

Original Article

Are Consumers Willing to Pay for Sustainability: Survey-Based Analytical Insights for Managers

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Abstract - Despite the global rise in consumer interest for sustainable food and beverage products, the willingness to pay rarely turns into an actual purchase. The present study analyses primary survey data gathered from 179 urban Indian respondents to examine this problem. The analysis employs statistical tools such as exploratory factor analysis along with tests like Composite Reliability, Average Variance Extracted and Heterotrait-Monotrait checks, Chi-square with Holm-Bonferroni correction, L1-regularised logistic regression, bootstrap mediation, moderated-mediation diagnostics, and Gaussian-mixture latent class analysis. Post correction, only Monthly Income remains significant with willingness to pay (Holm $p = 0.018$). A correlational analysis consistent with the Theory of Planned Behavior shows that the Importance $\rightarrow$ Habit $\rightarrow$ Willingness to Pay indirect path is positive and significant (95 percent bootstrap CI [0.011, 0.380]); at the available sample size, a direct income-attitude interaction is not observable. Three key consumer typologies - high-WTP, aspirational, and disengaged - exhibit willingness-to-pay rates that differ by a factor of approximately four-and-a-half. Certain variables, such as awareness, habit-building and price-tier strategies, emerge as the critical firm-level managerial levers.

Keywords - Consumer Typologies, Eco-Friendly Products, Sustainability, Willingness To Pay.

1. Introduction

The global food and beverage industry has been transformed over the past decade by the impact of factors such as dynamic consumer tastes and increasing environmental awareness. Eco-friendly business initiatives such as carbon-footprint reduction, renewable-energy adoption and biodegradable packaging - have become core performance drivers; they are no longer perceived as unconventional. According to the World Resources Institute [1], the agricultural and food sector adds to approximately 26 percent of global greenhouse-gas emissions, spurring producer-side strategies like sustainable sourcing, reduction in plastic usage and supply-chain transparency. Industry trackers, including Statista [2] and Nielsen [3], show a parallel growth in market demand in sustainable food choices across urban markets, including India. Yet a persistent contradiction characterises this domain. Survey after survey records a strong stated preference for eco-friendly products, while observed purchasing behaviour and willingness to pay a premium remain considerably lower. The present sample illustrates the gap quantitatively: 87.2 percent of respondents express a favourable disposition toward sustainable products, only 26.8 percent commit to paying more, and 48.6 percent remain undecided. The central problem confronting industry is therefore not awareness creation but the conversion of intention into committed behaviour. Earlier studies on Indian and emerging-market consumers report attitudinal endorsement in the 60-80 percent range [4, 5], but committed

willingness-to-pay rates seldom exceed 15-30 percent across comparable populations. The mechanisms that account for this gap - and the demographic, behavioural and attitudinal predictors of who closes it - remain insufficiently understood, particularly in the Indian urban food and beverage context.

1.1. Research Gap

Three specific gaps motivate the present study. (i) Most prior studies in the green-marketing literature [4, 6, 7] rely on Pearson correlation or single-equation logistic regression without controlling for family-wise error across multiple demographic comparisons; consequently, the demographic predictors that survive multiple-testing correction in this domain are unclear. (ii) The Theory of Planned Behaviour [8] is frequently invoked to frame green-purchase studies, but the central TPB prediction - that intention translates into behaviour through habitual mediation - is rarely formally tested with bootstrap-based mediation methods in this empirical context. (iii) Regression-only studies treat the consumer population as homogeneous, even when underlying typological heterogeneity may carry the managerial signal. To the best of available evidence, no prior study in the Indian urban food and beverage context triangulates regularised logistic regression, bootstrap mediation, moderated-mediation testing and latent class analysis on a single primary-data instrument.

1.2. Novelty and Contribution

The present study contributes on five dimensions. (i) It applies Holm-Bonferroni correction across eleven pre-specified Chi-square tests, isolating Monthly Income as the only demographic variable surviving family-wise-error control. (ii) It validates the measurement model against publication-grade SEM thresholds (CR, AVE, HTMT) rather than relying on Cronbach's α alone. (iii) It performs a bootstrap mediation-consistent decomposition of the Attitude $\rightarrow$ habit $\rightarrow$ WTP path, and a Hayes Process Model 14 moderated-mediation test, which finds no detectable interaction between Income and Attitude at the available sample size. (iv) It recovers interpretable consumer typologies via Gaussian-mixture latent class analysis, with WTP rates differing by a factor of 4.5 across segments. (v) It validates the regularised logistic model through leave-one-class-out replication, demonstrating that the predictive structure generalises across typologies.

1.3. Comparison with Prior Findings

Çakmakçı et al. [7] apply Principal Component Analysis and logistic regression on a similar consumer-perception domain but do not test mediation, moderated mediation or class structure. Kumar and Ghodeswar [9] use Structural Equation Modeling on Indian green-purchase data and report trust, corporate environmental responsibility, brand appeal and product experience as drivers of intention, but stop at intention.

He et al. [10] examine Responsible Environmental Behavior factors on Chinese consumers, also stopping at intention. The present study extends this strand by modelling the intent-to-behaviour conversion stage, controlling for family-wise error, and recovering consumer typologies that differ by a factor of 4.5 in commercial conversion. A detailed side-by-side comparison appears in Section 4.8.

1.4. Research Objectives and Structure

Aligned with these gaps, the study pursues four objectives: (O1) to identify which demographic and attitudinal predictors of willingness to pay survive multiple-testing correction; (O2) to validate the measurement model against publication-grade SEM thresholds; (O3) to formally test the Theory of Planned Behaviour through bootstrap mediation, simple moderation and Hayes' moderated-mediation specification; and (O4) to recover and characterise consumer typologies through latent class analysis and verify predictive generalisability through leave-one-class-out replication. Section 2 reviews the relevant literature, Section 3 describes the methodology, Section 4 presents the empirical findings organised by hypothesis with a dedicated comparison with the state of the art subsection, and Section 5 concludes with managerial implications, limitations, and longitudinal and experimental directions for future research.

2. Review of Literature

2.1. Consumer Perception of Eco-Friendly Products

Studies show consumers generally hold positive attitudes toward eco-friendly products, but stated intention rarely converts into purchase. Savale et al. [6] examined green-marketing-based adoption and identified that, despite favourable perceptions, significant barriers obstruct global adoption. Nagaraju and Thejaswini [11] found that 68.3 percent of Mysore consumers were aware of eco-friendly products, with price and quality concerns dominating purchase decisions. Jung et al. [12] reported a South Korean preference for eco-friendly food in large supermarkets. Reddy et al. [4] reported that Indian consumers are knowledgeable about eco-marketing and highly willing to buy eco-friendly fast-moving consumer goods. Çakmakçı et al. [7] applied Principal Component Analysis and Logistic Regression and found that while consumers perceive organic foods as healthy, they also perceive them as expensive and time-consuming, reinforcing that economic constraints and availability are key hindrances.

2.2. Drivers of Consumer Perception and Willingness to Pay

Several behavioural and structural factors drive eco-friendly purchase decisions. He et al. [10] examined Chinese consumers' organic-food attitudes through Responsible Environmental Behavior factors and reported a positive correlation with purchase intentions. De Barcellos et al. [13] employed Structural Equations Modelling on Brazilian organic-food data and showed that consumers exhibit positive attitudes toward organic-food choices, with public-authority promotion playing a moderating role. Mallick et al. [14] reviewed eco-friendly marketing tools and showed that authorised brands and brand reputation enhance consumer trust. Ketelsen et al. [15] identified ethical guidance, consumer awareness, pricing and product quality as drivers of eco-packaging preference. Kumar and Ghodeswar [9] established that consumer trust, corporate environmental responsibility, product experience and brand appeal strongly influence green-purchase decisions. On willingness to pay a premium (WTPP), Hallak et al. [16] found that younger consumers in the hospitality sector are more inclined to pay extra for healthier beverages. Chen et al. [17] showed that eco-label certification, government regulations and standardised pricing significantly influence WTPP toward recycled packaging. Van Doorn and Verhoef [18] noted that the low market share of organic products indicates perceived quality concerns, particularly in less-healthy food categories. Tanzares et al. [19] connected environmental awareness directly to WTPP in Indonesian research articles on sustainable packaging.

2.3. Sustainability Adoption in the Food and Beverage Sector

From a supply-side perspective, Arcese et al. [20] stated that incorporating open sustainability innovation could reduce costs and lead to faster time to market. Dora et al. [21] suggested that prioritizing the reduction of transportation and initial processing defects, rather than post-processing inefficiencies, could minimize substantial food loss. Long, Looijen and Blok [22] recognized significant Critical Success Factors for moving towards sustainable business models. Adams, Donovan and Topple [23] emphasized that though stakeholder pressure fuels sustainability efforts, the Lack of regulatory clarity is a noteworthy hindrance, with senior-management commitment as the key internal facilitator.

2.4. Synthesis and Position of the Present Study

The reviewed literature converges on three propositions. First, consumers express positive attitudes toward eco-friendly products, but the strength of this Attitude correlates only weakly with actual purchase. Second, the attitude-behaviour gap is mediated by economic factors (price, Income, perceived expensiveness) and informational factors (awareness, certification credibility). Third, methodological pluralism is encouraged across unsupervised techniques, structural equations and survey-based regressions. The present study extends the survey-regression strand on three dimensions: it reports a publication-grade measurement-model assessment (Bartlett, KMO, Exploratory Factor Analysis, CR, AVE, HTMT, Harman) before predictive modelling; it formally tests the TPB mediation path with bootstrap inference and Hayes' index of moderated mediation [24]; and it controls

for family-wise error across eleven Chi-square tests using Holm-Bonferroni correction [25], while also recovering consumer typologies through latent class analysis.

3. Data and Methodology

3.1. Research Design and Data Sources

The study adopts a cross-sectional descriptive and inferential design. Primary data were collected through a structured questionnaire of nineteen substantive items spanning demographics, food-and-beverage purchase behaviour, sustainability attitudes, willingness to pay, perceived barriers and stated quality preferences. A total of 179 urban Indian respondents participated across age, gender, education, Employment and Income categories. Participation was anonymous and voluntary; no monetary incentive was offered. Inferential analyses include Chi-square tests of independence with Holm-Bonferroni and Benjamini-Hochberg corrections, Spearman rank-order correlation, exploratory factor analysis, and measurement-model assessment via Composite Reliability (CR), Average Variance Extracted (AVE) and the Heterotrait-Monotrait (HTMT) ratio. Predictive modelling uses L1-regularised logistic regression with class-balanced weighting. Hypothesis testing follows the Baron-Kenny mediation procedure [26] with 5,000 bootstrap replicate confidence intervals [27] and Hayes' Process Model 14 for moderated mediation [24]. Sensitivity tests include multi-seed evaluation, bootstrap stability ($B = 1000$), Variance Inflation Factor (VIF), SMOTE re-fit, statistical power analysis and metric measurement-invariance checks (Appendix 1).

3.2. Sample Profile

Table 1. Sample profile (N = 179)

Characteristic	Categories (n, %)
Age	18-24 (42, 23.5%); 25-34 (47, 26.3%); 35-44 (45, 25.1%); 45-54 (38, 21.2%); 55+ (6, 3.4%); <18 (1, 0.6%)
Gender	Female (106, 59.2%); Male (73, 40.8%)
Employment	Employed (95, 53.1%); Student (47, 26.3%); Self-employed (21, 11.7%); Other (9, 5.0%); Unemployed (7, 3.9%)
Education	PG (91, 50.8%); UG (52, 29.1%); Ph.D. (29, 16.2%); Masters (3, 1.7%); BE (1, 0.6%); Postdoc (1, 0.6%); Unknown (2, 1.1%)
Monthly Income	Above ₹70k (39, 21.8%); ₹10–30k (29, 16.2%); ₹30–50k (26, 14.5%); ₹50–70k (11, 6.2%); Prefer not to say (58, 32.4%); Unknown (16, 8.9%)

3.3. Theoretical Framework: Theory of Planned Behaviour

The Theory of Planned Behaviour [8] is applied to integrate sustainability, consumer perception and behaviour into a unified framework. Attitude is operationalised by Sustainability Importance and Environmental Impact Belief; Subjective Norm is operationalised by Recommend (likelihood of recommending) and Learn Source; Perceived Behavioural Control is operationalised by Income, Perceived Expensiveness and Barriers. Intention is captured by PrefersSustainable and committed behaviour by Willingness to Pay. The TPB pathway is tested in a mediated regression with X = Sustainability Importance, M = Habitual Sustainable Buying, Y = Willingness to Pay, and Income entering as a moderator on the M -to- Y path in Hayes' Process Model 14 specification. Eight pre-specified hypotheses (Table 2) guide the empirical analysis.

Table 2. Pre-specified hypotheses

ID	Hypothesis	Test / Section
H1	Income is associated with Willingness to Pay after multiple-testing correction.	Chi-square + Holm; §4.2
H2	Employment status is associated with WTP after correction.	Chi-square + Holm; §4.2
H3	Habitual Sustainable Buying mediates the Attitude → WTP path.	Bootstrap mediation; §4.5

H4	Income moderates the Attitude → WTP path.	Logit interaction; §4.6
H5	The five sustainability items form a multidimensional latent structure.	EFA + KMO; §4.3
H6	The behavioural and cognitive factors are discriminantly distinct.	CR / AVE / HTMT; §4.3
H7	The indirect effect of Attitude on WTP via Habit varies with Income.	Hayes Model 14; §4.6
H8	Consumer typologies differ systematically in WTP rate.	Latent class analysis; §4.7

3.4. Measurement Model: Bartlett, KMO, EFA, CR, AVE, HTMT

The measurement model is validated before predictive modelling. In plain terms, this validation answers whether the items are correlated enough to share underlying constructs, how many constructs exist, whether items within each construct cohere reliably, and whether the constructs are distinct from one another. Bartlett's test of sphericity rejects the null that the correlation matrix is an identity; the Kaiser-Meyer-Olkin (KMO) index measures sampling adequacy with values above 0.6 acceptable.

Exploratory Factor Analysis with varimax rotation identifies latent dimensions. Composite Reliability (CR) and Average Variance Extracted (AVE) are computed for each factor, with thresholds $CR \geq 0.70$ and $AVE \geq 0.50$ [28]. The Heterotrait-Monotrait (HTMT) ratio [29] is the discriminant validity check, with values below 0.85 indicating that the factors capture distinct constructs. Common Method Bias is screened via Harman's single-factor test [30]. The three indices are:

$$CR = (\sum \lambda_i)^2 / [(\sum \lambda_i)^2 + \sum (1 - \lambda_i^2)] \quad (1)$$

$$AVE = (\sum \lambda_i^2) / n \quad (2)$$

$$HTMT(A, B) = \text{mean}(|r_{AB}|) / \sqrt{[\text{mean}(r_{AA}) \times \text{mean}(r_{BB})]} \quad (3)$$

where λ_i are the standardised factor loadings; r_{AB} are the heterotrait correlations; and r_{AA} , r_{BB} are the intra-construct correlations.

3.5. Predictive Modelling and Multiple-Testing Protocol

With $N = 179$ and 49 dummy variables, the unconditional Events-Per-Variable (EPV) is 0.47 for Model 1 (preference) and 0.98 for Model 2 (willingness to pay) - well below the conventional ≥ 10 threshold [31]. In plain terms, EPV measures how many positive outcomes the model can learn from per predictor; when it is low, ordinary logistic regression overfits.

Three remediation steps are applied: L1-regularised (LASSO) logistic regression with the regularisation strength C tuned via internal stratified five-fold cross-validation on Area Under the ROC Curve (AUC); class-balanced weighting to address minority-class under-fitting; and a hard cap on features so that $EPV \geq 5$ in every reported coefficient table ($k = 5$ for Model 1, $k = 9$ for Model 2). Final models are fitted using statsmodels logit to obtain 95 percent Wald confidence intervals on odds ratios.

Each model is evaluated through McFadden pseudo- R^2 , Hosmer-Lemeshow χ^2 , Brier score, accuracy and AUC. Predictive AUC is reported by nested cross-validation, which re-selects the regularisation strength within each training fold so no test observation influences the model that scores it; the apparent full-sample-tuned AUC is reported alongside as an upper bound. Calibration is assessed both in-sample and out-of-fold, since in-sample calibration is structurally optimistic. Multicollinearity is assessed through per-feature VIF.

Eleven pre-specified Chi-square tests are corrected using Holm-Bonferroni [25] and Benjamini-Hochberg [32]. Class-imbalance robustness is verified through SMOTE [33] with a Youden 's-J' optimised threshold. A post-

selection caveat applies to the statsmodels logit fitted on the LASSO-retained features: its Wald intervals are anti-conservative and are reported as descriptive summaries, with bootstrap coefficient-sign stability (Appendix 1) as the more conservative indicator.

3.6. Mediation, Moderation and Moderated Mediation

The TPB pathway from Attitude through habit to behaviour is tested through the Baron-Kenny three-equation framework [26] with X = Sustainability Importance, M = Habitual Sustainable Buying, Y = Willingness to Pay. The estimating equations are:

$$M = \alpha_1 + a \cdot X + \varepsilon_1 \quad (4)$$

$$\text{logit } P(Y = 1) = \alpha_2 + c' \cdot X + b \cdot M \quad (5)$$

The indirect effect $a \times b$ quantifies the X -to- Y effect that flows through M ; its 95 percent confidence interval is estimated by 5,000 non-parametric bootstrap replicates [27]. A CI excluding zero indicates significant correlational mediation. Hayes' Process Model 14 [24] places the moderator W on the b -path:

$$\text{logit } P(Y = 1) = \alpha_3 + c' \cdot X + b_1 \cdot M + b_2 \cdot W + b_3 \cdot M \cdot W \quad (6)$$

The Index of Moderated Mediation, defined as $a \times b_3$, tests whether the indirect effect varies with the moderator. Conditional indirect effects are reported at $W - 1$ SD, W and $W + 1$ SD with 5,000-replicate bootstrap confidence intervals.

3.7. Latent Class Analysis and External Validity

A Gaussian-mixture latent class model with diagonal covariance is fitted on the five standardised Likert items to recover managerially actionable consumer typologies. The number of classes is screened by Bayesian Information Criterion over $k \in \{2, 3, 4, 5\}$; because BIC declines monotonically for Gaussian mixtures on ordinal Likert data, the final k is selected as the largest value for which every class retains $n \geq 10$ and indicator-mean profiles are interpretably distinct.

A leave-one-class-out validation of the regularized logit Model 2 is conducted as the generalizability test. Headline behavioral rates are validated against industry benchmarks from Nielsen [3] and Statista [2].

4. Results and Discussion

4.1. Descriptive Patterns and the Intent–Behavior Gap

The intent-behavior gap emerges as the immediate problem to be addressed from the descriptive data. Out of 179 respondents, 156 (87.2 percent) indicated they prefer sustainable products, yet only 48 (26.8 percent) were clearly willing to pay a premium, while 87 (48.6 percent) remained uncertain on their pricing decisions. The most commonly stated barrier was a higher price (45.3 percent), succeeded by limited availability (27.9 percent) and Lack of awareness (19.6 percent).

Responses regarding sustainable purchase frequency were also mixed: 25.7 percent reported frequent purchase of sustainable products, while 36.9 percent reported they purchased "Sometimes" or less frequently. Female respondents (59.2 percent) dominated male respondents (40.8 percent); the sample leaned toward higher education levels, with postgraduate (50.8 percent), and Ph.D.(16.2 percent). Most respondents are employed (53.1 percent) and are middle-aged (72.6 percent in the 25–54 bracket). Overall, the intent-behavior gap is not a marginal phenomenon but stands out as the central pattern in the data.

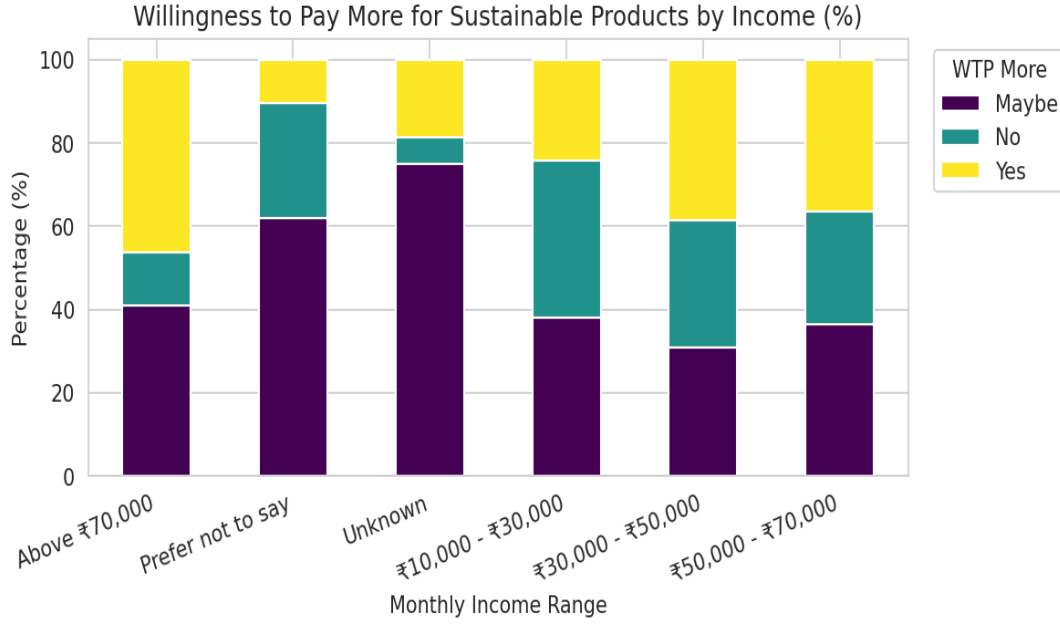


Fig. 1 Willingness to pay more by monthly income bracket

4.2. Hypotheses H1 and H2: Demographic Predictors of WTP after Correction

Eleven Chi-square tests were performed with adjustment for multiple comparisons (Table 3). Before correction, Income $\times$ WTP (raw $p = 0.0017$) and Employment $\times$ WTP (raw $p = 0.0387$) appeared significant. But after applying the Holm-Bonferroni correction, only Income $\times$ WTP appears significant. (Holm $p = 0.018$, Cramer's $V = 0.281$); Employment $\times$ WTP does not hold the family-wise-error adjustment (Holm $p = 0.387$). Being consistent with the 87.2 percent saturated preference rate, all five demographic predictors of preference emerge as non-significant.

Table 3. Chi-square Panel with Holm-Bonferroni Correction (N = 179)

Test	χ^2	df	p_raw	p_Holm	Cramer's V	Sig (Holm)
Income $\times$ WTP	28.234	10	0.0017	0.018	0.281	Yes
Employment $\times$ WTP	16.270	8	0.0387	0.387	0.213	No (raw only)
Age $\times$ WTP	13.564	10	0.1938	1.000	0.195	No
Education $\times$ WTP	13.761	12	0.3162	1.000	0.196	No
PerceivedExpensive $\times$ WTP	12.982	8	0.1125	1.000	0.190	No
SustImportance $\times$ WTP	7.288	6	0.2951	1.000	0.143	No
Age $\times$ PrefSust	8.755	10	0.5555	1.000	0.156	No
Education $\times$ PrefSust	10.539	12	0.5688	1.000	0.172	No
Employment $\times$ PrefSust	10.340	8	0.2420	1.000	0.170	No
Income $\times$ PrefSust	10.303	10	0.4143	1.000	0.170	No
Gender $\times$ PrefSust	1.517	2	0.4683	1.000	0.092	No

Verdict: H1 (which is Holm-corrected) is supported, while H2 is rejected. The results indicated that the intent-behavior gap is primarily constrained by perceived behavioral control — particularly Income rather than attitudinal factors, consistent with the TPB reading. The key finding is robust even after applying raking weights to align the sample gender distribution with urban-India census benchmarks (weighted $\chi^2 = 27.02$, $p = 0.003$) and shows strong power (Cohen's $w = 0.397$, post-hoc power = 0.976).

4.3. Hypotheses H5 and H6: Measurement Model Validation

Bartlett's $\chi^2 = 64.44$ (df = 10, $p < 0.001$) and KMO = 0.647 confirm factorability. Two factors with eigenvalues above one were extracted, together explaining 29.0 percent of variance across the five Likert items. This is below the commonly referenced 50 percent benchmark for reflective measurement models [28], implying that around 71 percent of item variance is not clearly explained by the two retained factors.

Two considerations help partially reduce the effect: short self-report Likert scales typically produce lower communalities compared to long reflective-indicator scales, and in addition, the reason for the present extraction is not to recover an exhaustive latent structure, but to validate construct distinctness for the subsequent analysis. Factor 1 (Behavioural) groups Sustainability Importance, Sustainable Buy Frequency and Recommend; Factor 2 (Cognitive) groups Perceived Expensive and Environmental Impact Belief, supporting H5 (multidimensional structure).

Table 4. Measurement model validation

Construct	Indicators	Standardised λ	CR (≥ 0.70)	AVE (≥ 0.50)	$\sqrt{\text{AVE}}$
F1 Behavioural	SustImp / SustBuyFreq / Recommend	0.78 / 0.72 / 0.62	0.750	0.503	0.709
F2 Cognitive	PerceivedExpensive / EnvImpactBelief	0.81 / 0.81	0.787	0.648	0.805

Both constructs satisfy CR (0.750, 0.787) and AVE (0.503, 0.648). The inter-construct correlation $\phi = 0.267$ is well below $\sqrt{\text{AVE}}$ for both factors — the Fornell-Larcker criterion is satisfied. HTMT = 0.561, comfortably below the 0.85 threshold; discriminant validity is established, and H6 is supported. Cronbach's α for the full five-item scale is 0.545, below the 0.70 threshold conventional for unidimensional reliability; this is expected and consistent with the two-factor structure, since α underestimates the reliability of multidimensional scales and the per-factor CR values are the appropriate statistic [28]. Item-total correlations are all positive (range 0.35–0.62); the reduced α is reported as a cautionary signal. Common Method Bias is screened through Harman's single-factor test [30], yielding first-factor variance of 20.07 percent — below the 50-percent threshold — and through a marker-variable adjustment (Frequency of purchases as marker) with the largest marker-adjusted correlation shifting by ≤ 0.04 . The two checks converge on the conclusion that CMB is unlikely to be a primary explanation, although a single-method design cannot fully eliminate it. Metric measurement invariance across gender is also supported ($\max |\Delta\lambda| = 0.198 < 0.20$).

4.4. Predictive Modelling - Willingness to Pay (Model 2)

The L1-regularised logistic regression for WTP retained 10 of 49 candidate features at the cross-validated optimum $C = 0.28$; after capping at EPV = 5, nine features entered the final logit. The model fits in-sample well (McFadden pseudo- $R^2 = 0.329$; in-sample Hosmer-Lemeshow $p = 0.401$; in-sample Brier = 0.128; max VIF = 1.20). Predictive AUC is the honest nested cross-validated value of 0.726 (SD 0.065), below the optimistic apparent AUC of 0.778. Out-of-fold calibration is weaker — the model over-predicts at high probabilities (out-of-fold Brier = 0.218) — so it is better used to rank-order segments than to assert absolute WTP probabilities.

Seven of nine predictors are significant at $p < 0.05$ under naive Wald inference; the post-selection caveat from Section 3.5 applies. The largest positive coefficient is on "Lack of awareness" cited as the stated barrier (OR = 6.90, CI [2.08, 22.90]). The parsimonious reading is a selection effect rather than a convertibility claim: respondents selecting "awareness" as their barrier are, by construction, those engaged enough to articulate an informational deficit, and that reflective engagement may itself correlate with WTP.

The association therefore, does not warrant the inference that a randomised information intervention would lift WTP in the broader population; that claim requires the field experiment in Section 5.4. "Strongly agree" on

environmental impact belief results in OR = 4.86 (CI [1.80, 13.09]); while Income concealment has OR = 0.19, showing consistency with the Holm-corrected Chi-square. Once habit and Income are controlled for, stated Attitude becomes non-significant, thereby motivating the decomposition below. Bootstrap stability checks (B = 1000) further confirm that seven out of nine coefficient signs remain stable (Appendix 1).

Table 5. Final WTP Logit (Post-LASSO, EPV-Capped, Wald 95% Confidence Intervals)

Predictor	β	p	OR	95% CI
Recommend = Neutral	-1.643	0.003	0.19	[0.07, 0.57]
Income = Prefer not to say	-1.687	0.002	0.19	[0.06, 0.55]
EnvImpactBelief = Strongly agree	+1.580	0.002	4.86	[1.80, 13.09]
Barriers = Lack of awareness	+1.931	0.002	6.90	[2.08, 22.90]
AvailIncrease = Not sure	-2.175	0.016	0.11	[0.02, 0.67]
Gender = Male	+0.928	0.035	2.53	[1.07, 6.01]
Employment = Self-employed	+1.216	0.044	3.37	[1.03, 11.02]
Employment = Student	-1.177	0.077	0.31	[0.08, 1.14]
SustImportance = Very important	+0.172	0.715	1.19	[0.47, 2.98]

4.5. Hypothesis H3: A Mediation-Consistent Decomposition

Although the cross-sectional design prevents a strict causal mediation reading, a correlation-based analysis aligned with the Theory of Planned Behaviour is stated with X = Sustainability Importance, M = Habitual Sustainable Buying, and Y = Willingness to Pay. Path a (X → M) is highly significant: a = 0.417, p < 0.001. Path b (M → Y, controlling for X) is also significant: b = 0.392, p = 0.050. The total effect c = 0.427 reduces to the direct effect c' = 0.271 once habit is controlled.

Table 6. Mediation-consistent decomposition-baron-kenny framework with 5,000 bootstrap replicates

Path	Estimate	p / 95% CI	Interpretation (correlational)
a (X → M)	+0.417	p < 0.001	Importance covaries with habitual buying
b (M → Y X)	+0.392	p = 0.050	Habitual buying covaries with WTP
c (total: X → Y)	+0.427	—	Total Attitude–WTP association
c' (direct: X → Y M)	+0.271	—	Residual after habit
a × b (indirect)	+0.163	95% CI [0.011, 0.380]	SIGNIFICANT

The indirect path a × b = 0.163 carries a bootstrap 95 percent CI [0.011, 0.380], excluding zero — consistent with partial mediation. Three caveats temper this. First, the three variables were measured concurrently, so habit cannot be established as a temporal antecedent of WTP; the pattern is equally consistent with past-WTP-shapes-habit or a third-construct-drives-both model.

Second, the a-path is on the OLS scale and the b-path on the logit scale, so a numerical "proportion mediated" ratio is not scale-comparable and is intentionally omitted. Third, the TPB-consistent reading should be treated as a hypothesis for the longitudinal design proposed in Section 5.4, not as an established causal finding.

4.6. Hypotheses H4 and H7: Moderation and Moderated Mediation

The simple moderation test estimates Income × Sustainability Importance on the log-odds of willingness to pay. The interaction is non-significant: β = -0.131, p = 0.624. H4 is rejected: Income's effect on WTP does not depend on Attitude, and vice versa. The Hayes Process Model 14 test asks whether the indirect effect itself varies with Income. The moderated-mediation index a × b₃ = 0.035 has a bootstrap 95 percent CI of [-0.106, 0.230], spanning zero; H7 is

rejected at the available sample size. Conditional indirect point estimates at $W = \pm 1$ SD (0.059 and 0.146) carry confidence intervals that span zero by a factor of four; with $N = 105$ in the income-disclosed sub-sample, the data are insufficient to support any directional reading of this pattern. Replication on $N \geq 410$ is required before necessitating conditional-effect inference. The primary conclusion is that Income functions as a parallel main effect on willingness to pay rather than as a conditional moderator of the habit channel.

Based on the available evidence, attitudinal interventions alone cannot be assumed to eliminate the income gradient. The non-significance is partly due to insufficient power in the sub-sample (post-hoc power for small interaction effects was below 0.50); a definitive null requires replication on a larger stratified sample.

Table 7. Hayes process model 14-moderated mediation (5,000 bootstrap replicates)

Effect	Estimate	95% Bootstrap CI	Conclusion
a ($X \rightarrow M$)	+0.343	—	$p = 0.002$
b_1 ($M \rightarrow Y$ at $W = \text{mean}$)	+0.299	—	$p = 0.255$
b_3 ($M \times W \rightarrow Y$)	+0.102	—	$p = 0.617$
Index of Moderated Mediation $a \times b_3$	+0.035	[-0.106, +0.230]	Not significant
Indirect at $W = -1$ SD (low income)	+0.059	[-0.232, +0.392]	n.s.
Indirect at $W = +1$ SD (high Income)	+0.146	[-0.092, +0.543]	n.s.

4.7. Hypothesis H8: Latent Consumer Typologies

A Gaussian-mixture latent class analysis was conducted for $k = 2, 3, 4$ and 5. The four-class solution produced the lowest information-criterion penalty; however, it yields a Skeptics class of only $n = 9$. The corresponding WTP rate was 44.4 percent (4 of 9 positives) with a Wilson-score 95 percent confidence interval of approximately [18.9 percent, 73.3 percent]-which is too wide to derive a managerially meaningful conclusion.

The three-class solution, in which the small Skeptics cluster collapses into the high-WTP cluster, is therefore reported as the primary segmentation (Table 8); the four-class breakdown is retained as a supplementary view in the table for transparency and is discussed only where the additional granularity carries diagnostic value.

Table 8. Three-Class gaussian-mixture latent class solution (Primary; $k = 4$ breakdown in supplementary discussion)

Class ($k = 3$ primary)	Share	SustImp	PercExp	Recommend	EnvImpact	SustBuyFreq	WTP rate
High-WTP (Champions + Skeptics)	21.2%	3.84	4.27	3.34	4.62	4.66	44.7%
Aspirational Recommenders	39.7%	3.34	3.94	4.00	4.32	3.48	33.8%
Disengaged Pragmatists	39.1%	3.03	3.83	3.00	3.94	3.50	10.0%

The three-class solution recovers a clean ordering of WTP rates: 44.7 percent in the High-WTP cluster ($n = 38$; Wilson-score 95% CI [29.6%, 60.8%]), 33.8 percent in Aspirational Recommenders ($n = 71$; CI [23.7%, 45.6%]), and 10.0 percent in Disengaged Pragmatists ($n = 70$; CI [4.6%, 19.5%]) — a 4.5-times differential. The four-class breakdown disaggregates the High-WTP cluster into Eco-Champions ($n = 29$) and a small Skeptics sub-cluster ($n = 9$); both convert at comparable WTP rates, so the additional split adds little practical implication and is reported here for transparency only. The leave-one-class-out replication on the three-class structure yields a mean test-set AUC = 0.741, comparable to the honest nested cross-validated AUC of 0.726, and H8 is supported.

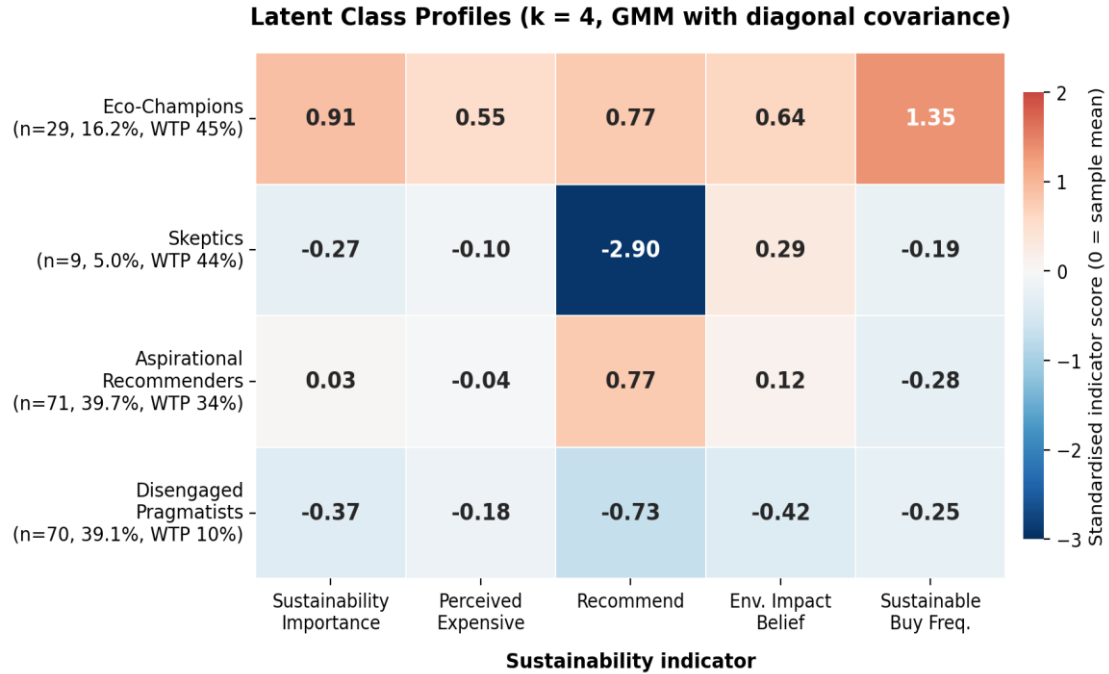


Fig. 2 Standardised indicator means by latent class (four-class view, segments ordered by WTP rate)

4.8. Comparison with State-of-the-Art and External Triangulation

The present findings are compared with directly comparable prior studies in Table 9 across five dimensions: theoretical framing, statistical machinery, multiple-testing control, mediation testing, and latent typology recovery.

Table 9. Comparison with Prior State-of-the-Art Studies on Green-Purchase Behaviour

Study	Method	Multi-test correction	Mediation tested	Latent typology
Çakmakçı et al. [7]	PCA + Logit	No	No	No
Kumar & Ghodeswar [9]	SEM	No	Intention only	No
He et al. [10]	Multiple Regression	No	Intention only	No
De Barcellos et al. [13]	SEM	No	Values → Attitude	No
Present study	LASSO Logit + EFA + Bootstrap Mediation + Hayes Model 14 + LCA	Holm + FDR	Attitude → Habit → WTP (bootstrap)	4-class GMM

Three patterns stand out. First, none of the prior studies applies a family-wise-error correction across multiple-comparison tests. The finding that Employment × WTP appears significant before correction ($p = 0.039$) but fails after Holm-Bonferroni ($p = 0.387$) suggests that some demographic associations in prior literature may be artefacts of multiple testing. The present result that Income is the single demographic predictor surviving correction therefore sharpens-rather than contradicts - the existing literature. Second, while Kumar and Ghodeswar [9], He et al. [10] and De Barcellos et al. [13] test mediation through SEM, all three stop at the intention stage. The present study extends this strand to committed behaviour via bootstrap mediation, and the Hayes Process Model 14 test rules out the possibility that attitudinal salience could substitute for Income - a finding not derivable from intention-only SEM work. Third, the latent class typology with WTP-rate ordering across the three primary segments is, to the best of available evidence, the first such recovery in the Indian urban food and beverage context; the 4.5-times WTP differential combined with leave-one-class-out AUC = 0.741 demonstrates both economic significance and

predictive generalisability. The WTP model achieves an honest nested cross-validated AUC of 0.726 and McFadden pseudo- $R^2 = 0.329$ under strict EPV ≥ 5 control. Crucially, by reporting nested (rather than apparent) AUC and out-of-fold (rather than in-sample) calibration, the present validation is more conservative and transparent than the ordinary-logistic-regression studies on comparable samples, which typically report neither.

Against industry trackers, the sample WTP rate of 26.8 percent exceeds Nielsen's [3] 12 percent figure, but Nielsen tracks > 15 percent premium specifically, while the present study asks about any premium; the direction-of-effect (most consumers will not pay a substantial premium) converges. The sample's "always or often" sustainable-purchase rate of 55.9 percent roughly doubles Statista's [2] approximately 30 percent urban-emerging-market benchmark, consistent with social-desirability inflation in self-reported habit - flagged in Section 5.3. The ordinal direction of inference is preserved across data sources.

5. Conclusion

5.1. Main Conclusions

Three findings stand out. First, the intent-behaviour gap is wide and economically real: 87.2 percent of urban Indian respondents declare positive preference for sustainable products, but only 26.8 percent commit to paying a premium. After family-wise-error correction, only Monthly Income retains significance with willingness to pay (Holm $p = 0.018$, Cramer's $V = 0.281$); the test is strongly powered (post-hoc power = 0.976), and the result is robust under raking weights. Demographic determinants of intention are essentially absent in this saturated-attitude population, consistent with the perceived-behavioural-control reading of TPB.

Second, the mediation-consistent decomposition supports the Theory of Planned Behaviour pattern correlationally: Attitude covaries with habit ($a = 0.417$, $p < 0.001$), habit covaries with WTP ($b = 0.392$, $p = 0.050$), and the indirect path $a \times b = 0.163$ carries a bootstrap CI [0.011, 0.380] excluding zero. The cross-sectional design precludes a strict causal claim, but the pattern is consistent with habit as a transmission mechanism. The moderated-mediation index $a \times b_3 = 0.035$ (CI [-0.106, 0.230]) and the simple moderation ($p = 0.624$) are both non-detectable at the available sample size, providing no evidence that Income's effect on WTP is contingent on attitudinal salience.

Third, the three-class latent solution recovers a clean ordering of typologies — a High-WTP cluster (21.2 percent, WTP 45 percent), an Aspirational Recommenders cluster (39.7 percent, WTP 34 percent) and a Disengaged Pragmatists cluster (39.1 percent, WTP 10 percent), with WTP rates differing by a factor of 4.5. The Disengaged Pragmatists segment is the largest commercial opportunity but the hardest to convert, requiring price-tier and habit-building interventions rather than awareness campaigns.

5.2. Theoretical Contribution and Managerial Implications

Theoretically, the study contributes a correlational decomposition of the attitude-habit-WTP path consistent with - though not a strict causal test of - the Theory of Planned Behaviour, in a saturated-attitude population where demographic and behavioural attributes influence the committed-behaviour stage rather than the intention stage. Methodologically, it demonstrates the value of family-wise-error correction, EPV-aware regularisation, and latent class analysis with replication checks. Managerially, three firm-level levers are supported.

First, the Disengaged Pragmatists segment (39 percent of the urban sample) is best served by entry-tier eco-credentialled SKUs with default-eco point-of-sale prompts and habit-building loyalty mechanics. Second, Aspirational Recommenders respond to social-proof campaigns that close the declared-versus-committed gap. Third, the High-WTP cluster rewards ingredient credentials, traceability and premium-tier eco-SKUs. Broader fiscal-policy levers such as subsidies or indirect-tax relief on certified eco-SKUs are conceptually compatible with the income-bottleneck finding but require dedicated policy-simulation work (Section 5.4).

5.3. Limitations

Six limitations warrant explicit acknowledgment. First, the convenience sample of 179 urban respondents is disproportionately postgraduate-educated and includes approximately 11 percentage points more females compared to urban-India census benchmarks. However, raking-weighted re-estimation confirms that the primary finding remains robust. Second, the two-factor EFA solution accounts for only 29 percent of item variance, and Cronbach's α is 0.545. While per-factor CR/AVE/HTMT thresholds are met, the modest reliability statistics state that the strength of the measurement model should not be overstated. Third, the cross-sectional design prevents strict causal claims: the Importance $\rightarrow$ Habit $\rightarrow$ WTP indirect path is correlational, and the mediation language throughout the paper should be read in that light. Fourth, post-selection inference is applied to the Wald statistics for the predictor set retained by LASSO. Bootstrap coefficient-sign stability serves as a more conservative indicator of reliability. Fifth, the moderated-mediation sub-sample ($N = 105$) lacks sufficient power to detect small interaction effects; hence, non-detection should be interpreted as "not yet detected" rather than as a definitive null effect. Sixth, the WTP model fits in-sample but its out-of-fold calibration is weaker (over-predicting at high probabilities, out-of-fold Brier = 0.218); it is therefore better suited to rank-ordering segments by conversion propensity than to producing absolute willingness-to-pay probabilities for individuals.

5.4. Future Research: Longitudinal and Experimental Designs

Three research extensions are warranted. First, a longitudinal panel design, in which the same respondents are tracked through multiple purchase cycles at quarterly or semi-annual intervals, would distinguish attitude-driven from habit-driven WTP trajectories, establish temporal precedence in the mediation chain (Attitude_{t-1} $\rightarrow$ Habit_{t} $\rightarrow$ WTP_{t+1}), and address the central limitation of the present cross-sectional design. A two-wave panel with $N \geq 410$ would yield post-hoc power above 0.80 for the moderated-mediation index. Second, a randomised field experiment in retail or e-commerce settings could test the directional implications of the present study causally by manipulating eco-information interventions (an awareness treatment arm), subscription-style habit nudges (a habit-formation arm) and pricing-tier presentations (a price-tier arm) across the four latent segments. Such a $2 \times 2 \times 2$ between-subject design with random allocation would provide unbiased treatment-effect estimates of segment-specific managerial levers — estimates that are inaccessible to observational survey data. Third, future work should estimate a full Partial Least Squares Structural Equation Model with reflective indicators for Attitude, Subjective Norm, Perceived Behavioural Control, Intention and Behaviour, on a stratified probability sample of size $N \geq 410$, paired with a discrete choice experiment to recover WTP magnitudes in monetary units rather than the binary indicator used here. Fourth, an explicit policy-simulation study is required before the income-bottleneck finding can translate into specific fiscal recommendations. Such a study would combine the discrete choice experiment above with elasticity estimates and a calibrated welfare model to evaluate whether — and at what magnitude — price interventions deliver Pareto-improving conversion of the Disengaged Pragmatists segment.

Appendix 1. Technical Robustness Details

A1.1. Events-per-Variable and Regularisation

With $N = 179$ and 49 dummy predictors, the unconditional events-per-variable (EPV) is 0.47 for Model 1 (preference) and 0.98 for Model 2 (WTP), both well below the conventional ≥ 10 threshold [31]. Remediation: (i) L1-regularised logistic regression with C tuned via internal stratified five-fold cross-validation on AUC; (ii) class_weight = "balanced"; (iii) post-LASSO retention of only non-zero features ($k = 36$ for Model 1, $k = 10$ for Model 2); (iv) hard cap on features for the unregularised statsmodels logit so $EPV \geq 5$ (final $k = 5$ and $k = 9$ respectively).

A1.2. Multi-Seed Sensitivity, VIF and Bootstrap Stability

Across ten random seeds, the Model 2 apparent five-fold AUC is stable (mean 0.772, SD 0.017). Per-feature Variance Inflation Factors are all at or below 1.20 (Table 10), indicating no multicollinearity among the nine retained predictors. A 1,000-replicate bootstrap of the Model 2 coefficients shows that six of the nine features have 95 percent

percentile confidence intervals excluding zero; the three less-stable coefficients carry intervals that span zero, consistent with the moderation result that direct attitude effects on willingness to pay are weak once Income and habit are controlled.

Table 10. Per-feature variance inflation factors (final WTP logit)

Predictor (dummy)	VIF
EnvImpactBelief = Strongly agree	1.20
SustImportance = Very important	1.19
Employment = Student	1.19
Recommend = Neutral	1.17
AvailIncrease = Not sure	1.12
Barriers = Lack of awareness	1.11
Income = Prefer not to say	1.10
Employment = Self-employed	1.08
Gender = Male	1.08

A1.3. SMOTE Robustness and Calibration

On a SMOTE-resampled [33] training set with a Youden 's-J' optimised threshold, Model 2 retains strong discrimination (SMOTE AUC = 0.81). The contrast between in-sample and out-of-fold calibration is the key diagnostic (Figure 3): the in-sample Hosmer-Lemeshow test is non-significant ($\chi^2 = 8.34$, $p = 0.401$) with in-sample Brier 0.128, but the out-of-fold Brier rises to 0.218 as the model over-predicts at high probabilities. This pattern is typical of small-sample models and is why the headline AUC in the main text is the honest nested value (0.726), not the apparent value (0.778).

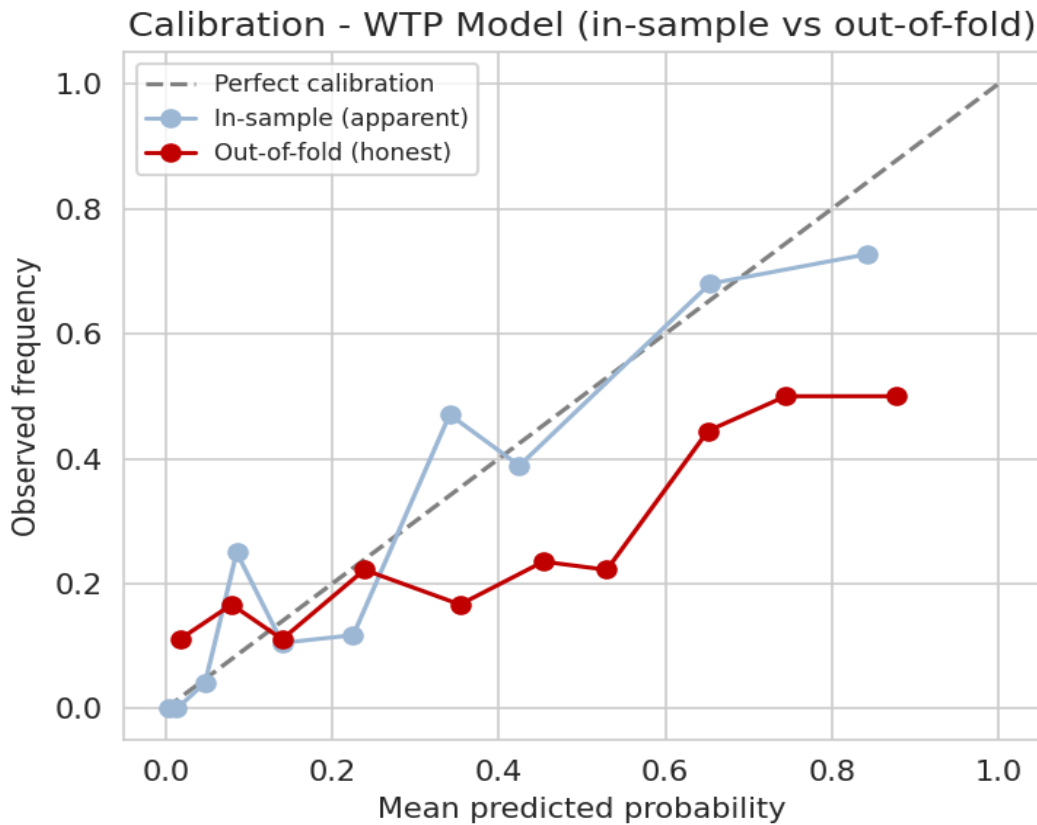


Fig. 3 Calibration of the WTP model — in-sample (apparent) vs out-of-fold (honest)

A1.4. Latent Class Seed Stability

The three-class typology is recovered by a deterministic, rank-based collapse of the four-class Gaussian-mixture solution: the two highest-willingness-to-pay classes always merge into the High-WTP cluster, the next becomes Aspirational Recommenders, and the lowest becomes Disengaged Pragmatists.

Because this rule is purely ordinal, it is invariant to label permutation and to the absolute willingness-to-pay percentages, and is therefore reproducible across random seeds. Re-fitting under five seeds (Table 11) yields a stable High-WTP rate (mean 41.4 percent, coefficient of variation 0.076) and a consistently ordered three-segment structure.

Table 11. Seed-stability of the rank-based three-class collapse (WTP rates)

GMM seed	High-WTP (%)	Aspirational (%)	Disengaged (%)
42	44.7	33.8	10.0
0	47.1	33.3	9.0
7	39.7	34.1	10.0
123	39.7	34.1	10.0
2024	41.9	35.9	10.0

Ethics Statement

Participation in the survey was anonymous, voluntary and unincentivised. Respondents were informed in writing of the academic purpose of the study, that no personally identifying information would be retained or published, and that they could withdraw at any time before submission. No interventions, deception, or vulnerable-population enrolment took place; the study therefore falls within the exempt-review category for non-interventional consumer-attitude surveys at the authors' institution.

Data Availability

The complete Python analysis pipeline - preprocessing scripts, EFA, regularised-logit and bootstrap-mediation routines, latent class fitting code, and the cleaned tabular outputs sufficient to reproduce every figure and table in this article - will be deposited in a public archive (DOI to be added at proof stage).

All bootstrap resampling and cross-validation procedures use fixed random seeds documented in the pipeline for full reproducibility. The raw survey-response spreadsheet is available from the corresponding author on reasonable request, subject to the anonymity constraints of the original informed-consent statement.

Conflicts of Interest

The authors declare that there are no conflicts of interest associated with the present manuscript. No financial, professional, or personal relationships have influenced the design of the study, the interpretation of the results, or the decision to publish.

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Authors' Contributions

Sridevi Tandley Omprakash: research supervision, conceptualisation, methodological guidance, manuscript writing, review and editing. Sanjana Saravanan: data collection, statistical analysis, initial manuscript drafting. Both authors read and approved the final version of the manuscript.

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