrate sustainable packaging solutions.

1.2 Objectives of the Study

This study aims to explore the key factors influencing consumer acceptance of biodegradable packaging in the e-commerce sector. The specific objectives include:

- **Assess Consumer Awareness:** Evaluate consumer knowledge regarding environmental issues related to packaging waste and their familiarity with biodegradable packaging options.

- **Examine Perceived Benefits:** Investigate consumer perceptions of the advantages of biodegradable packaging, including reduced environmental impact, biodegradability, and personal satisfaction in making eco-conscious choices.

- **Identify Perceived Barriers:** Explore consumer concerns regarding biodegradable packaging, such as higher costs, potential durability issues, and its ability to protect products effectively during shipping.

- **Analyse Social Influences:** Determine how social norms, peer recommendations, and the role of influencers and social media affect consumer attitudes toward biodegradable packaging.

- **Evaluate Ease of Use:** Determine how ease and convenience of use and disposal of biodegradable packaging impact the adoption of biodegradable packaging.

- **Evaluate Price Sensitivity:** Assess how price differences influence consumer willingness to purchase products with biodegradable packaging, considering affordability as a key adoption barrier.

- **Determine Purchase Intentions:** Measure the likelihood of consumers purchasing products with biodegradable packaging based on the identified determinants

1.3 Importance of the Study

Many stakeholders will find great value in this research:

- **For Businesses:** E-commerce companies can use the study's insights to create sustainable, cost-effective, consumer-friendly packaging methods.

- **For Policymakers:** The results can guide incentives and policy changes to promote the use of sustainable packaging.

- **For Academics:** The study adds to the body of knowledge already available on environmentally friendly customer behaviour, especially in the e-commerce industry.

- **For Customers:** Being aware of the main issues and driving forces will help consumers become more conscious and have an impact on their future purchases.

By employing a **survey-based approach and analysing it using Partial Least Squares Structural Equation Modeling (PLS-SEM)**, this study provides a **data-driven framework** for businesses and policymakers to promote sustainable packaging adoption effectively.

Modern quick commerce companies using biodegradable packaging

2. Literature Review

Psychological and Behavioral Factors

- **Customer Interest Drivers**: Consumer perception of biodegradable packaging is influenced by *perceived health safety*, *brand reputation*, and *environmental benefits* (Van Birgelen et al., 2009).
- **Brand Differentiation**: Customers are more likely to support eco-friendly initiatives when sustainability is seen as a *brand differentiation strategy* (Prakash & Pathak, 2017).

Social Influences

- **Role of Social Variables**: Social factors such as *influencer endorsements* and *peer recommendations* significantly shape consumer preferences for sustainable packaging.
- **Impact of Social Media**: Social media endorsements strongly influence eco-friendly purchasing habits, particularly among younger consumers (Kim & Seock, 2019).
- **Moral Obligation**: Social norms create a sense of *moral responsibility*, encouraging consumers to make sustainable choices (Wang et al., 2020).

Cost Barriers

- **Price Sensitivity**: Cost remains a major deterrent; *cost-conscious buyers* hesitate to adopt biodegradable packaging unless incentivised (Prakash & Pathak, 2017).
- **Cost-Benefit Communication**: Openly communicating the trade-offs between cost and environmental benefits improves consumer acceptance (Magnier & Schoormans, 2015).

Ease of Use and Functionality

- **Consumer Preferences**: Packaging solutions must be *durable, easy to handle*, and convenient to use (Koenig-Lewis et al., 2014).
- **Design Considerations**: Consumers prefer biodegradable packaging that is *lightweight, resealable*, and easy to store (Lindh et al., 2016).
- **Disposal Challenges**: Specialized disposal methods like industrial composting can discourage adoption if infrastructure is unavailable (Steenis et al., 2017).
- **E-commerce Considerations**: Protective features during transit are prioritised by consumers in e-commerce scenarios, limiting adoption if biodegradable alternatives are perceived as fragile (Nordin & Selke, 2010).

Adoption Barriers

- **Cost Issues**: Higher production costs lead to increased retail prices, making biodegradable packaging less appealing to budget-conscious users(Steenis et al., 2017).
- **Performance Concerns**: Some consumers believe biodegradable packaging lacks the strength and functionality of traditional plastics (Van Birgelen et al., 2009).
- **Limited Availability**: Sustainable packaging solutions are not widely accessible across all product categories or e-commerce platforms (Ghazali et al., 2017).

3. Methodology

The methodology section outlines the research design, data collection process, and analytical techniques used in this study. The study employs a **quantitative approach** using **Partial Least Squares Structural Equation Modeling (PLS-SEM)** to analyse consumer attitudes toward biodegradable packaging.

3.1 Research Design

This study employs a **cross-sectional survey research design** to collect primary data at a single point in time. Key constructs such as price sensitivity, perceived benefits, social impact, environmental awareness, simplicity of use, and adoption intention were assessed using a structured questionnaire informed by prior research. A deductive approach was adopted, formulating hypotheses based on existing theories and testing them through empirical data.

3.2 Sampling and Data Collection

Target Group: Since research shows that younger generations are more environmentally concerned and inclined to choose sustainable packaging solutions, the study focuses on active e-commerce consumers who are 18 years of age and older, with a special focus on millennials and Generation Z. Younger consumers are a crucial demographic for comprehending adoption behaviour in biodegradable packaging since prior research has shown that they are more conscious of and inclined toward eco-friendly items.

Data Collection Method: Data was collected via an online survey distributed through social media platforms, email lists, and consumer forums. Respondents were required to complete a self-administered questionnaire measuring their attitudes, perceptions, and behavioural intentions regarding biodegradable packaging.

Sample Size Calculation: The sample size of 385 is derived using Cochran's formula, which is commonly used for determining an appropriate sample size for surveys when the population is large or unknown. The formula is:

$$\text{Sample size} = Z^2\, p\,(1-p) / C^2$$

Where:

- Z = z-score (depends on confidence level, 1.96 for 95% confidence)
- p = estimated proportion of the population with the characteristic of interest (usually 0.5 if unknown)

- c = margin of error (typically 5% or 0.05)

3.3 Measurement Instrument & Ethical Considerations

The questionnaire consisted of multiple sections, each measuring a different construct using validated scales from prior studies. A 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree) was used to measure all constructs.

Before distributing the final survey, a pilot test was conducted with 40 respondents to ensure the clarity and reliability of the items. Necessary modifications were made to improve question wording/response format and reduce the number of questions.

All respondents provided informed consent before participation. The study ensured the anonymity and confidentiality of responses, and participation was entirely voluntary.

4. Questionnaire Development, Pilot Testing and Final Questionnaire Analysis

4.1 Hypothesis Development

Hypotheses:

- **H1:** Consumers with higher environmental awareness are more likely to favour products with biodegradable packaging.
- **H2:** Perceived benefits (e.g., reduced environmental impact, improved brand image) positively influence the adoption intention.
- **H3:** Social influence (e.g., recommendations from peers or influencers) positively impacts consumers' packaging choices.
- **H4:** Concerns regarding cost and packaging performance negatively affect the adoption of biodegradable packaging.
- **H5:** Ease and convenience of use and disposal of biodegradable packaging positively impacts the adoption of biodegradable packaging.
- **H6:** Price sensitivity negatively affects the adoption of biodegradable packaging, with higher prices discouraging consumers from choosing sustainable alternatives

4.2 Questionnaire for Pilot Testing

Dependent Variable (DV): Adoption of Biodegradable Packaging

These items assess consumer preference, purchase intention, and overall commitment to products that use biodegradable packaging.

1. **DV1:** “I prefer products that use biodegradable packaging over those with conventional packaging.”
   (5-point Likert: 1 = Strongly Disagree, 5 = Strongly Agree)

2. **DV2:** “I am willing to pay a premium for products with biodegradable packaging.”
   (5-point Likert)

3. **DV3:** “Biodegradable packaging influences my overall purchasing decision.”
   (5-point Likert)

4. **DV4:** “I actively seek out products that come in eco-friendly packaging.”
   (5-point Likert)

5. **DV5:** “The type of packaging is an important factor in my satisfaction with a product.”
   (5-point Likert)

6. **DV6:** “I feel a sense of loyalty toward brands that use biodegradable packaging.”
   (5-point Likert)

Independent Variables (IVs)

IV1: Environmental Awareness and Attitudes

These items measure the consumer’s awareness of and attitudes toward environmental issues.

1. **IV1-1:** “I am very aware of environmental issues such as plastic pollution.”
   (5-point Likert)

2. **IV1-2:** “I frequently read or watch news related to environmental sustainability.”
   (5-point Likert)

3. **IV1-3:** “I consider myself well-informed about environmental conservation practices.”
   (5-point Likert)

4. **IV1-4:** “I believe individual actions can make a significant difference in protecting the environment.”
   (5-point Likert)

5. **IV1-5:** “I am concerned about the negative impacts of plastic waste on the environment.”
   (5-point Likert)

6. **IV1-6:** “I actively seek out eco-friendly alternatives in my daily life.”
   (5-point Likert)

7. **IV1-7:** “Sustainability is an essential aspect of my lifestyle.”
   (5-point Likert)

IV2: Perceived Benefits of Biodegradable Packaging

These questions explore consumers’ beliefs about the positive impacts and benefits of biodegradable packaging.

1. **IV2-1:** “Biodegradable packaging effectively reduces environmental harm.”
   (5-point Likert)

2. **IV2-2:** “Products with biodegradable packaging have a positive impact on public health.”
   (5-point Likert)

3. **IV2-3:** “Using biodegradable packaging enhances the overall brand image.”
   (5-point Likert)

4. **IV2-4:** “Biodegradable packaging contributes significantly to waste reduction.”
   (5-point Likert)

5. **IV2-5:** “Companies using biodegradable packaging show a strong commitment to sustainability.”
   (5-point Likert)

6. **IV2-6:** “I believe biodegradable packaging helps conserve natural resources.”
   (5-point Likert)

IV3: Perceived Barriers and Concerns

These items capture potential obstacles, such as cost, durability, and performance issues, that may hinder the adoption of biodegradable packaging.

1. **IV3-1:** “I am concerned that biodegradable packaging might be less durable than conventional packaging.”
   (5-point Likert)

2. **IV3-2:** “I worry that biodegradable packaging may not adequately protect products during shipping.”
   (5-point Likert)

3. **IV3-3:** “There is limited information available about the performance of biodegradable packaging.”
   (5-point Likert)

4. **IV3-4:** “I am hesitant to try products with biodegradable packaging due to quality uncertainties.”
   (5-point Likert)

5. **IV3-5:** “Biodegradable packaging might have a shorter shelf life compared to traditional packaging.”
   (5-point Likert)

IV4: Social Influence / Normative Beliefs

These items assess how social factors, including recommendations from peers and the influence of social media, impact sustainable purchasing behaviour.

1. **IV4-1:** “My family and friends encourage me to choose eco-friendly products.”
   (5-point Likert)

2. **IV4-2:** “Positive reviews about eco-friendly packaging on social media influence my choices.”
   (5-point Likert)

3. **IV4-3:** “Using biodegradable packaging is seen as a socially responsible choice.”
   (5-point Likert)

4. **IV4-4:** “I feel that choosing eco-friendly packaging is becoming a social norm.”
   (5-point Likert)

5. **IV4-5:** “I am likely to try a product if many people endorse its sustainable packaging.”
   (5-point Likert)

IV5: Perceived Ease / Convenience

These questions gauge how easy and convenient consumers find the use and disposal of biodegradable packaging.

1. **IV5-1:** “I find biodegradable packaging easy to dispose of.”
   (5-point Likert)

2. **IV5-2:** “Biodegradable packaging is convenient for recycling.”
   (5-point Likert)

3. **IV5-3:** “Handling biodegradable packaging is user-friendly.”
   (5-point Likert)

4. **IV5-4:** “I understand how to properly recycle biodegradable packaging.”
   (5-point Likert)

5. **IV5-5:** “The design of biodegradable packaging makes it simple to use.”
   (5-point Likert)

6. **IV5-6:** “I experience minimal hassle when disposing of biodegradable packaging.”
   (5-point Likert)

7. **IV5-7:** “Biodegradable packaging is as convenient as traditional packaging.”
   (5-point Likert)

IV6: Price Sensitivity

These items assess how cost considerations might affect the decision to purchase products with biodegradable packaging.

1. **IV6-1:** “I am very sensitive to price increases when shopping online.”
   (5-point Likert)

2. **IV6-2:** “A price increase of more than 10% would discourage me from purchasing a product with biodegradable packaging.”
   (5-point Likert)

3. **IV6-3:** “I compare prices carefully before buying eco-friendly products.”
   (5-point Likert)

4. **IV6-4:** “Even if a product with biodegradable packaging costs more, I might still choose it if the quality is high.”
   (5-point Likert)

5. **IV6-5:** “I believe that the environmental benefits of biodegradable packaging justify a small premium.”
   (5-point Likert)

6. **IV6-6:** “I am willing to pay extra for sustainable products only if the price difference is minimal.”
   (5-point Likert)

7. **IV6-7:** “Do you think eco-friendly products should be priced similarly to conventional products?”
   (5-point Likert)

Demographic Data

This section gathers background information to help segment and analyse responses.

1. Age:
   ☐ Under 18 ☐ 18–25 ☐ 26–35 ☐ 36–45 ☐ 46 and above

2. Gender:
   ☐ Male ☐ Female ☐ Other/Prefer not to say

3. Education Level:
   ☐ High School or below ☐ Undergraduate ☐ Postgraduate ☐ Other

4. Monthly Income (in local currency):
   ☐ Below 30K ☐ 30K–60K ☐ 60K–90K ☐ Above 90K

5. Location:
   ☐ Urban ☐ Semiurban ☐ Rural

4.3 Analysis of Pilot Testing Data

Cronbach's alpha (CA) is used to measure composite reliability (CR). The rule of thumb states that reliability in a test is achieved when its scale value is greater or equal to 0.7. Obtaining values higher than 0.7 means that all the research constructs are reliable, and therefore, the validity test can be conducted. This is tested from convergent validity, which is measured and pronounced to be valid when the average variance extracts (EVA) meet the threshold of value of 0.5.

Table: Variable Reliability and Validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
DV	0.811	0.825	0.863	0.514
IV1	0.861	0.883	0.89	0.539
IV2	0.838	0.879	0.881	0.558
IV3	0.488	0.017	0.048	0.237
IV4	0.824	0.886	0.873	0.583
IV5	0.84	0.88	0.877	0.51

IV6	0.704	0.485	0.16	0.229

Table Indicator Reliability and Validity

	Factor loadings		Factor loadings
DV1 <- DV	0.703		
DV2 <- DV	0.798	IV3-4 <- IV3	0.649
DV3 <- DV	0.731	IV3-5 <- IV3	0.585
DV4 <- DV	0.796	IV4-1 <- IV4	0.828
DV5 <- DV	0.611	IV4-2 <- IV4	0.586
DV6 <- DV	0.643	IV4-3 <- IV4	0.837
IV1-1 <- IV1	0.556	IV4-4 <- IV4	0.77
IV1-2 <- IV1	0.765	IV4-5 <- IV4	0.771
IV1-3 <- IV1	0.65	IV5-1 <- IV5	0.672
IV1-4 <- IV1	0.692	IV5-2 <- IV5	0.658
IV1-5 <- IV1	0.849	IV5-3 <- IV5	0.801
IV1-6 <- IV1	0.796	IV5-4 <- IV5	0.556
IV1-7 <- IV1	0.79	IV5-5 <- IV5	0.863
IV2-1 <- IV2	0.652	IV5-6 <- IV5	0.647
IV2-2 <- IV2	0.866	IV5-7 <- IV5	0.755
IV2-3 <- IV2	0.623	IV6-1 <- IV6	-0.389
IV2-4 <- IV2	0.842	IV6-2 <- IV6	-0.431
IV2-5 <- IV2	0.831	IV6-3 <- IV6	-0.134
IV2-6 <- IV2	0.617	IV6-4 <- IV6	0.682
IV3-1 <- IV3	-0.619	IV6-5 <- IV6	0.755

IV3-2 <- IV3	0.016	IV6-6 <- IV6	0.451
IV3-3 <- IV3	-0.19	IV6-7 <- IV6	0.08

Next, we move on to checking the **discriminant validity**, i.e. to check whether the constructs are not correlating too highly. We utilise the **Heterotrait-Monotrait Ratio (HTMT)**, and HTMT < 0.9 is considered appropriate. From the table, we see it is satisfied.

For the **Fornell - Larcker Criterion**, the table structurally consists of diagonal elements and off-diagonal elements. The diagonal elements are the square root of the Average Variance Extracted (AVE). The diagonal elements become the reference for the off-diagonal elements that must not exceed the diagonal elements. This criterion is also satisfied.

Tabl: Heterotrait-Monotrait Ratio (HTMT) Discriminant Validity

	DV	IV1	IV2	IV3	IV4	IV5	IV6
DV							
IV1	0.74						
IV2	0.541	0.632					
IV3	0.545	0.678	0.351				
IV4	0.66	0.62	0.817	0.414			
IV5	0.509	0.662	0.868	0.471	0.766		
IV6	0.395	0.444	0.477	0.733	0.505	0.506	

Table: Fornell - Larcker Discriminant Validity

	DV	IV1	IV2	IV3	IV4	IV5	IV6
DV	0.717						
IV1	0.712	0.734					
IV2	0.451	0.58	0.747				
IV3	-0.455	-0.394	-0.115	0.486			

IV4	0.593	0.577	0.709	-0.284	0.764		
IV5	0.421	0.552	0.712	-0.144	0.668	0.714	
IV6	0.352	0.385	0.225	-0.245	0.442	0.218	0.478

The next step assesses **multicollinearity** using the **Variance Inflation Factor (VIF)** (**Table 4**). Since all values are **≤3**, there is **no significant multicollinearity**, ensuring stable regression coefficients. A **VIF <3** confirms that each construct provides distinct information, enhancing model validity and reliability.

Tabl: Variance Inflation Factor (VIF)

	VIF
IV1 -> DV	2.03
IV2 -> DV	2.791
IV3 -> DV	1.269
IV4 -> DV	2.838
IV5 -> DV	2.374
IV6 -> DV	1.355

Pilot Testing Inference :

- IV3 and IV6 violate the CR and AVE criteria, respectively. Thus, we tried to remove questions with factor loading < 0.7 to improve the criteria, but it was found that even after doing so, they violated the criteria and were hence removed from the final questionnaire.
- For the others (DV, IV-1/2/4/5), we wanted to reduce the number of questions for the final questionnaire and thus proceeded to remove questions with factor loading < 0.7 and found that the constructs were reliable and valid even after doing so.

5. Final Questionnaire Analysis

Based on the pilot testing, the final questionnaire included only the following questions -

- DV 1/3/4/5
- IV1 - 2/5/6/7 , IV2 - 2/4/5 , IV4 - 1/5/6/7 , IV5 - 3/5/7

Construct Reliability & Validity/ Discriminant Validity

From the Tables below, we see that Cronbach Alpha > 0.7, AVE > 0.5, Composite Reliability > 0.7 and factor loadings > 0.7 (given in Fig Model Result) for all, therefore **Indicator Reliability, Internal Consistency and Convergent Validity Checked.**

For **discriminant validity**, we used **cross-loadings** to see that each indicator had the highest loading on its intended construct compared to all other constructs.Since none of these values exceeds the commonly accepted threshold of 3, it can be concluded that there is no significant multicollinearity among the constructs in the data set.

Table: Variable Reliability and Validity

	Cronbach's alpha	**Composite reliability (rho_a)**	**Composite reliability (rho_c)**	**Average variance extracted (AVE)**
DV	0.764	0.775	0.849	0.584
IV1	0.826	0.838	0.885	0.66
IV2	0.865	0.881	0.917	0.787
IV4	0.791	0.793	0.865	0.616
IV5	0.801	0.815	0.883	0.716

Table: Cross Loadings

	DV	**IV1**	**IV2**	**IV4**	**IV5**
DV1	0.807	0.635	0.425	0.602	0.459
DV3	0.704	0.415	0.335	0.516	0.421
DV4	0.757	0.446	0.238	0.479	0.491
DV5	0.785	0.694	0.428	0.470	0.473
IV1-2	0.504	0.702	0.400	0.500	0.411

IV1-5	0.605	0.822	0.585	0.615	0.515
IV1-6	0.583	0.845	0.458	0.527	0.488
IV1-7	0.672	0.869	0.419	0.611	0.504
IV2-2	0.481	0.581	0.913	0.610	0.371
IV2-4	0.375	0.434	0.886	0.477	0.367
IV2-5	0.396	0.492	0.862	0.502	0.459
IV4-1	0.521	0.567	0.377	0.769	0.419
IV4-5	0.566	0.611	0.633	0.839	0.551
IV4-6	0.509	0.533	0.408	0.795	0.550
IV4-7	0.522	0.469	0.459	0.732	0.478
IV5-3	0.501	0.571	0.439	0.583	0.869
IV5-5	0.569	0.524	0.333	0.501	0.882
IV5-7	0.447	0.399	0.373	0.546	0.784

Table: Variance Inflation Factor (VIF)

	VIF
IV1 -> DV	2.229

IV2 -> DV	1.694
IV4 -> DV	2.533
IV5 -> DV	1.817

The Variance Inflation Factor (VIF) values in the tables indicate no significant multicollinearity.

PLS SEM

PLS-SEM was used to test the adoption of biodegradable packaging based on four hypotheses: **environmental awareness, benefits, social influence, and convenience**. **Bootstrapping (5000 samples)** confirmed significance at **95% (p-value = 0.000 < 0.005)** for **H1, H3, and H4**.

- **Environmental awareness (IV1)** has the **strongest positive impact** (**β = 0.464, p = 0.005**).
- **Benefits of biodegradable packaging (IV2)** are **insignificant** (**p > 0.005**).
- **Social influence (IV4)** positively impacts adoption (**β = 0.256, p = 0.005**).
- **Ease & convenience (IV5)** also has a **significant positive impact** (**β = 0.174, p = 0.005**).

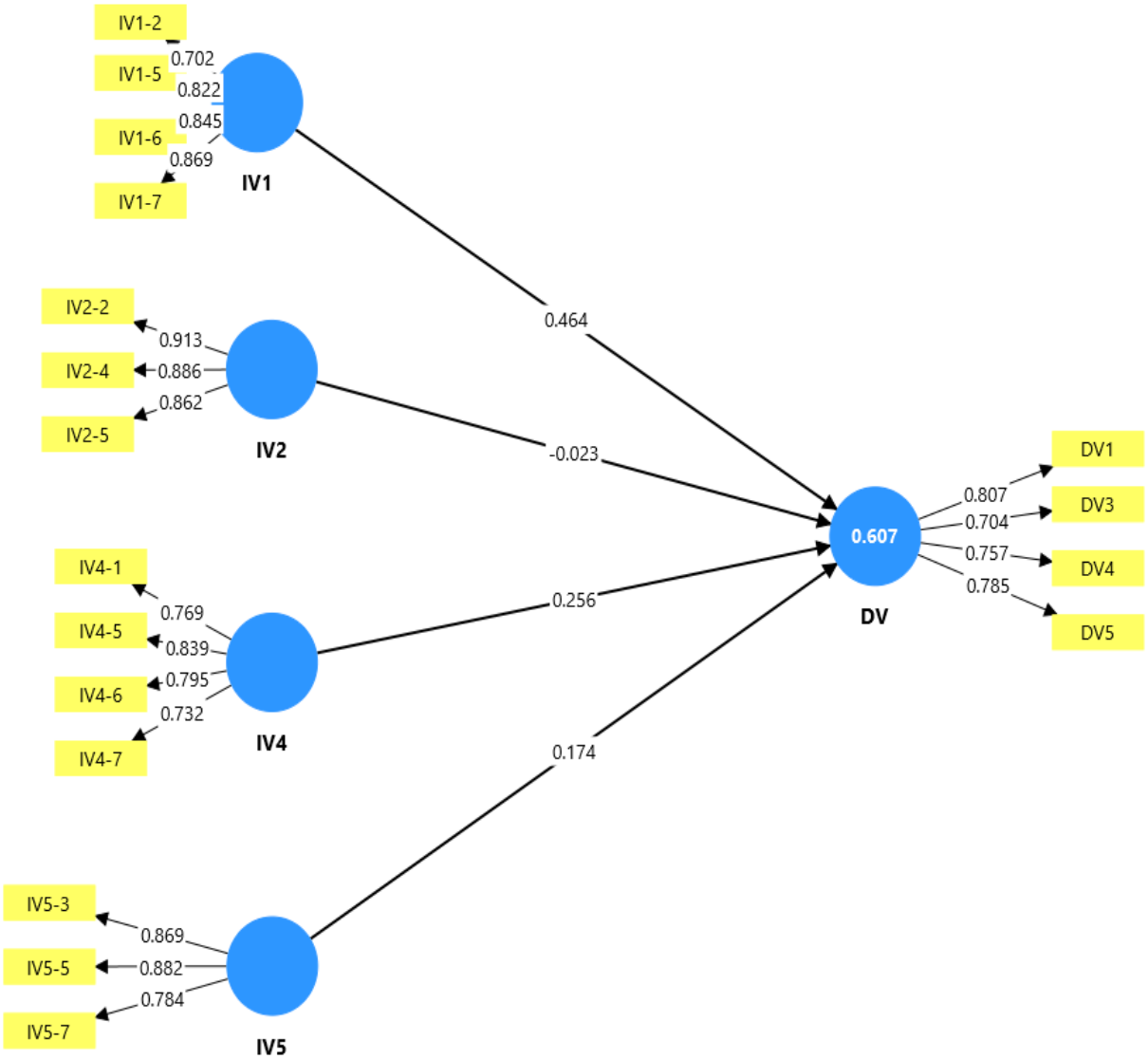
Environmental awareness, social influence, and ease of use drive **biodegradable packaging adoption**, while **perceived benefits (IV2) are insignificant**. The questionnaire should focus on awareness, social norms, and convenience, as they strongly impact adoption.

Table: PLS-SEM tests on casual relationships and variables

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
IV1 -> DV	0.464	0.463	0.056	8.216	0
IV2 -> DV	-0.023	-0.024	0.031	0.738	0.461
IV4 -> DV	0.256	0.258	0.072	3.549	0

IV5 -> DV	0.174	0.176	0.043	4.032	0

Fig: The Model Result



R2, f2, Q2 tests

- **Coefficient determination (R2) / Adjusted R Square**

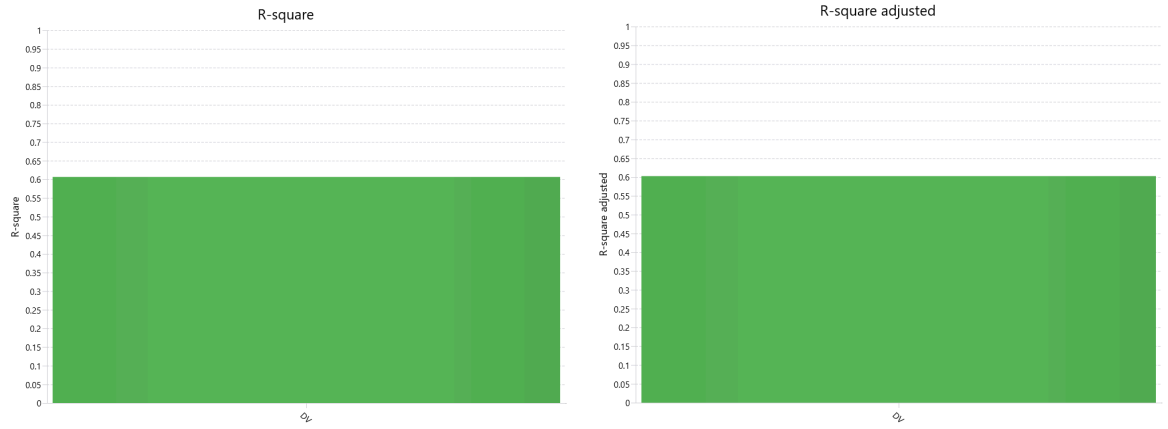
  The R-square (R^2) and Adjusted R-square values obtained from the PLS-SEM analysis provide insights into the explanatory power of the model in predicting the dependent variable. The R^2 value of 0.607 indicates that approximately 60.7% of the variation in the

dependent variable (adoption of biodegradable packaging) is explained by the independent variables included in the model. This suggests that the chosen predictors—such as environmental awareness, perceived benefits, social influence, convenience, and ease of use — collectively account for a substantial portion of consumer behaviour towards biodegradable packaging.

The Adjusted R^2 value of 0.602 accounts for the number of independent variables in the model and prevents overfitting. Since it is only slightly lower than the R^2 value, it confirms that the model is well-specified without unnecessary predictors inflating the explanatory power. The minimal difference between R^2 and Adjusted R^2 suggests that the independent variables included in the model contribute meaningfully to explaining the dependent variable, and the model does not suffer from excessive complexity.

Interpreting these values in terms of model strength, an R^2 between 0.60 and 0.70 is generally considered moderately strong in behavioural and social science research.

Fig : R2 / Adj R2



- **Frequency Strength**

  The f-square (f^2) values in PLS-SEM measure the effect size of each independent variable (IV) on the dependent variable (DV). It helps determine the relative contribution of each predictor in explaining the variance of the dependent variable. The interpretation is -

  - $f^2 \geq 0.02$ = Small effect
  - $f^2 \geq 0.15$ = Medium effect
  - $f^2 \geq 0.35$ = Large effect

Interpretation of Results:

- IV1 → DV (f^2 = 0.245): This indicates a moderate effect of IV1 on the dependent variable. IV1 plays an important role in influencing the adoption of biodegradable packaging.

- IV2 → DV (f^2 = 0.001): This suggests a negligible or no effect of IV2 on the dependent variable. The predictor does not significantly contribute to explaining the variation in adoption behaviour.

- IV4 → DV (f^2 = 0.066): This represents a small effect, meaning IV4 contributes somewhat to the model but is not a strong predictor.

- IV5 → DV (f^2 = 0.042): This also indicates a small effect, suggesting that IV5 has a limited but noticeable influence on the dependent variable.

Table : F2 Test Result

	f-square
IV1 -> DV	0.245
IV2 -> DV	0.001
IV4 -> DV	0.066
IV5 -> DV	0.042

- **Q^2 Test**

  The Q^2 value is a measure used in PLS-SEM to evaluate the predictive accuracy of a model. It is derived from the blindfolding procedure, which systematically removes specific data points, estimates missing values using the model, and compares these estimates to the actual values. The smaller the difference between predicted and actual values, the higher the Q^2, indicating stronger predictive accuracy.

  However, Q^2 is not a pure measure of out-of-sample prediction; rather, it blends elements of out-of-sample prediction and in-sample explanatory power. To assess the predictive relevance of an endogenous construct, the Q^2 value should be greater than zero.

  As a general rule:

  - $Q^2 > 0$ indicates predictive relevance.

  - $Q^2 \approx 0.25$ suggests moderate predictive relevance.

- $Q^2 \approx 0.50$ or higher signifies strong predictive relevance.

$Q^2 = 0.596$

Since the Q^2 value is 0.596, it falls into the category of large predictive relevance according to standard thresholds. This means that the PLS-SEM model demonstrates a high level of predictive accuracy for the endogenous construct being analysed. In other words, the structural model effectively explains and predicts the values of the dependent variable.

Model Fit / Model Selection Criteria

The Bayesian Information Criterion (BIC) is a widely used model selection criterion that balances model complexity and fit. It penalises complex models to prevent overfitting while ensuring that the chosen model adequately explains the data. In this case, the BIC value for the dependent variable is **-330.363**. Lower BIC values indicate a better model fit when comparing multiple models. A negative BIC value suggests that the model explains the data well while maintaining an optimal level of complexity.

The Standardized Root Mean Square Residual (SRMR) is a measure of the average discrepancy between the observed and predicted correlations. In this case, an SRMR value of 0.078 for both the saturated and estimated models suggests an acceptable fit, as values below 0.08 are generally considered to indicate a good model fit.

The squared Euclidean distance measure, d_ULS, is 1.053, which reflects the model's deviation from a perfect fit. A lower value indicates a better fit, though there is no strict threshold for d_ULS interpretation. Similarly, d_G, the geodesic distance measure, is 0.477, which measures the discrepancy between the empirical and model-implied covariance matrices. A smaller d_G value suggests that the structural model closely aligns with the data.

The Chi-square value of 1032.262 is another measure of overall model fit. In PLS-SEM, the Chi-square statistic is used less frequently for absolute fit assessment, as PLS focuses more on predictive accuracy than covariance-based fit measures. However, a lower Chi-square value typically suggests a better fit.

The Normed Fit Index (NFI) of 0.743 provides an indication of incremental model fit. It compares the proposed model to a null model (a model assuming no relationships among variables). While an NFI value closer to 1 indicates a better fit, a value of 0.743 suggests a moderate fit. Although it does not reach the commonly accepted threshold of 0.9 for a strong model fit, it still indicates that the model explains a reasonable portion of the variance in the data.

Table: Model Fit

	Saturated model	**Estimated model**

SRMR	0.078	0.078
d_ULS	1.053	1.053
d_G	0.477	0.477
Chi-square	1032.262	1032.262
NFI	0.743	0.743

PLSpredict

The PLS-Predict procedure in PLS-SEM is a robust method used to evaluate the out-of-sample predictive performance of a model, ensuring that its predictions generalise beyond the original dataset. Unlike in-sample measures like Q^2, which blend explanatory power with predictive accuracy, PLS-Predict focuses purely on out-of-sample predictive validity, making it a critical tool for assessing model reliability in real-world applications.

The procedure employs a k-fold cross-validation approach, where the dataset is randomly split into k subsets (folds). The model is trained on (k-1) folds and tested on the remaining fold, with this process iterating k times to generate predicted values for the dependent (endogenous) variables. After obtaining predictions, the prediction errors are computed by comparing these predicted values with the actual observed values using metrics such as Root Mean Square Error (RMSE), which quantifies the average squared differences between actual and predicted values, and Mean Absolute Error (MAE), which measures the absolute differences. A key aspect of PLS-Predict is the $Q^2\_predict$ statistic, which benchmarks the model's predictive performance against a naïve model, typically a simple linear regression (LM) or a mean-based prediction. If $Q^2\_predict$ is greater than zero, the model exhibits out-of-sample predictive relevance, meaning it provides better predictions than simply assuming the mean of the dependent variable.

RMSE measures the average squared difference between the actual and predicted values, giving higher weight to larger errors and making it sensitive to outliers. A lower RMSE indicates better predictive performance. MAE, on the other hand, calculates the average absolute difference between actual and predicted values, providing a more straightforward interpretation of prediction accuracy without emphasising large errors disproportionately. Both RMSE and MAE are compared against benchmark models, such as a simple linear regression (LM) model or naïve mean-based predictions. If the PLS-SEM model produces lower RMSE and MAE values than these benchmarks, it demonstrates strong out-of-sample predictive ability.

We compare the PLS-SEM model with two benchmark models:

1. Linear Model (LM) – A basic linear regression used as a comparison benchmark.

2. Indicator Average (IA) – A naïve benchmark where predictions are based on the average values of indicators.

Interpretation of Results by Dependent Variable (DV)

DV1:

- Q^2_predict = 0.434 → Indicates medium-to-strong predictive relevance.

- PLS-SEM RMSE = 0.811, MAE = 0.613 vs. LM RMSE = 0.804, MAE = 0.598 → The PLS-SEM model performs slightly worse than LM but still significantly better than IA (RMSE = 1.078, MAE = 0.848).

DV3:

- Q^2_predict = 0.242 → Suggests low-to-moderate predictive relevance.

- PLS-SEM RMSE = 1.183, MAE = 0.941 vs. LM RMSE = 1.144, MAE = 0.926 → The PLS-SEM model performs slightly worse than LM but is better than IA (RMSE = 1.359, MAE = 1.193).

DV4:

- Q^2_predict = 0.265 → Indicates moderate predictive relevance.

- PLS-SEM RMSE = 1.138, MAE = 0.943 vs. LM RMSE = 1.087, MAE = 0.892 → The PLS-SEM model performs slightly worse than LM but is better than IA (RMSE = 1.327, MAE = 1.143).

DV5:

- Q^2_predict = 0.429 → Indicates medium-to-strong predictive relevance.

- PLS-SEM RMSE = 1.000, MAE = 0.789 vs. LM RMSE = 0.891, MAE = 0.701 → The PLS-SEM model performs worse than LM but is significantly better than IA (RMSE = 1.324, MAE = 1.174).

Predictive Relevance: DV1 and DV5 show strong predictive relevance, while DV3 and DV4 have moderate relevance based on Q^2_predict values.

Model Performance vs. LM: The PLS-SEM model does not outperform LM in RMSE and MAE for any dependent variable. This suggests that while the model has predictive power, it may

need refinements, such as improving construct measurements, adding more relevant predictors, or addressing multicollinearity.

Model Performance vs. IA: PLS-SEM significantly outperforms IA in all cases, confirming that it adds predictive value beyond just using mean-based predictions.

Table: PLSpredict MV Overview

	Q^2predict	PLS-SEM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE	IA_RMSE	IA_MAE
DV1	0.434	0.811	0.613	0.804	0.598	1.078	0.848
DV3	0.242	1.183	0.941	1.144	0.926	1.359	1.193
DV4	0.265	1.138	0.943	1.087	0.892	1.327	1.143
DV5	0.429	1	0.789	0.891	0.701	1.324	1.174

5.1 Final Survey Results

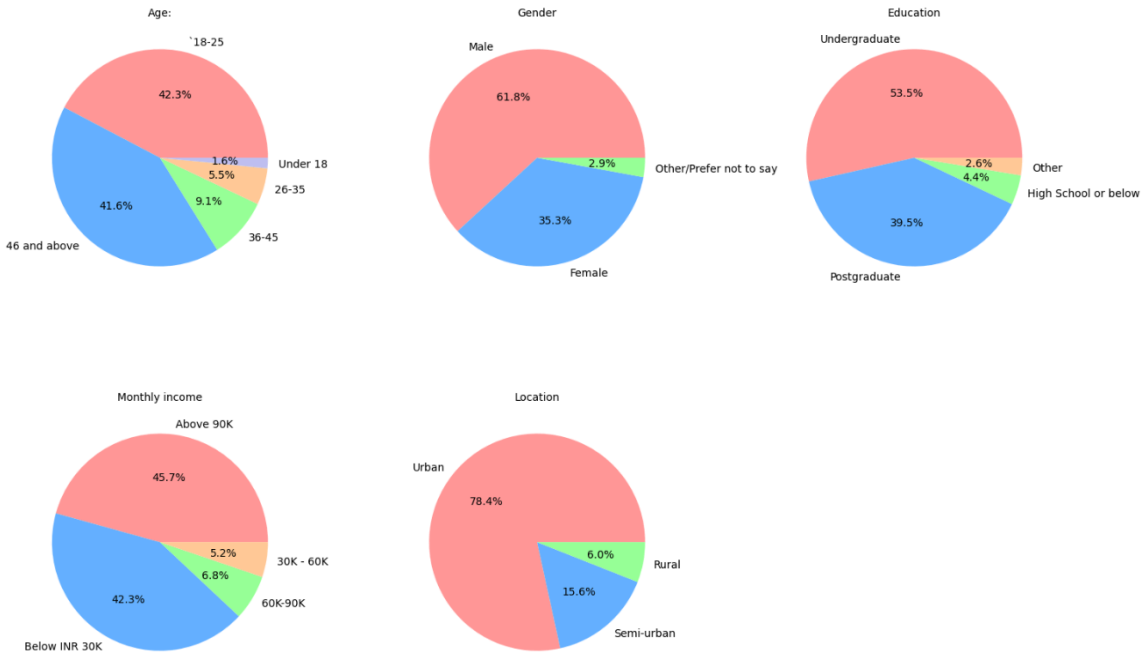
Variable	Item	Result (%)
1. I prefer products that use biodegradable packaging over those with conventional packaging.	5	65.19
	4	19.26
	3	9.63
	2	2.96
	1	2.96
2. I am willing to pay a premium for products with biodegradable packaging.	5	31.11
	3	21.48
	4	21.48
	2	14.81
	1	11.11
3. Biodegradable packaging influences my overall purchasing decision.	5	22.96
	3	21.48
	2	21.48
	4	20.74

	1	13.33
4. I actively seek out products that come in eco-friendly packaging.	5	33.33
	3	30.37
	4	14.81
	2	14.07
	1	7.41
1. I frequently read or watch news related to environmental sustainability	3	31.85
	4	25.93
	5	20.74
	2	12.59
	1	8.89
2. I am concerned about the negative impacts of plastic waste on the environment.	5	64.44
	4	27.41
	1	4.44
	3	2.22
	2	1.48
3. I actively seek out eco-friendly alternatives in my daily life	5	30.37
	4	30.37
	3	28.89
	2	5.93
	1	4.44
4. Sustainability is an essential aspect of my lifestyle	4	32.59
	5	30.37
	3	25.93
	2	5.93
	1	5.19
1. Products with biodegradable packaging have a positive impact on public health.	5	64.44
	4	29.63
	1	2.96
	3	1.48
	2	1.48
2. Biodegradable packaging contributes	5	68.15

significantly to waste reduction	4	22.96
	1	3.7
	3	2.96
	2	2.22
3. Companies using biodegradable packaging show a strong commitment to sustainability.	5	57.78
	4	24.44
	3	9.63
	2	5.93
	1	2.22
1. My family and friends encourage me to choose eco-friendly products	4	29.63
	5	28.89
	3	28.15
	2	9.63
	1	3.7
2. Using biodegradable packaging is seen as a socially responsible choice	5	60.74
	4	28.89
	3	6.67
	1	2.22
	2	1.48
3. I feel that choosing eco-friendly packaging is becoming a social norm	5	31.11
	4	29.63
	3	25.93
	2	11.85
	1	1.48
4. I am likely to try a product if many people endorse its sustainable packaging	5	42.22
	4	30.37
	3	15.56
	1	5.93
	2	5.93
1. Handling biodegradable packaging is user-friendly	5	33.33
	4	31.11
	3	24.44

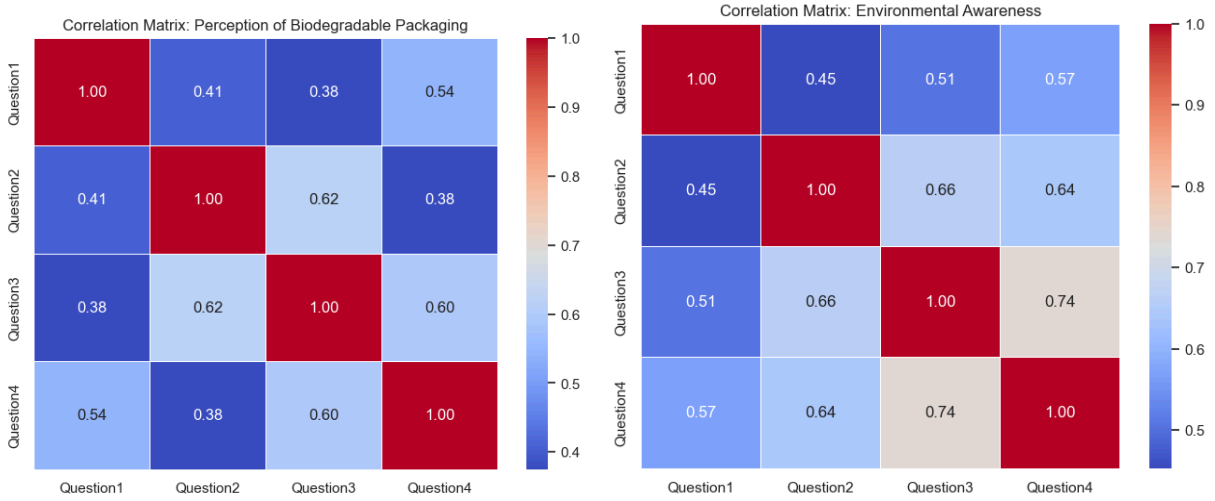
	2	8.15
	1	2.96
2. The design of biodegradable packaging makes it simple to use	4	31.85
	3	30.37
	5	25.93
	2	8.15
	1	3.7
3. Biodegradable packaging is as convenient as traditional packaging	4	30.37
	5	28.89
	3	24.44
	2	12.59
	1	3.7

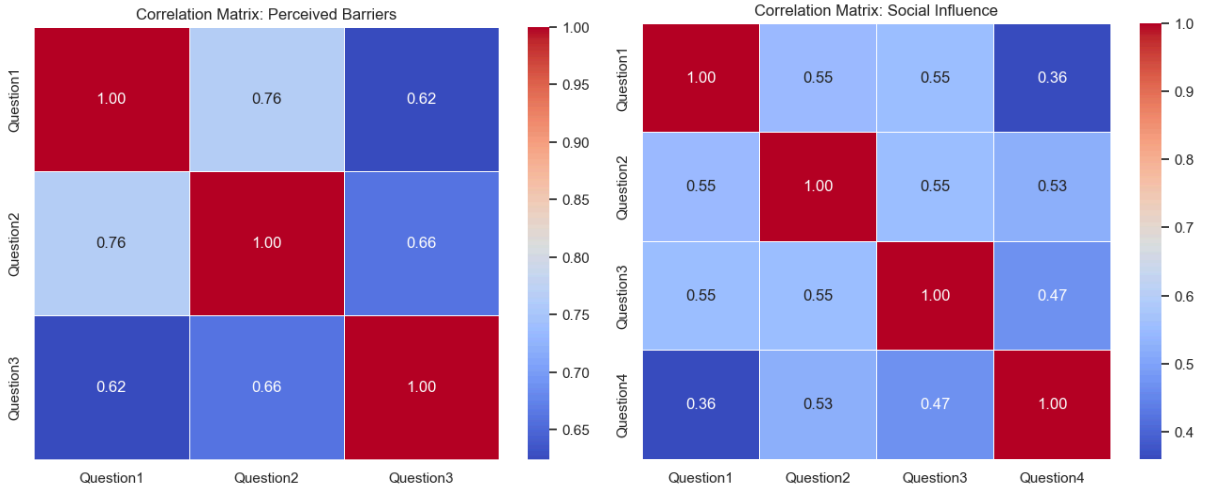
Demographics Study:

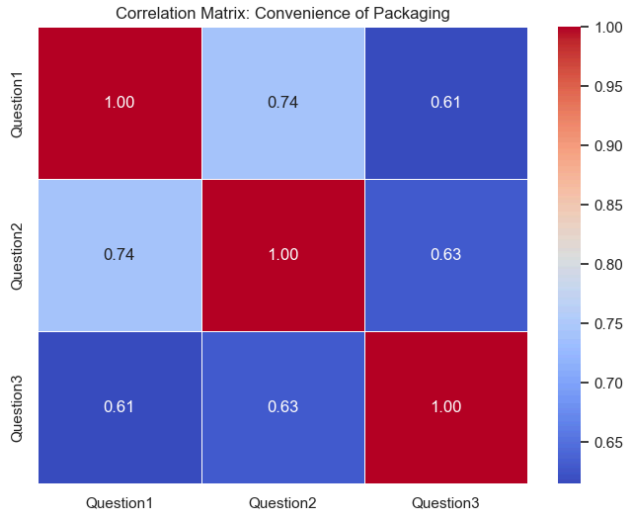


Correlation Analysis

We analyse the correlation between each question under a direct variable. We see that under each direct variable, there is no value where the cross-correlation between 2 independent variables is more than 0.8. This shows that each independent variable is unique, and there is minimal information overlap.







6. Summary

Method	Description	

Reflective Measurement Models	- Indicator loadings ≥ 0.7 ensure reliability. - Internal consistency reliability (Cronbach's Alpha: 0.70–0.90). - Convergent validity requires AVE ≥ 0.50. - Discriminant validity tested using HTMT thresholds (< 0.90 for similar constructs, < 0.85 for different constructs).	- Constructs like Environmental Awareness, Social Influence, and Ease of Use showed high reliability and validity. - Perceived Benefits and Price Sensitivity constructs were removed due to low AVE and factor loadings (< 0.7).
Formative Measurement Models	- Convergent validity assessed via redundancy analysis (correlation ≥ 0.70). - VIF < 3 avoids multicollinearity. - Statistical significance of weights determined by p-value < 0.05. - Indicators with significant weights and loadings ≥ 0.50 are considered relevant.	- Multicollinearity was avoided as all VIF values were below the threshold of 3. - Relevant indicators were retained after pilot testing; non-significant indicators were removed to improve model fit.
Structural Model Analysis (PLS-SEM)	- Collinearity assessed via VIF (ideally < 3). - R2 values: substantial (> 0.75), moderate (0.50), weak (0.25). - Q2 > 0 indicates predictive relevance. - Bootstrapping with 5000 samples tested hypotheses using Beta (β) values and p-values (< 0.05).	- R2=0.607 indicates that the model explains 60.7% of the variance in adoption behaviour. - Environmental Awareness (β=0.464), Social Influence (β=0.256), and Ease of Use (β=0.174) positively impacted adoption. - Perceived Benefits were insignificant (p > 0.05).
Model Fit and Predictive Accuracy	- Model fit assessed using SRMR (< 0.08 indicates good fit), d_ULS, d_G, and Chi-square. - Predictive accuracy evaluated using Q^2_predict (> 0 indicates relevance). - RMSE/MAE compared with benchmark models (Linear Model and Indicator Average).	- SRMR = 0.078, indicating acceptable model fit. - Q^2_predict = 0.596, demonstrating strong predictive relevance. - PLS-SEM performed slightly worse than Linear Model benchmarks but significantly better than Indicator Average in RMSE/MAE comparisons for dependent variables like DV1 and DV5.

7. Conclusion

In conclusion, our study provides valuable insights into the online purchase behaviour and packaging desired, shedding light on several key aspects that influence their decision-making process to consider the adoption of biodegradable packaging.

7.1 Findings

This study aimed to explore the key factors influencing consumer acceptance of biodegradable packaging in the e-commerce sector. The findings indicate that consumer awareness of environmental issues, perceived benefits of biodegradable packaging, and social influences significantly impact the adoption of sustainable packaging solutions. Specifically:

- Environmental Awareness:
    - Consumers with higher environmental awareness are more likely to favour products with biodegradable packaging, supporting Hypothesis H1.
    - Evidence from Data:
        - Environmental awareness had a **strong positive impact** on adoption (**β=0.464)**.
- Perceived Benefits:
    - The perceived benefits of biodegradable packaging, such as reduced environmental impact and enhanced brand image, do not significantly influence the adoption of biodegradable packaging. Thus, H2 was not supported.
    - Consumers may feel that **eco-friendly packaging is a corporate responsibility, not a purchasing factor**.
- Social Influence:
    - Social norms and peer recommendations play a crucial role in shaping consumer attitudes toward biodegradable packaging, supporting Hypothesis H3.
    - Evidence from Data:
        - Social influence had a **positive and significant impact on adoption** (**β=0.256)**.
- Ease of Use:
    - The ease and convenience of using and disposing of biodegradable packaging positively impacts adoption, supporting Hypothesis H5.
    - Evidence from Data:
        - Ease of use had a **significant impact on adoption** (**β=0.174)**.

  Out of all, environmental awareness has the most positive impact. Consumers who are **knowledgeable about plastic waste issues** are more willing to support biodegradable packaging.

7.2 Implications

The study's findings have several implications for stakeholders, particularly in light of the supported hypotheses:

1. **Environmental Awareness** (H1):

    - For Businesses: Companies can take measures focussing on environmental awareness campaigns to promote biodegradable packaging, emphasising how it aligns with consumers' values and contributes to sustainability.
    - For Policymakers: Encouraging environmental education and awareness programs can foster a culture that supports sustainable practices, including the adoption of biodegradable packaging.
2. **Social Influence** (H3):
    - For Businesses: Utilizing social media influencers and peer endorsements can effectively promote biodegradable packaging, as these channels are influential in shaping consumer attitudes toward eco-friendly products.
    - For Policymakers: Collaborating with social media platforms to disseminate information about sustainable packaging can amplify its reach and impact.
3. **Ease and Convenience of Use** (H5):
    - For Businesses: Designing biodegradable packaging that is user-friendly and easy to dispose of can enhance consumer adoption. This includes clear instructions on recycling or composting.
    - For Policymakers: Implementing an infrastructure that supports the easy disposal of biodegradable packaging (e.g., accessible composting facilities) can encourage its use.

7.3 Limitations and Future Recommendations

While this study provides valuable insights into consumer attitudes toward biodegradable packaging, several limitations exist:

- **Methodological Limitations**: The study relies on a cross-sectional survey design, which captures data at a single point in time. Future research could employ longitudinal designs to track changes in consumer attitudes over time.
    - **Future Direction:** Future research should adopt **longitudinal studies** to track how consumer attitudes **shift over time**, particularly in response to policy changes or increased awareness campaigns.
- **Sample Focus**: The study focuses on younger generations, particularly millennials and Gen Z. Expanding the demographic scope could provide a more comprehensive understanding of consumer behaviour across different age groups.
    - **Future Direction:** Expanding the sample to include **Gen X and Baby Boomers** could provide a **comprehensive, multi-generational perspective** on biodegradable packaging adoption.
- **Geographical Limitations**: The study does not specify the geographical location of respondents. Future studies should consider regional differences in consumer preferences and regulatory environments.
    - **Future Direction:** Future research should conduct **cross-country comparisons** or **regional case studies** to understand how local regulations, cultural attitudes, and economic factors impact consumer choices.
- **Future Research Directions**:

    - Investigating the impact of specific policy interventions or technological innovations in biodegradable packaging could offer additional insights into how to increase adoption rates.
    - Exploring the role of influencers and social media in promoting sustainable packaging choices could provide actionable strategies for businesses and policymakers. Constructs which were removed, like barriers to adoption and price sensitivity, could also be studied.
- **Alternative Analytical Models:**
    - Advanced techniques such as **neural networks, PCA (Principal Component Analysis), and cluster analysis** could uncover **hidden patterns** in consumer decision-making.
    - Network-based modelling could analyze **peer interactions, online discussions, and word-of-mouth referrals** to understand how **eco-friendly trends spread through social networks**.
- **Mixed-Methods Approaches**: Combine qualitative and quantitative methods to gain deeper insights into consumer attitudes and behaviours.
    - While survey-based research offers **quantifiable results**, it lacks **in-depth consumer perspectives** on behavioural drivers and emotional triggers.
    - Future research should integrate **focus groups, in-depth interviews, and ethnographic studies** to explore the **psychological factors** influencing adoption.

Appendix

Pilot testing questionnaire: Pilot Questionnaire

Final Questionnaire: Final Form

Name	No.	Type	Missings	Mean	Median	Scale min	Scale max	Observed min	Observed max	Standard deviation	Excess kurtosis	Skewness
DV1	1	MET	0	4.304	5.000	1.000	5.000	1.000	5.000	1.076	1.974	-1.647
DV3	2	MET	0	3.481	4.000	1.000	5.000	1.000	5.000	1.354	-1.085	-0.390
DV4	3	MET	0	3.236	3.000	1.000	5.000	1.000	5.000	1.323	-1.140	-0.151
DV5	4	MET	0	3.592	4.000	1.000	5.000	1.000	5.000	1.320	-1.062	-0.408
IV1-2	5	MET	0	3.410	3.000	1.000	5.000	1.000	5.000	1.166	-0.613	-0.360
IV1-5	6	MET	0	4.351	5.000	1.000	5.000	1.000	5.000	1.024	3.301	-1.910
IV1-6	7	MET	0	3.800	4.000	1.000	5.000	1.000	5.000	1.141	-0.253	-0.738
IV1-7	8	MET	0	3.792	4.000	1.000	5.000	1.000	5.000	1.130	-0.264	-0.713
IV2-2	9	MET	0	4.452	5.000	1.000	5.000	1.000	5.000	0.947	4.906	-2.228
IV2-4	10	MET	0	4.382	5.000	1.000	5.000	1.000	5.000	1.023	3.393	-1.958
IV2-5	11	MET	0	4.268	5.000	1.000	5.000	1.000	5.000	1.013	2.098	-1.578
IV4-1	12	MET	0	3.774	4.000	1.000	5.000	1.000	5.000	1.130	-0.242	-0.708
IV4-5	13	MET	0	4.379	5.000	1.000	5.000	1.000	5.000	0.930	3.692	-1.875
IV4-6	14	MET	0	3.753	4.000	1.000	5.000	1.000	5.000	1.123	-0.704	-0.530
IV4-7	15	MET	0	3.904	4.000	1.000	5.000	1.000	5.000	1.208	0.052	-0.987
IV5-3	16	MET	0	3.756	4.000	1.000	5.000	1.000	5.000	1.111	-0.390	-0.591
IV5-5	17	MET	0	3.535	3.000	1.000	5.000	1.000	5.000	1.132	-0.672	-0.286
IV5-7	18	MET	0	3.631	4.000	1.000	5.000	1.000	5.000	1.180	-0.828	-0.445
Age:	19	TEXT	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Gender	20	TEXT	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Education	21	TEXT	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Monthly income	22	TEXT	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Location	23	TEXT	0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

	DV1	DV3	DV4	DV5	IV1-2	IV1-5	IV1-6	IV1-7	IV2-2	IV2-4	IV2-5	IV4-1	IV4-5	IV4-6	IV4-7	IV5-3	IV5-5	IV5-7
DV1	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DV3	0.431	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DV4	0.397	0.551	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
DV5	0.557	0.294	0.457	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IV1-2	0.360	0.352	0.346	0.472	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IV1-5	0.613	0.362	0.274	0.544	0.400	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IV1-6	0.504	0.254	0.363	0.604	0.462	0.627	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IV1-7	0.561	0.379	0.457	0.622	0.505	0.615	0.647	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IV2-2	0.446	0.319	0.222	0.447	0.413	0.565	0.461	0.449	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IV2-4	0.343	0.291	0.210	0.292	0.341	0.420	0.346	0.311	0.731	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IV2-5	0.326	0.279	0.201	0.382	0.298	0.560	0.399	0.337	0.659	0.656	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
IV4-1	0.471	0.377	0.350	0.386	0.425	0.419	0.465	0.527	0.426	0.279	0.277	1.000	0.000	0.000	0.000	0.000	0.000	0.000
IV4-5	0.537	0.443	0.386	0.365	0.401	0.616	0.446	0.510	0.628	0.509	0.535	0.532	1.000	0.000	0.000	0.000	0.000	0.000
IV4-6	0.462	0.327	0.366	0.388	0.393	0.432	0.413	0.486	0.415	0.333	0.327	0.525	0.557	1.000	0.000	0.000	0.000	0.000
IV4-7	0.412	0.468	0.401	0.339	0.351	0.452	0.329	0.391	0.431	0.364	0.422	0.361	0.511	0.427	1.000	0.000	0.000	0.000
IV5-3	0.401	0.425	0.377	0.343	0.362	0.493	0.470	0.514	0.359	0.379	0.439	0.393	0.522	0.495	0.414	1.000	0.000	0.000
IV5-5	0.400	0.369	0.455	0.513	0.410	0.445	0.416	0.434	0.302	0.281	0.303	0.322	0.429	0.435	0.383	0.668	1.000	0.000
IV5-7	0.363	0.267	0.412	0.327	0.257	0.363	0.348	0.323	0.282	0.276	0.445	0.357	0.455	0.476	0.426	0.532	0.521	1.000

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