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Determinants of Purchase Intention Toward Beverages with Eco-Friendly Packaging: An Extended TPB-S-O-R Approach in Vietnam

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Abstract

Growing environmental concerns have intensified interest in sustainable packaging; however, consumer adoption of beverages with environmentally friendly packaging remains relatively low in developing markets. This study investigates the determinants of consumers' purchase intentions toward such beverages in Central Vietnam using the extended Theory of Planned Behaviour (TPB), integrated with the Stimulus–Organism–Response (S-O-R) framework. Data were collected from 475 consumers and analysed using structural equation modelling (SEM). The results indicate low consumer familiarity with eco-friendly packaging labels, such as the Forest Stewardship Council (FSC), Green Dot Logo, and Compostable Logos, and only moderate adoption of sustainable packaging materials, with particularly low willingness to purchase beverages in fully recycled packaging. SEM findings show that attitude, perceived behavioural control, and perceived consumer effectiveness are significant direct predictors of purchase intention. Subjective norms and perceived environmental packaging knowledge show positive but marginal direct effects, whereas packaging functions have no significant direct effect. Attitude and perceived behavioural control act as key mediators. The study highlights the need to strengthen consumer awareness, improve recognition of eco-labels, and enhance social and psychological support to promote the adoption of environmentally friendly beverage packaging.

Keywords: consumer; beverage packaging; purchase intention; environmentally friendly packaging; TPB-S-O-R framework; Vietnam

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1. Introduction

There has been increasing concern regarding the environmental sustainability of food packaging worldwide. Traditional food packaging, particularly conventional plastic-based packaging, continues to raise environmental concerns because it is often derived from petroleum-based resources, degrades slowly, contributes to pollution, and increases post-consumer plastic waste [1,2]. In the beverage sector, packaging waste has been reported to account for 4–48% of urban solid waste and 26% of marine debris [3]. This growing waste burden is tightly linked to the rapid expansion of the global beverage market, where the food and beverage packaging segment is projected to reach US$456.6 billion in 2027, marking the highest growth in the packaging sector [4]. Recent reviews show that sustainable and biodegradable food-packaging materials are increasingly viewed as

alternatives to conventional petroleum-based plastics because of their biodegradability, compostability, and potential to reduce carbon footprints [5].

In Vietnam, the food and beverage industry is identified as a major source of environmental pollution [6]. The World Bank (2021) estimates that Vietnam discharges about 3.1 million metric tons of plastic waste on land each year, while more than 60% of plastic items found at surveyed river and coastal sites were single-use plastics [7]. In these field surveys, take-away food packaging was the most abundant source of plastic waste, accounting for 44% of the items counted [7]. More specific evidence on single-use beverage containers shows that PET bottles and aluminium cans account for approximately 98% of the market share for single-use beverage containers in Vietnam, with estimated collection rates of 50% for PET bottles and 80% for aluminium cans [8]. However, much of the recovered material is downcycled into lower-value products, suggesting that beverage packaging remains a relevant environmental and waste-management issue in Vietnam [8].

The beverage sector provides a particularly important context for examining environmentally friendly packaging. In this study, beverages refer to fluids consumed by humans, including water and other beverages, such as tea, coffee, sugar-sweetened beverages, milk, fruit juices, and alcoholic drinks [9]. Beverage consumption in Vietnam has continued to increase due to rapid urbanisation, rising incomes, changing lifestyles, modern retail, and growing demand for convenience-oriented products. Food and beverage spending accounts for approximately 20% to 48% of household budgets in Vietnam [10]. The Vietnamese food and beverage market was valued at US$124.5 billion in 2024 and is projected to reach US$210.4 billion by 2032 [11]. In the beverage sector, Vietnam's beverage market is projected to grow at a compound annual growth rate of 4.7% during 2026–2035, while the non-alcoholic beverage segment is expected to grow at a higher rate of 5.3% [12]. Changing consumption patterns are also evident among younger consumers, with 36% of students in Ho Chi Minh City reported to consume at least one sugar-sweetened beverage daily [13]. At the same time, policy pressure on beverage consumption has increased, as Vietnam approved a roadmap in June 2025 to raise the special consumption tax on beer and strong liquor to 90% by 2031 and to introduce a new levy on sugar-sweetened drinks containing more than 5 g/100 mL of sugar, starting in 2027 [14]. These developments indicate that the beverage sector is expanding rapidly and becoming increasingly relevant to both market and policy discussions.

The rapid growth of beverage consumption increases demand for packaging, particularly single-use packaging, thereby adding pressure to existing waste-management systems. Packaging performs essential functions such as containment, protection, product promotion, and convenience [15]. However, under increased environmental pressures, recycling and minimising negative environmental impacts have become increasingly important alongside these traditional roles [15]. Consequently, the transition to sustainable packaging has become increasingly vital in the beverage sector.

In this study, environmentally friendly packaging refers to materials that are capable of being reused or recycled throughout their life cycle, from production to consumption and post-consumption, thereby minimising negative environmental impacts and ensuring safety for human health. Such packaging typically includes biodegradable, non-toxic, reusable, recyclable, or paper-based materials that align with circular economy principles [16–18].

Beverages were selected as the focus of this study because beverage packaging involves both product-use and post-consumption considerations that are especially relevant to environmentally friendly packaging. Prior research has examined beverage packaging in relation to consumers' pro-environmental purchase and disposal decisions [19], while deposit-refund systems have also been widely discussed as a mechanism for managing beverage packaging after consumption [3]. In addition, packaging performs key functions

related to containment, protection, product communication, convenience [15], and product safety [20]. These characteristics may shape how consumers evaluate environmentally friendly beverage packaging. Therefore, the beverage context provides a relevant setting to examine how environmental packaging knowledge, perceived consumer effectiveness, and perceived packaging functions influence purchase intention.

Although the environmental threats posed by traditional food and beverage packaging are widely recognised, consumer adoption of sustainable beverage packaging remains modest, particularly in developing countries [21]. Strengthening consumer willingness to purchase sustainably packaged beverages is therefore essential to bridge the gap between sustainable production efforts and market demand. In Vietnam, beverage-sector-specific evidence on plastic waste generation, eco-certification, and consumer adoption of sustainable beverage packaging remains limited. Given the rapid expansion of the food and beverage market and the projected growth of the beverage sector [11,12], greater attention is needed to understand consumer-side factors that may support the transition toward environmentally friendly beverage packaging.

Despite increasing attention to sustainable consumption, research on consumers' purchase intentions toward beverages with environmentally friendly packaging in Southeast Asia, especially in Vietnam, remains underexplored. While many studies applying the Theory of Planned Behaviour (TPB) include attitude, subjective norms, and perceived behavioural control as predictors of intention, prior research has primarily focused on attitude as the key mediating mechanism [22,23], giving less attention to whether perceived behavioural control also mediates the effects of antecedents on purchase intention. Moreover, contextual and perceptual influences, such as perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions, have been insufficiently examined in relation to attitude and perceived behavioural control.

To address these theoretical and empirical gaps, this study proposes an extended TPB framework integrated with the Stimulus–Organism–Response (S-O-R) model [24]. In this extended TPB-S-O-R approach, perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions are conceptualised as external stimuli. These stimuli shape internal psychological evaluations—attitude and perceived behavioural control—which, in turn, drive purchase intention toward beverages with environmentally friendly packaging. Additionally, the study examines whether attitude and perceived behavioural control mediate the relationships between these external stimuli and purchase intention. By doing so, the study provides a more comprehensive understanding of the psychological mechanisms underlying consumers' intentions to purchase beverages with environmentally friendly packaging.

This study contributes to the literature in three main ways. First, it extends TPB by integrating it with the S-O-R framework, thereby explaining how external perceptions of environmentally friendly beverage packaging shape internal psychological evaluations and purchase intention. Second, it examines both attitude and perceived behavioural control as mediating mechanisms, providing a clearer explanation of how perceived consumer effectiveness, environmental packaging knowledge, and packaging functions influence purchase intention. Third, by focusing on consumers in Central Vietnam, the study provides empirical evidence from a developing market context where environmentally friendly packaging is still emerging and where rapid growth in the beverage sector continues to intensify packaging-related environmental pressure [25]. The findings also offer useful implications for producers, retailers, and policymakers seeking to promote sustainable beverage packaging adoption.

The remainder of this paper is organised as follows. Section 2 reviews the background and develops the hypotheses. Section 3 describes the study methodology. The results are presented in Section 4. Section 5 provides a discussion, and Section 6 presents the conclusions of the study.

2. Conceptual Framework

2.1. Integration of the Theory of Planned Behaviour and Stimulus–Organism–Response Framework

Theory of Planned Behaviour (TPB) is widely used to assess the factors affecting purchase intention toward environmentally friendly products [26,27]. According to the TPB, attitude, subjective norms, and perceived behavioural control may affect purchase intention, which, in turn, determines purchase behaviour [28].

The TPB is built on three fundamental elements; however, its structure allows for the inclusion of additional variables to fit specific research contexts. It is emphasised that integrating relevant factors is important for enhancing its explanatory and predictive power [29]. In response, efforts have been made to expand the TPB through the inclusion of new factors, aiming to better capture purchase intentions in a particular context. The TPB has been widely applied across various fields, with numerous studies exploring its use in areas such as green product purchase, waste management, green eating behaviour, environmentally friendly packaging, and sustainable packaging [30–34].

An extended TPB framework was employed in this study to examine the determinants of purchase intention toward beverages with environmentally friendly packaging. The TPB provides a foundation for explaining consumers' behavioural intentions through attitude, subjective norms, and perceived behavioural control [28]. However, TPB has been criticised for its limited ability to account for contextual and perceptual influences that shape these cognitive evaluations. To strengthen its explanatory power, this study integrates the Stimulus–Organism–Response (S-O-R) framework [24] with TPB. Within this integrated approach, perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions are conceptualised as stimuli (S) that trigger consumers' internal psychological evaluations—attitude and perceived behavioural control (O). These evaluations subsequently drive the behavioural response (R), represented in this study by purchase intention toward beverages with environmentally friendly packaging.

The added value of incorporating the S-O-R framework lies in its ability to clarify the sequential psychological mechanism through which contextual perceptions influence behavioural intention. An extended TPB model can include additional predictors of intention, but it does not always specify whether these predictors function as external contextual stimuli or as internal psychological evaluations. In contrast, the S-O-R framework provides a clearer theoretical structure by distinguishing external stimuli from organismic states and behavioural responses. In this study, perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions are not treated merely as additional TPB predictors. Rather, they are conceptualised as stimulus factors related to consumers' perceptions of environmentally friendly beverage packaging. These stimuli are expected to shape attitude and perceived behavioural control, which represent internal evaluative and control-related states, before influencing purchase intention. Therefore, combining TPB and S-O-R allows the study to explain not only which factors influence purchase intention, but also how these factors are transmitted through consumers' psychological evaluations.

In this beverage-specific context, the three extended factors are specified to capture consumers' perceptions of environmentally friendly beverage packaging rather than general food packaging. Perceived consumer effectiveness reflects consumers' belief that choosing beverages with environmentally friendly packaging can contribute to environmental protection, reduce environmental problems, and conserve natural resources. Perceived environmental packaging knowledge captures consumers' perceived knowledge of environmentally friendly beverage packaging, including their ability to select packaging that reduces environmental waste and understand environmental phrases, labels, and symbols on beverage packages. Perceived packaging functions reflect consumers' evaluations of whether environmentally friendly beverage packaging can perform key packaging roles, including protecting the product, ensuring safety for health and consumption, and communicating product messages or attracting consumers' attention. By linking these beverage-related stimuli to attitude and perceived behavioural control, the model explains how consumers' perceptions of environmentally friendly beverage packaging are translated into purchase intention.

2.2. Research Questions

Based on the extended TPB-S-O-R framework, this study addresses the following research questions:

Research Question 1 (RQ1): Which TPB constructs and additional antecedents directly influence consumers' purchase intention toward beverages with environmentally friendly packaging?

Research Question 2 (RQ2): How do perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions indirectly shape purchase intention through attitude and perceived behavioural control?

2.3. Hypothesis Development

To address the research questions, the following hypotheses were proposed.

Subjective norms refer to social pressure or support from family and friends, or communities, that may influence the performance of a particular behaviour [28]. Subjective norms were found to have a positive effect on purchase intention toward organic products [26], green food [32], and ecological products [27]. In contrast, Kumar et al. (2017) [1] found no significant impact of subjective norms on purchase intention toward environmentally sustainable products. Based on the literature, the following hypothesis is set forth:

H1. *Subjective norms are positively associated with purchase intention toward beverages with environmentally friendly packaging.*

Attitude toward a behaviour indicates an individual's positive or negative evaluation of a particular behaviour [28]. Positive attitudes toward environmentally friendly behaviour are linked to higher purchase intentions toward sustainable products [35]. A more favourable attitude toward organic or ecological products correlates with higher purchase intention [1,27]. Positive attitude toward buying green products has been shown to significantly influence purchase intention toward green products [32], and a more positive attitude toward eco-friendly products is associated with higher purchase intention toward products with eco-friendly packaging [36,37]. Hence, the following hypothesis is proposed:

H2. *Attitude toward purchasing beverages with environmentally friendly packaging is positively associated with purchase intention toward beverages with environmentally friendly packaging.*

Perceived behavioural control refers to the perceived ease of execution of a particular behaviour given the availability of resources or opportunities [28]. Perceived behavioural control has been identified as a determinant of purchase intention toward ecological or sustainable products [27,35,38], and organic products [26]. Greater perceived behavioural control strengthens purchase intention toward products with environmentally friendly packaging [37]. In contrast, Wongsaichia et al. (2022) [32] found no significant impact of perceived behavioural control on purchase intention toward green food.

H3. *Perceived behavioural control is positively associated with purchase intention toward beverages with environmentally friendly packaging.*

Perceived consumer effectiveness refers to an individual's belief that their personal actions can contribute to environmental protection [39]. It was found to be a driver of purchase intention for ecological products [26,31,36,38] and is linked to the purchase of environmentally friendly products, including recycled materials [40]. In contrast, perceived consumer effectiveness was not found to significantly influence ecologically conscious buying behaviour [39]. Consequently, the following hypothesis is developed:

H4. *Perceived consumer effectiveness toward beverages with environmentally friendly packaging is positively associated with purchase intention toward beverages with environmentally friendly packaging.*

Having more knowledge about green packaging products may positively support purchase intentions [41]. Heo and Muralidharan (2017) [39] found a positive association between environmental knowledge and ecologically conscious buying behaviour. Knowledge also drives preference for products with green packaging [41] and plays an important role in shaping purchase intentions for sustainable packaging [34], though it was not a significant determinant of purchase intention for sustainable products [1]. As a result, the following hypothesis is formulated:

H5. *Perceived environmental packaging knowledge is positively associated with purchase intention toward beverages with environmentally friendly packaging.*

Packaging functions, such as safeguarding product quality and ensuring consumer health safety, are vital features affecting consumer preferences [20]. Packaging functions have also been found to positively affect purchase intention [41]. Given the importance of packaging in food and beverage choices, its impact on purchase intention should be investigated.

H6. *Perceived packaging functions of beverages with environmentally friendly packaging are positively associated with purchase intention toward beverages with environmentally friendly packaging.*

While TPB-based studies have examined purchase intention toward organic food and environmentally friendly products [26,27], and recent studies have investigated environmentally friendly or sustainable packaging in general [33,34], fewer studies have examined how perceived consumer effectiveness, environmental packaging knowledge, and packaging functions shape both perceived behavioural control and attitude in the context of beverages with environmentally friendly packaging. Within the integrated TPB-

S-O-R framework [24,28], these factors are conceptualised as external stimuli that influence consumers' internal psychological evaluations before shaping purchase intention.

Drawing on the TPB view of perceived behavioural control as perceived capability to perform a behaviour [42], perceived consumer effectiveness may enhance perceived behavioural control because consumers who believe that their choices can contribute to environmental protection may feel more capable of choosing beverages with environmentally friendly packaging [43]. It may also strengthen attitude, as consumers who perceive their actions as environmentally meaningful are more likely to evaluate sustainable products more positively [23]. Therefore, the following hypotheses are proposed:

H7a. *Perceived consumer effectiveness is positively associated with perceived behavioural control.*

H7b. *Perceived consumer effectiveness is positively associated with attitude.*

Perceived environmental packaging knowledge may help consumers better understand environmental claims, packaging labels, recyclability, and material-related information. Drawing on the TPB view of perceived behavioural control as perceived capability to perform a behaviour [42], such knowledge may increase perceived behavioural control by reducing uncertainty and enabling consumers to identify and choose beverages with environmentally friendly packaging more confidently [44]. It may also support more favourable attitudes because environmental knowledge has been shown to shape consumers' environmental attitudes and green purchase-related evaluations [22,45]. Therefore, the following hypotheses are proposed:

H8a. *Perceived environmental packaging knowledge is positively associated with perceived behavioural control.*

H8b. *Perceived environmental packaging knowledge is positively associated with attitude.*

Perceived packaging functions may also shape perceived behavioural control and attitude. In the beverage context, packaging functions are closely related to product containment, protection, and product communication [15], while safety is also an important concern in food and beverage packaging materials [20]. Beverage packaging is further associated with purchase and post-consumption disposal decisions [19]. From the TPB perspective, perceived behavioural control reflects consumers' perceived ease or difficulty in performing a behaviour and is influenced by factors that may facilitate or hinder behavioural performance [28,42]. Therefore, when environmentally friendly beverage packaging is perceived as functionally reliable, consumers may feel more capable of choosing such products because practical concerns about product protection, safety, usability, and product information are likely to be reduced. Functional reliability may also contribute to a more favourable attitude because environmentally oriented packaging still needs to satisfy traditional packaging functions, and consumption-supportive packaging functionality can enhance consumers' perceived product meaningfulness [46,47]. Therefore, the following hypotheses are proposed:

H9a. *Perceived packaging functions of beverages with environmentally friendly packaging is positively associated with perceived behavioural control.*

H9b. *Perceived packaging functions of beverages with environmentally friendly packaging is positively associated with attitude.*

In addition, this study proposes that perceived behavioural control and attitude may serve as partial mediators in the relationship between key antecedents—namely (1) perceived consumer effectiveness, (2) perceived environmental packaging knowledge, and (3) perceived packaging functions of beverages with environmentally friendly packaging—and consumers' purchase intention. Prior research shows that perceived consumer effectiveness may influence intention both directly and indirectly through attitudes, indicating a partial mediation effect [23]. Likewise, knowledge alone does not necessarily translate into pro-environmental intentions unless it first shapes fundamental evaluations such as attitude [22]. However, most prior studies have primarily focused on how perceived consumer effectiveness, knowledge, and packaging functions influence purchase intention via attitude as a mediator [22,23], while paying less attention to their effects on perceived behavioural control, which is also a key predictor of intention in the TPB. This gap is particularly notable in the context of beverages with environmentally friendly packaging, where perceived capability may play important roles in shaping purchase intention. To address this gap, the present study extends the TPB by investigating how these antecedents influence attitude and perceived behavioural control—rather than attitude alone. Given that few studies have examined these mediating effects within the context of environmentally friendly beverage packaging, this research seeks to address this gap. Accordingly, the following hypotheses are developed:

H10a. *Perceived consumer effectiveness has a positive indirect effect on purchase intention through perceived behavioural control.*

H10b. *Perceived consumer effectiveness has a positive indirect effect on purchase intention through attitude.*

H11a. *Perceived environmental packaging knowledge has a positive indirect effect on purchase intention through perceived behavioural control.*

H11b. *Perceived environmental packaging knowledge has a positive indirect effect on purchase intention through attitude.*

H12a. *Perceived packaging functions of beverages with environmentally friendly packaging have a positive indirect effect on purchase intention through perceived behavioural control.*

H12b. *Perceived packaging functions of beverages with environmentally friendly packaging have a positive indirect effect on purchase intention through attitude.*

The conceptual framework for the study is proposed in Figure 1 below:

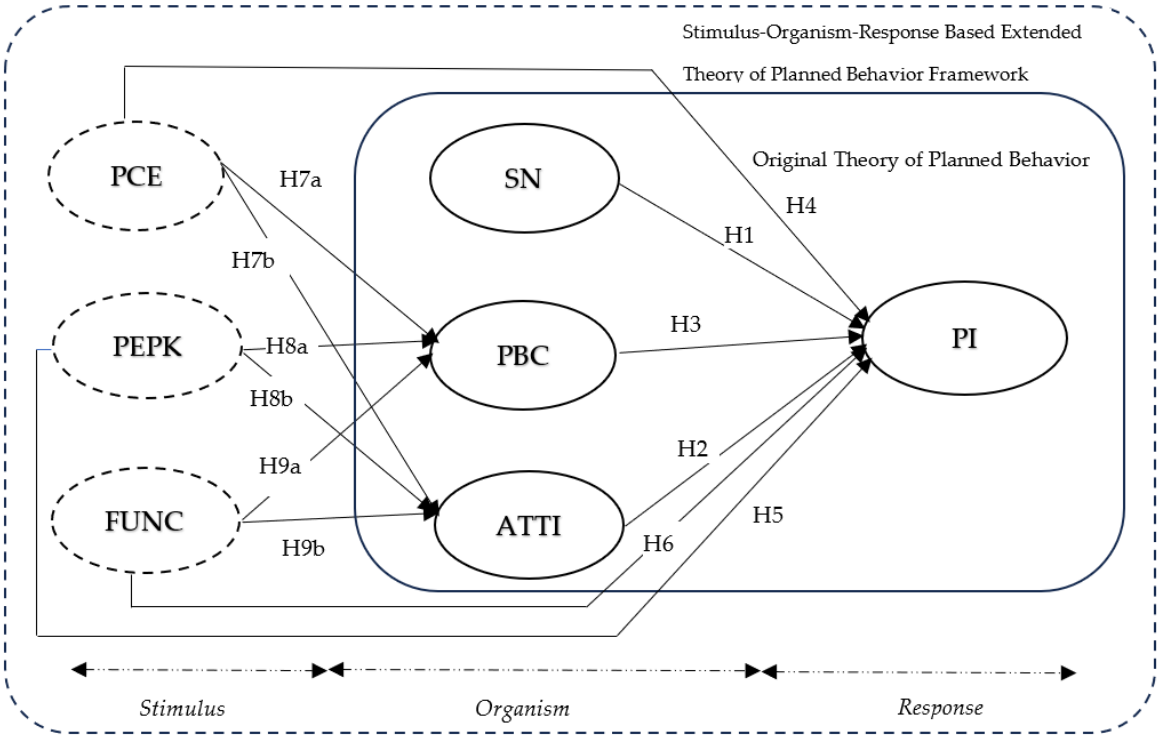

Figure 1. Conceptual framework of the study. Note. Indirect (mediated) effects. Via PBC: H10a: PCE → PBC → PI; H11a: PEPK → PBC → PI; H12a: FUNC → PBC → PI. Via ATTI: H10b: PCE → ATTI → PI; H11b: PEPK → ATTI → PI; H12b: FUNC → ATTI → PI. PI: Purchase intention; ATTI: Attitude toward purchasing beverages with environmentally friendly packaging; PBC: Perceived behavioural control; SN: Subjective norm; PCE: Perceived consumer effectiveness; PEPK: Perceived environmental packaging knowledge; FUNC: Perceived packaging functions.

3. Materials and Methods

3.1. Data Collection

Cross-sectional data were collected in January and February 2026 using an on-site consumer survey (n = 475) conducted in urban areas in Central Vietnam, including Hue, Quang Tri, Da Nang, and Gia Lai. A cross-sectional design was selected because it enables efficient assessment of behavioural intentions from a large group of consumers at a single point in time. A quota random sampling approach was employed to guide participant recruitment and to ensure that the sample reflected key demographic characteristics of the consumer population in the region. Within each province, common beverage purchasing environments such as supermarkets, shops, and local markets were randomly selected as sampling points. Quotas were established based on provincial population proportions as well as gender and age distributions to better align the sample with key population characteristics. The target sample size for each province was determined according to its population share in the regional population. Gender and age quotas were then considered within each province to improve the balance of key demographic groups. During fieldwork, enumerators monitored completed questionnaires by province, gender, and age group. Because updated GSO population statistics for the newly reorganised administrative units were not available at the time of sampling, quota allocation was based on the pre-reorganisation provincial units, including Thua Thien Hue, Quang Tri, Quang Binh, Da Nang, Quang Nam, Gia Lai, and Binh Dinh. These units were subsequently aggregated into the current study areas of Hue City, Quang Tri Province, Da Nang City, and Gia Lai Province for reporting purposes.

Eligible participants were consumers aged 16 years and above who had experience purchasing beverages. Participants were recruited at the entrances of supermarkets, shops, and local markets during different times of the day and across weekdays and weekends to improve consumer coverage and reduce sampling bias. They were briefly informed about the study without revealing the specific research topic to limit response bias. Participation was voluntary, and informed consent was obtained prior to the survey. For respondents aged 16–17, informed consent was obtained directly from the participants in accordance with local survey research norms. All ethical procedures ensured voluntary participation, anonymity, and the right to withdraw at any time. Respondents received a small incentive (50,000 VND) as compensation for their time and travel. The socioeconomic characteristics of the participants are presented in Table 1. More than 42% of the participants were male. Approximately 58% of the participants had completed high school or higher. More than 50% of the participants had a monthly income of 5 million VND and above.

Table 1. Socioeconomic characteristics of the sample.

Items	Sample (Percent)	Study-Area Population Statistics (Percent)
Gender		
Male	42.3	49.9 [a]
Female	57.7	50.1 [a]
Age		
≤40	54.3	54.7 [a]
>40	45.7	45.3 [a]
Education		
High school and lower	42.3	45.9 [a]
Above high school	57.7	54.1 [a]
Household monthly income		
Up to 5 million VND	49.5	-
>5 million VND	50.5	-

Note: [a] GSO (2020) [48].

3.2. Measures

The constructs of TPB and the extended factors were adapted from literature related to consumer behaviour toward environmentally friendly products. The measurements of the items are presented in Table 2. Adapted from Fishbein and Ajzen (1975) [49], Nolan et al. (2008) [50], and Van Birgelen et al. (2009) [19], subjective norms were investigated using three items. Similar to Ajzen (2002) [42], perceived behavioural control (PBC) was measured using a three-item scale. We adapted a three-item scale for perceived consumer effectiveness from Ellen et al. (1991) [43] and Jaiswal and Kant (2018) [51]. Perceived environmental packaging knowledge was assessed using a scale similar to that of Mostafa (2007) [45], Fenta et al. (2024) [52], and Jaiswal and Kant (2018) [51]. The perceived quality of the packaging, or the packaging functions of beverages with eco-friendly packaging, was evaluated using a scale adapted from Kassaye and Verma (1992) [46] and Rettie and Brewer (2000) [53]. All statements were measured on a 7-point interval scale from 1 = totally disagree to 7 = totally agree. Attitude was measured using a 7-point semantic differential scale. Participants were presented with the statement, "Please indicate how you feel while purchasing beverages with environmentally friendly packaging?". The bipolar adjectives were extremely negative/extremely positive, extremely unpleasant/extremely pleasant, and strongly against/strongly for, a commonly used scale for assessing attitude [54].

Table 2. Description of measurement items.

Factor		Item Description	Sources
Subjective norm (SN)	SN1	People in my circle of friends encourage and highly value my decision to purchase beverages with environmentally friendly packaging	[19,49,50]
	SN2	My family encourages and highly values my decision to purchase beverages with environmentally friendly packaging	
	SN3	People in my community encourage and highly value my decision to purchase beverages with environmentally friendly packaging	
Perceived behavioural control (PBC)	PBC1	If I want, I can buy beverages with environmentally friendly packaging instead of those with conventional ones	[42]
	PBC2	I think it is possible (easy) to buy beverages with environmentally friendly packaging	
	PBC3	I can consider and control the purchase of beverages with environmentally friendly packaging	
Attitude toward behaviour (ATTI)		Please indicate how you feel while purchasing beverages with environmentally friendly packaging?	[54]
	ATTI1	Extremely negative → Extremely positive	
	ATTI2	Extremely unpleasant → Extremely pleasant	
	ATTI3	Strongly against → Strongly for	
Perceived consumer effectiveness (PCE)	PCE1	I believe that choosing beverages with environmentally friendly packaging can have a positive effect on environmental protection	[43,51]
	PCE2	Individual consumers' choices of environmentally friendly beverage packaging can help reduce environmental problems	
	PCE3	I believe that purchasing beverages with environmentally friendly packaging can contribute to conserving natural resources	
Perceived Environmental Packaging Knowledge (PEPK)	PEPK1	I am very knowledgeable about environmentally friendly beverage packaging	[45,51,52]
	PEPK2	I know how to select beverage products with packaging that reduces environmental waste	
	PEPK3	I understand the environmental phrases, labels, and symbols on beverage packaging	
Function (FUNC)	FUNC1	I think that beverage packaging with environmentally friendly materials can protect the product inside like the ones with conventional materials	[46,53]
	FUNC2	I think beverage packaging with environmentally friendly materials is safe for human health and consumption	
	FUNC3	I think beverage packaging with environmentally friendly materials can convey the message of product and attract consumers' attention like conventional packaging materials.	
Purchase intention (PI)		It is [. . .] that I will purchase beverages with environmentally friendly packaging.	[55,56]
	PI1	Unlikely → Likely	
	PI2	Improbable → Probable	
	PI3	Impossible → Possible	

Note. All items were measured on a 7-point scale. Subjective norm, perceived behavioural control, perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions were measured from 1 = totally disagree to 7 = totally agree. Attitude and purchase intention were measured using 7-point semantic differential scales.

Adapted from MacKenzie et al. (1986) [55] and Michaelidou and Hassan (2008) [56], purchase intention toward beverages with environmentally friendly packaging was measured using a 7-point semantic differential scale. The bipolar adjectives used were improbable/probable, impossible/possible, and unlikely/likely.

3.3. Data Analysis

Statistical analyses were performed using SPSS 22.0 (SPSS Inc., Chicago, IL, USA) and STATA 15.0 [57]. Before SEM estimation, the dataset was screened for incomplete responses and missing values. Only valid and complete questionnaires were retained for the final analysis. The distributions of the observed items were examined using skewness and kurtosis, and the results indicated that the assumption of normality was not violated.

The study assessed common method bias [58,59] and conducted Pearson's bivariate correlation analysis to examine the relationships among the variables. To reduce potential common method bias, several procedural remedies were applied during the questionnaire design and data collection. Participation was voluntary and anonymous, and respondents were informed that there were no right or wrong answers. The specific research hypotheses were not disclosed during the survey in order to reduce response bias. In addition, different response formats were used for key constructs. While most antecedent variables were measured using a 7-point agreement scale, attitude and purchase intention were measured using 7-point semantic differential scales. These procedures were adopted to reduce social desirability bias and common response patterns. Harman's single-factor test was then used as an additional diagnostic check [58,59].

A two-step approach was applied, consisting of the evaluation of the measurement model followed by the structural model [60,61]. For the measurement model, the internal reliability consistency of the multi-item scales was evaluated using Cronbach's α, with a threshold exceeding 0.7 demonstrating acceptable internal consistency [61]. To determine adequate convergent validity, the average variance extracted (AVE) was applied, which should surpass a value of above 0.5, across all constructs [62].

Next, the structural equation model (SEM) was used with the robust maximum likelihood estimation method in STATA 15.0. The SEM parameters were then derived, and the goodness-of-fit indices were appraised using the following indices: Root Mean Square Error of Approximation (RMSEA), Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Standardised Root Mean Square Residual (SRMR), and Coefficient of Determination (CD). The evaluation of an adequate model fit involved examining several measures, aiming for RMSEA and SRMR values of less than 0.08, CFI and TLI values higher than 0.90 [61], while a CD value of 1 represents a perfect fit [57].

The study further investigates whether perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions indirectly influence purchase intention through the two psychological constructs of the TPB, namely attitude and perceived behavioural control. To assess these mediation effects, a product-of-coefficients approach was employed using Stata 15.0. Consistent with the framework proposed by MacKinnon et al. (2007) [63], the indirect effects were estimated. The nlcom command was applied to calculate the indirect effects and to obtain standard errors and confidence intervals based on the delta method, following the approach introduced by Sobel (1982) [64]. Additionally, to improve the robustness of the estimates and account for potential non-normality, a nonparametric bootstrap procedure with 5000 replications was conducted to generate bias-corrected 95% confidence intervals for each mediating path [65]. This approach is widely used for testing mediation effects and helps clarify the indirect pathways through which consumer perceptions are associated with purchase intention.

In addition, descriptive statistics were used to describe consumers' familiarity with eco-friendly logos on product packaging, their access to various types of environmentally friendly packaging materials while purchasing beverages, and their willingness to purchase beverages with recycled packaging.

4. Results

4.1. Familiarity with Eco-Friendly Logos on Beverage Packaging

Participants were presented with a number of eco-friendly logos related to beverage packaging and asked about their familiarity (Table 3). More than half were extremely familiar with the recycling logo, while approximately 78% recognised the garbage disposal logo. Nearly half identified the plastic recycling (PET) symbol. Nevertheless, only 31.8% knew the Forest Stewardship Council (FSC) logo, which certifies sustainable wood-based packaging. The Green Dot Logo, indicating financial contributions to recycling, was familiar to 32% of participants. The compostable packaging logo, requiring compliance with EN 13432 standards [66], was recognised by 33.9%. In general, consumers were familiar with some eco-friendly logos but less aware of others on beverage packaging.

Table 3. Familiarity with eco-friendly logos on beverage packaging (%).

Logo Description		Not at All Familiar	Slightly Familiar	Moderately Familiar	Familiar	Extremely Familiar
Recycling logo		3.2	5.7	13.5	27.6	50.1
Plastic recycling/PET symbol		7.6	15.2	28.4	23.8	25.1
Garbage disposal/Tidyman logo		0.4	1.1	7.4	13.1	78.1
Forest Stewardship Council (FSC) logo		14.7	23.2	30.3	19.6	12.2
Green Dot logo		15.6	23.6	28.8	18.7	13.3
Compostable packaging logo		16.0	22.3	27.8	21.3	12.6

4.2. Access to the Different Types of Environmentally Friendly Packaging

There are various types of environmentally friendly packaging materials, such as biodegradable materials, paper-based materials, metals, glass, and other eco-friendly materials. Consumers were asked how often they purchased beverage products with various types of eco-friendly packaging (Table 4).

Table 4. Access to the various types of environmentally friendly packaging material types while purchasing beverages.

Packaging Material Type [1]	Mean	Standard Deviation
Biodegradable plastic	5.44	2.67
Paper and cardboard	5.65	2.57
Metal	4.52	2.86
Glass	4.14	2.94
Ceramics and other materials	3.25	3.09

Note. [1] Respondents were asked: "Out of 10 times that you buy beverages, how often do you choose beverages with the following packaging materials?" Higher mean values indicate more frequent purchases of beverages using that packaging material.

The results show that consumers purchase beverage products packed in paper-based materials relatively often, with a score of 5.65/10. Consumers also reported relatively frequent purchases of beverages packaged in biodegradable plastic, with a mean score of 5.44 out of 10. The frequency of purchasing beverages with metal and glass packaging is less than often, with ratings of 4.52/10 and 4.14/10, respectively. The purchase frequency of beverages packaged in other materials was relatively low, with an average score of 3.25 out of 10.

4.3. Willingness to Purchase Beverages with Recycled Packaging

The willingness to buy beverages with recycled packaging is shown in Table 5. The majority of consumers (over 36%) were willing to purchase beverages with 50% recycled materials in their packaging. More than 19% of consumers were willing to purchase beverages with 75% recycled content in their packaging. Only more than 17% of consumers were willing to buy beverages with packaging made entirely (100%) from recycled materials. More than 8% refused to purchase beverages with recycled materials in their packaging.

Table 5. Consumers' willingness to purchase beverages by recycled packaging content.

Degree of Recycling (or Packaging Material Circulation)	%
0% recycled, all packaging materials are made from completely new materials	8.6
25% recycled, or 25% of packaging materials are made from recycled materials	18.1
50% recycled, or 50% of packaging materials are made from recycled materials	36.3
75% recycled, or 75% of packaging materials are made from recycled materials	19.6
100% recycled, the entire packaging materials are made from recycled materials	17.3

4.4. Factors Affecting the Intention to Purchase Environmentally Friendly Packaged Beverages

To assess potential common method bias, the study applied both procedural remedies and a statistical diagnostic check. During questionnaire design and data collection, several procedural remedies were adopted, including anonymous and voluntary participation, non-disclosure of the specific research hypotheses, and the use of different response formats for key constructs. In addition, Harman's one-factor test was performed. The results showed that the single factor explained 43.23% of the total variance, which is below the commonly used 50% threshold. These results indicate that common method bias is unlikely to be a concern. The correlation coefficients between the variables were assessed. All correlation coefficients were significantly below 0.7, indicating no concern for multicollinearity in the present data [67].

Exploratory factor analysis (EFA) was performed for the proposed scale (Table 6). The KMO value was acceptable. There were no cross-loadings of concern (i.e., equal to or above 0.4 [61]). The factor-loading value of each variable was greater than 0.5. The results of the rotation matrix show that the observed variables were initially grouped into six groups,

corresponding to six factors. The initial eigenvalues satisfied this requirement. The total variance extracted was greater than 50%.

Table 6. Results of the exploratory factor analysis.

Items	Factor Loading					
	1	**2**	**3**	**4**	**5**	**6**
FUNC1	0.917					
FUNC2	0.907					
FUNC3	0.897					
ATT1		0.908				
ATT3		0.863				
ATT2		0.858				
PBC2			0.891			
PBC1			0.859			
PBC3			0.857			
PCE1				0.821		
PCE3				0.807		
PCE2				0.750		
SN2					0.804	
SN3					0.781	
SN1					0.773	
PEPK2						0.858
PEPK1						0.845
PEPK3						0.777

The corresponding confirmatory factor analysis (CFA) was performed to validate the full measurement model, including the six antecedent constructs and the dependent construct, purchase intention. Standardised factor loadings, reliability, and validity estimates were evaluated (Table 7). The individual item loadings for the constructs were highly significant, with values between 0.675 and 0.948. The reliability estimates (i.e., Cronbach's alpha) for the constructs ranged from 0.862 to 0.957, indicating proper internal consistency [61]. In addition, the composite reliability (CR) values ranged from 0.866 to 0.958, exceeding the recommended threshold of 0.7. Furthermore, convergent validity was satisfied, with the average variance extracted (AVE) values for all constructs exceeding the threshold of 0.5 [62]. Therefore, the results fulfil the criteria for the convergent validity of the internal constructs in the proposed model [61]. All the variance-extracted estimates in the model were greater than the corresponding inter-construct squared correlation estimates. Hence, the constructs in the model satisfy the criteria for discriminant validity. The CFA results showed that the model performed well, as supported by the satisfactory goodness-of-fit indices: X^2 = 193.624, df = 168, X^2/df = 1.153; RMSEA = 0.018, SRMR = 0.028, CFI = 0.996, TLI = 0.995, and CD = 1.000. The results confirmed the theoretical constructs of the items included in the model.

Based on the CFA, a structural model was developed to analyse the factors that affect purchase intention toward beverages with environmentally friendly packaging (Table 8). The model performed well, as supported by the goodness-of-fit indices: X^2 = 306.336, df = 171, X^2/df = 1.791, RMSEA = 0.041, SRMR = 0.050, CFI = 0.983, TLI = 0.979, and CD = 1.000.

Table 7. Results of the confirmatory factor analysis.

	Standardised Factor Loading	SE	*p*-Value	Cronbach's Alpha	CR	AVE
Subjective norm				0.866	0.866	0.683
SN1	0.890	0.020	<0.001			
SN2	0.775	0.027	<0.001			
SN3	0.811	0.023	<0.001			
Perceived behavioural control				0.918	0.918	0.789
PBC1	0.911	0.017	<0.001			
PBC2	0.881	0.020	<0.001			
PBC3	0.872	0.023	<0.001			
Attitude toward behaviour				0.919	0.919	0.792
ATTI1	0.896	0.026	<0.001			
ATTI2	0.867	0.023	<0.001			
ATTI3	0.906	0.018	<0.001			
Perceived environmental packaging knowledge				0.875	0.877	0.705
PEPK1	0.886	0.018	<0.001			
PEPK2	0.919	0.021	<0.001			
PEPK3	0.675	0.036	<0.001			
Perceived consumer effectiveness				0.862	0.871	0.695
PCE1	0.769	0.030	<0.001			
PCE2	0.849	0.022	<0.001			
PCE3	0.896	0.017	<0.001			
Packaging function				0.957	0.958	0.883
FUNC1	0.944	0.009	<0.001			
FUNC2	0.948	0.008	<0.001			
FUNC3	0.927	0.013	<0.001			
Purchase intention				0.889	0.892	0.733
PI1	0.813	0.030	<0.001			
PI2	0.884	0.023	<0.001			
PI3	0.870	0.020	<0.001			

Note. X^2 = 193.624, df = 168, X^2/df = 1.153, RMSEA = 0.018, SRMR = 0.028, CFI = 0.996, TLI = 0.995, and CD = 1.000.

Table 8. Path coefficients and hypothesis testing (direct effects).

Hypothesis	Path	Path Coefficient	SE	z-Value	*p*-Value	95% CI	Result
H1	SN → PI	0.106 *	0.0567	1.88	0.060	[−0.0046; 0.2175]	Marginally Supported
H2	ATTI → PI	0.407 ***	0.0434	9.36	0.000	[0.3217; 0.4920]	Supported
H3	PBC→ PI	0.335 ***	0.0448	7.48	0.000	[0.2475; 0.4233]	Supported
H4	PCE → PI	0.116 **	0.0585	1.99	0.047	[0.0017; 0.2310]	Supported
H5	PEPK → PI	0.078 *	0.0401	1.95	0.051	[−0.0002; 0.1568]	Marginally Supported
H6	FUNC → PI	0.034	0.0418	0.81	0.417	[−0.0480; 0.1160]	Not supported
H7a	PCE → PBC	0.433 ***	0.0515	8.42	0.000	[0.3325; 0.5343]	Supported
H7b	PCE → ATTI	0.527 ***	0.0497	10.61	0.000	[0.4300; 0.6249]	Supported
H8a	PEPK → PBC	0.228 ***	0.0436	5.22	0.000	[0.1422; 0.3133]	Supported
H8b	PEPK → ATTI	−0.002	0.0446	−0.04	0.969	[−0.0892; 0.0857]	Not supported
H9a	FUNC → PBC	0.096 *	0.0517	1.85	0.064	[−0.0055; 0.1971]	Marginally Supported
H9b	FUNC → ATTI	0.111 **	0.0518	2.14	0.033	[0.0092; 0.2122]	Supported

Note. *** $p < 0.001$, ** $p < 0.05$, * $p < 0.1$; X^2 = 306.336, df = 171, X^2/df = 1.791, RMSEA = 0.041, SRMR = 0.050, CFI = 0.983, TLI = 0.979, and CD = 1.000.

4.4.1. Direct Effects

The direct-effect results show that attitude, perceived behavioural control, and perceived consumer effectiveness are significant predictors of purchase intention. Subjective norms and perceived environmental packaging knowledge also show positive effects, but these effects are only marginally significant and are not robustly supported by the 95% confidence intervals. Perceived packaging functions do not directly influence purchase intention. Regarding the mediators, perceived consumer effectiveness significantly affects both perceived behavioural control and attitude, while perceived environmental packaging knowledge affects perceived behavioural control but not attitude. Perceived packaging functions significantly affect attitude, whereas their effect on perceived behavioural control is positive and marginally significant but not robustly supported by the 95% confidence interval.

4.4.2. Mediating Effects

The study further explores the mediating effects of perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions through attitude and perceived behavioural control on purchase intention (Table 9, Figure 2). Mediation was tested following the approach described in the Data Analysis section. Indirect effects were interpreted based on whether the 95% bias-corrected bootstrap confidence intervals excluded zero, indicating statistically significant mediation [65].

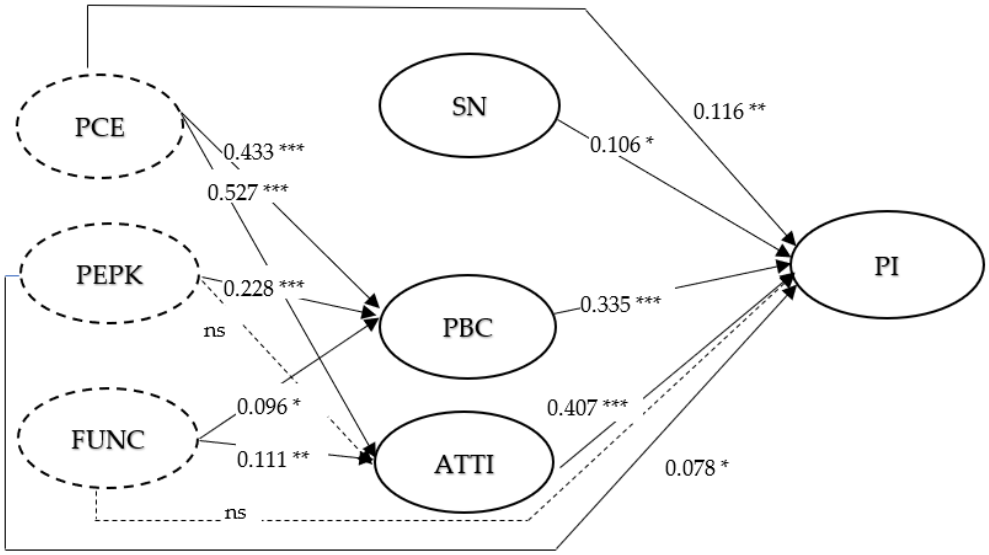

Figure 2. Illustration of the direct and mediated effects. Note. Values shown on the arrows are direct path coefficients. Indirect effects were estimated using a bootstrap mediation procedure with 5000 resamples and are presented separately by mediating pathway. Indirect effects via PBC: H10a: PCE → PBC → PI = 0.1710 ***. H11a: PEPK → PBC → PI = 0.0731 ***. H12a: FUNC → PBC → PI = 0.0242 * (not robustly supported by the 95% bootstrap CI). Indirect effects via ATTI: H10b: PCE → ATTI → PI = 0.2525. *** H11b: PEPK → ATTI → ns. H12b: FUNC → ATTI → PI = 0.0339 **. *** $p < 0.001$, ** $p < 0.05$, * $p < 0.10$; ns = not significant. Robust mediation was assessed based on the 95% bootstrap confidence intervals reported in Table 9.

The analysis revealed several significant indirect effects. Perceived consumer effectiveness had significant indirect effects through both perceived behavioural control and attitude. Perceived environmental packaging knowledge had a significant indirect effect through perceived behavioural control, but not through attitude. Perceived packaging functions had a significant indirect effect through attitude, whereas the indirect effect through perceived behavioural control was not robustly supported.

Table 9. Mediating effects of PBC and ATTI.

	Path	Coefficient	SE	*p*-Value	Bootstrap 95% CI	
					Lower Limit	Upper Limit
H10a	PCE → PBC → PI	0.1710 ***	0.0325	0.000	0.1074	0.2347
H10b	PCE → ATTI → PI	0.2525 ***	0.0398	0.000	0.1745	0.3305
H11a	PEPK → PBC → PI	0.0731 ***	0.0175	0.000	0.0387	0.1075
H11b	PEPK → ATTI → PI	−0.0007	0.0174	0.969	−0.0347	0.0334
H12a	FUNC → PBC → PI	0.0242 *	0.0136	0.074	−0.0024	0.0507
H12b	FUNC → ATTI → PI	0.0339 **	0.0164	0.039	0.0017	0.0661

Note. *** $p < 0.001$, ** $p < 0.05$, * $p < 0.10$.

5. Discussion

This section discusses how the findings address the two research questions and contribute to advancing the extended TPB-S-O-R framework in the context of environmentally friendly beverage packaging.

Addressing the first research question (RQ1), the findings confirm that subjective norms, perceived behavioural control, and attitude are the primary determinants of purchase intention toward beverages with environmentally friendly packaging. This supports the TPB assumption [28] that favourable evaluations, perceived social expectations, and perceived behavioural control play a central role in shaping behavioural intentions [68]. Consumers are therefore more likely to choose sustainable packaging when they feel social encouragement, confidence in their ability to buy such products, and positive attitudes toward eco-friendly packaging. These direct-effect results should be interpreted with different levels of strength. Attitude, perceived behavioural control, and perceived consumer effectiveness have significant positive direct effects on purchase intention. By contrast, subjective norms and perceived environmental packaging knowledge show positive effects that are only marginally significant and are not robustly supported by the 95% confidence intervals; therefore, they should be interpreted with caution. This suggests that social influence and packaging knowledge may contribute to purchase intention, but their direct roles are weaker. Taken together, the direct-effect pattern indicates that functional attributes alone may not be sufficient to motivate consumers to choose beverages with environmentally friendly packaging.

Perceived consumer effectiveness also contributes to this process. Its direct impact on purchase intention is statistically significant, and it also exerts meaningful indirect effects by strengthening attitude and perceived behavioural control, which in turn drive purchase intention. This aligns with prior research showing that when consumers believe their actions can make a difference, they are more likely to behave sustainably [43,69]. Hence, targeted communication strategies that highlight the environmental contribution of individual choices through clear labelling and credible sustainability messaging across marketing channels may further reinforce pro-environmental purchase behaviour.

Alongside perceived consumer effectiveness, perceived environmental packaging knowledge has only a marginally significant direct effect on purchase intention, but it has a significant indirect effect through perceived behavioural control. This pattern suggests that knowledge does not automatically translate into purchase intention; rather, its influence becomes stronger when it enhances consumers' perceived capability to perform the behaviour. From the TPB perspective, perceived behavioural control reflects the perceived ease or difficulty of performing a behaviour [28,42]. In the context of environmentally friendly beverage packaging, environmental knowledge may support environmentally conscious consumption, as it has been identified as an important predictor of environmentally conscious consumer behaviour [39]. More specifically, clearer product labelling

may provide product-specific information that strengthens perceived behavioural control and purchase intention [44]. Thus, packaging-related knowledge may reduce uncertainty and make consumers feel more capable of identifying and choosing beverages with environmentally friendly packaging. The non-significant pathway through attitude further suggests that such knowledge functions more as practical decision-support information than as a source of more favourable attitudes toward these products. Therefore, firms should provide clear and transparent packaging information to support consumers' ability to make environmentally friendly beverage choices.

Further addressing the second research question (RQ2), the results indicate that perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions influence purchase intention indirectly through attitude and perceived behavioural control. The mediation analysis shows that perceived consumer effectiveness and perceived environmental packaging knowledge have significant indirect effects via perceived behavioural control, whereas the indirect effect of perceived packaging functions via perceived behavioural control is positive but not robustly supported by the 95% confidence interval. These findings provide partial support for the hypothesised mediation and highlight the importance of TPB constructs, particularly attitude and perceived behavioural control, as key psychological mechanisms linking external perceptions to behavioural intentions.

Perceived consumer effectiveness retains a significant direct effect on purchase intention while also indirectly influencing intention through attitude and perceived behavioural control, indicating a partial mediation effect. This is consistent with prior evidence suggesting that perceived consumer effectiveness can strengthen intention through its influence on internal evaluations such as attitude [23]. When consumers believe their actions can meaningfully contribute to environmental protection, they may develop more favourable attitudes and feel greater capability to make sustainable choices [44], which collectively enhance their intention to choose beverages with environmentally friendly packaging.

Perceived environmental packaging knowledge demonstrates a similar mediated pattern. Although its direct effect on purchase intention is only marginally significant (H5), it exerts a significant positive effect on perceived behavioural control (H8a) (Table 8), which, in turn, significantly mediates its impact on purchase intention (Table 9). In contrast, the indirect pathway through attitude is not supported. These findings suggest that knowledge alone may not be sufficient to directly drive purchase intention; rather, its influence operates primarily through enhancing consumers' perceived behavioural control. In other words, consumers are more likely to develop stronger purchase intentions for environmentally friendly packaged beverages when their perceived knowledge increases their confidence in making such choices.

Perceived packaging functions do not have a significant direct effect on purchase intention (H6). However, they have a significant positive effect on attitude (H9b), whereas their effect on perceived behavioural control (H9a) is positive and marginally significant but not robustly supported by the 95% confidence interval (Table 8). The mediation results further show that the indirect effect of perceived packaging functions through attitude is significant, while the pathway through perceived behavioural control should be interpreted with caution because it is not fully supported by the bootstrap confidence interval (Table 9). These findings suggest that perceived packaging functions influence purchase intention mainly by shaping consumers' favourable attitudes rather than through a direct pathway or through perceived behavioural control.

Prior packaging research suggests that consumption-supportive packaging functionality can influence purchase intentions through perceived product meaningfulness [47]. In the present beverage packaging context, however, functional attributes such as product

protection, safety, and product communication may be viewed as basic expectations rather than independent drivers of purchase intention. These attributes may help consumers evaluate the packaging more positively, but they may not be sufficient by themselves to translate into purchase intention. The Vietnamese market context may further explain this result. As environmentally friendly beverage packaging is still developing, consumers may view product protection, safety, and product communication as basic requirements rather than as sufficient reasons for purchase. Limited familiarity with eco-labels and practical difficulties in identifying suitable products may also reduce the direct persuasive role of packaging-function claims. Therefore, functional attributes may improve attitudes, but they may not directly translate into purchase intention unless they are supported by credible labels, clear information, and accessible product options. Accordingly, implications related to packaging functions should be interpreted with caution. Firms may communicate functional benefits as supportive information to strengthen favourable attitudes, rather than as the main persuasive message.

A comparison of the two mediating pathways provides further insight into the practical significance of the model. As shown in Table 9, the attitude-mediated effect is stronger than the perceived behavioural control-mediated effect for perceived consumer effectiveness. This suggests that consumers' belief in the environmental impact of their individual choices mainly increases purchase intention by strengthening favourable evaluations of environmentally friendly beverage packaging. For perceived environmental packaging knowledge, however, the perceived behavioural control-mediated pathway is the only significant indirect pathway, indicating that knowledge influences intention mainly when it increases consumers' confidence and capability to identify and choose such products. In contrast, perceived packaging functions influence purchase intention mainly through attitude, while the pathway through perceived behavioural control is not robustly supported. Overall, these results suggest that attitude is a more relevant pathway when consumers' perceptions involve favourable evaluations of environmentally friendly packaging, whereas perceived behavioural control becomes especially important when knowledge reduces uncertainty and increases consumers' confidence in performing the behaviour [28,42].

These findings provide empirical support for the extended TPB-S-O-R framework by showing that perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions act as external stimuli that activate internal evaluative and control-related states—attitude and perceived behavioural control—which subsequently enhance purchase intention toward beverages with environmentally friendly packaging. By confirming the mediating roles of attitude and perceived behavioural control—particularly the indirect effects involving perceived consumer effectiveness and perceived environmental packaging knowledge—the study provides valuable insights into the psychological mechanisms through which environmental perceptions shape purchase decisions. Importantly, this contribution addresses a key theoretical gap in the literature, which has largely focused on attitude as a mediator while paying limited attention to the role of perceived behavioural control. In this respect, the study advances theoretical understanding of sustainable packaging adoption. Additionally, testing this extended model in Vietnam, where environmentally friendly packaging is still emerging, broadens the applicability of the TPB-S-O-R framework and offers valuable insights into consumer behaviour in the context of developing markets.

The managerial implications should be interpreted in line with the empirical results. Since perceived consumer effectiveness has both significant direct and indirect effects on purchase intention, communication campaigns should emphasise the environmental value of individual consumer choices. Simple messages showing how choosing environmentally

friendly beverage packaging can reduce waste or support collective environmental benefits may strengthen both attitude and perceived behavioural control.

In addition, because perceived environmental packaging knowledge influences intention mainly through perceived behavioural control, firms should provide practical information that reduces uncertainty and supports consumers' purchase decisions. Clear eco-labels, simple recycling instructions, transparent packaging claims, and point-of-purchase guidance can reduce uncertainty and increase consumers' confidence in choosing such products. Finally, because perceived packaging functions do not have a significant direct effect on purchase intention, functional claims such as product protection, safety, and product communication should be used as supportive information rather than as the main persuasive message.

The findings also indicate that consumers are currently not familiar with other symbols that represent the environmental friendliness of product packaging, such as the FSC logo, green dots, or the Compostable logo. Because these logos are often used to signal environmentally friendly packaging, communication through social networks, television, and distribution locations can be considered to increase consumers' awareness of environmentally friendly symbols. In addition, a segment of consumers remains unwilling to purchase beverages with a recycled content of 50% or higher in their packaging. Further research is needed to examine the reasons for this reluctance and to identify strategies for improving willingness to purchase beverages with recycled packaging.

In the context of developing countries, it is recommended to strengthen public–private partnerships to promote environmental consumption behaviour [70]. The private sector should be active and demonstrate its key role in adopting and promoting environmentally friendly packaging. The government can initiate an enabling environment to support the private sector and consumers in adopting products such as beverages with eco-friendly packaging.

This study has several limitations. First, the sample mainly includes consumers in urban areas in Central Vietnam. Although this context is relevant because these consumers are more exposed to modern retail channels and environmentally friendly packaging, it limits the generalizability of the findings to other regions, and the broader Vietnamese population. Consumer perceptions may differ across regions due to differences in income, retail infrastructure, product availability, environmental awareness, and consumption habits. Future studies should use multi-regional or nationwide samples, including both urban and rural consumers, to test the stability of the proposed TPB-S-O-R model across Vietnam.

Second, the findings should be interpreted within the Vietnamese market context. Consumer responses to environmentally friendly beverage packaging may be shaped by Vietnam's specific regulatory, cultural, and market conditions, such as rapid food and beverage market growth, increasing urban consumption, emerging policy attention, and uneven familiarity with eco-labels. Therefore, the generalizability of the findings to other national contexts should be interpreted with caution. Future cross-country studies should compare markets with different levels of environmental regulation, eco-label familiarity, retail infrastructure, and consumer awareness.

Third, reliance on self-reported data may be affected by recall or social desirability bias, which limits the ability to extend the findings to actual behaviour. In addition, because the study used a cross-sectional design, the possibility of reverse causality cannot be fully ruled out.

6. Conclusions

This study aimed to (1) examine the direct determinants of purchase intention toward beverages with environmentally friendly packaging and (2) assess how perceived consumer effectiveness, perceived environmental packaging knowledge, and perceived packaging functions indirectly shape intention through psychological evaluations. The findings reveal that attitude, perceived behavioural control, and perceived consumer effectiveness significantly strengthen purchase intention. Subjective norms and perceived environmental packaging knowledge show weaker positive effects, while perceived packaging functions do not exert a significant direct influence. Additionally, mediation analyses confirm that attitude and perceived behavioural control act as important psychological pathways through which external perceptions translate into consumers' purchase intention. However, the mediating effects differ across antecedents. Perceived consumer effectiveness influences purchase intention through both attitude and perceived behavioural control, whereas perceived environmental packaging knowledge works mainly through perceived behavioural control, and perceived packaging functions operate primarily through attitude. These results provide empirical support for the extended TPB-S-O-R model in explaining sustainable packaging adoption in a developing market context.

In practice, low familiarity with eco-friendly symbols and limited willingness to purchase beverages in fully recycled packaging highlight the need for clearer communication and awareness strategies. Enhancing practical consumer knowledge, strengthening perceived consumer effectiveness, and increasing access to eco-friendly packaging options may help drive behavioural change. In particular, clear eco-labels, simple recycling information, and transparent packaging claims can help consumers feel more capable of identifying and choosing beverages with environmentally friendly packaging. Strategic messaging that emphasises both individual and collective environmental benefits, supported by credible labelling, social influence mechanisms, and targeted incentives, can further reinforce consumers' positive attitudes and encourage sustainable beverage choices. These practical implications should be interpreted as complementary strategies: improving consumer knowledge, strengthening perceived effectiveness, and increasing the availability and credibility of environmentally friendly beverage packaging.

Overall, this study provides insights that support policymakers and industry stakeholders in encouraging environmentally responsible consumption behaviour in Vietnam. Future research should apply the model to multi-regional or nationwide samples and conduct cross-country comparisons to examine the generalizability of the findings. Incorporating observed purchasing behaviour or sales data would further strengthen the model's applicability.

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