

Advancing low-carbon consumption: drivers of purchase intention for carbon-labeled agricultural products in China

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Received 28 August 2025
Revised 25 October 2025
18 November 2025
Accepted 27 November 2025

Abstract

Purpose – This paper aims to analyze Chinese consumers' purchase intention for carbon-labeled agricultural products and to identify and empirically examine the perceptual, attitudinal and policy-related determinants of purchase intention.

Design/methodology/approach – A quantitative research design was adopted. Data for this study were collected from an online questionnaire survey targeting consumers in Shanghai ($n = 734$). Hypotheses were developed based on theories and literature. Partial Least Squares Structural Equation Modeling was used to analyze data and test the hypothesized relationships.

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Funding: The work is supported by the Young Scientist Project of National Natural Science Foundation of China (NSFC) (grant number: 72303101); Fellowship of China Postdoctoral Science Foundation (grant number: 2024M751455); Philosophy and Social Science Laboratories of Jiangsu Higher Education Institutions–Intelligent Laboratory for Food Security Governance and Policy, Nanjing Agricultural University (grant number: 2025SYS14); Jiangsu Province Department of Education General Project of Philosophy and Social Science Research in Colleges and Universities (grant number: 2023SJYB0057); Humanities and Social Science Project of Nanjing Agricultural University Fundamental Research Funds for the Central Universities (grant number: SKYC2023008).

Conflicts of interest: No potential conflict of interest was reported by the authors.



International Journal of Climate
Change Strategies and
Management
Vol. 18 No. 1, 2026
pp. 91-109
Emerald Publishing Limited
1756-8692
DOI 10.1108/IJCCSM-08-2025-0280

Findings – Although consumer awareness of carbon labeling is relatively low (Mean = 2.77, SD = 1.13), their willingness to purchase carbon-labeled products is notably high (Mean = 3.96, SD = 0.67). Consumption attitudes exert a significant positive influence on purchase intention ($\beta = 0.215$, $p < 0.001$). Consumers' perceptions of both carbon labeling ($\beta = 0.201$, $p < 0.001$) and climate change ($\beta = 0.186$, $p < 0.001$) significantly enhance consumption attitudes, which in turn positively affect purchase intention ($\beta = 0.043$, $p < 0.001$; $\beta = 0.040$, $p < 0.001$). Subsidy policies are found to significantly strengthen the relationship between consumption attitudes and purchase intention ($\beta = 0.075$, $p < 0.05$).

Originality/value – The application of carbon labels to agricultural products has emerged only recently. To date, limited research has assessed Chinese consumers' purchase intentions for carbon-labeled agricultural products. This study not only identifies the direct drivers of consumers' purchase intentions but also uncovers important mediators and moderators. From a theoretical standpoint, this study captures the crucial link between consumers' perceptions of climate change and their purchase intentions for carbon-labeled agricultural products. The findings offer actionable insights for policy planning and future research aimed at promoting low-carbon consumption.

Keywords Climate change, Low-carbon consumption, Carbon labeling, Partial Least Squares Structural Equation Modeling, Consumers' purchase intention

Paper type Research paper

1. Introduction

Agricultural activities exert a profound impact on the environment and natural resources, accounting for approximately 15% of global greenhouse gas (GHG) emissions (Xu *et al.*, 2024a, 2024b, 2024c). In China, the agricultural sector contributes around 8.6% of the nation's total GHG emissions (Hu *et al.*, 2023). Key production activities – such as rice cultivation and animal husbandry – release substantial quantities of methane (CH₄) and nitrous oxide (N₂O), amounting to an estimated annual emission of 605–800 million tons of carbon dioxide equivalent (Chinese Academy of Agricultural Sciences, 2024). According to the IPCC (2023), emissions from agricultural systems significantly exacerbate global warming, posing one of the most complex and urgent challenges facing humanity. With the global population projected to approach 10.3 billion in the future (United Nations, 2024), the demand for agricultural production is expected to rise sharply. Without effective interventions to curb carbon emissions from agricultural systems, the environmental burden of agricultural activities will intensify. This will place increasing pressure on ecosystems and undermine sustainability goals.

China has pledged to peak its carbon emissions by 2030 and achieve its “dual carbon” goals – carbon neutrality by 2060 (Yang *et al.*, 2022). This national strategy seeks to address the urgent global challenge of climate change by curbing GHG emissions and accelerating the transition to a low-carbon economy. In response, China has undertaken substantial efforts to reduce emissions across various sectors. In agriculture, government agencies, public institutions and private enterprises have actively developed and promoted a range of low-carbon technologies and practices. These include the rice–fish coculture system, straw incorporation into fields, the use of organic fertilizers and cropping techniques such as intercropping and relay cropping. However, China's carbon reduction strategies have predominantly focused on the production stage, with relatively limited attention given to the consumption side. This imbalance is notable given that household daily consumption accounts for approximately 53% of China's total GHG emissions (Chinese Academy of Sciences, 2023). Encouraging consumers to adopt low-carbon consumption behaviors – such as purchasing carbon-labeled agricultural products – could therefore play a critical role in mitigating emissions (Guan *et al.*, 2025).

Carbon labeling was introduced as a tool to help consumers actively participate in low-carbon consumption (Roa-Goyes and Pickering, 2024). It is defined as “a measure of the total

GHG emissions caused by a particular product throughout its life cycle” (Rondoni and Grasso, 2021). Carbon labeling can provide transparent information about a product’s carbon footprint and its environmental impact. Therefore, carbon labeling enables consumers to make more informed and sustainable purchasing decisions (Taufique *et al.*, 2022). Many developed countries have systematically implemented and promoted carbon labeling initiatives. The UK pioneered this effort in 2007, becoming the first country to introduce carbon footprint labels (Thøgersen and Nielsen, 2016). That same year, Tesco – the UK’s largest retailer – began displaying carbon labels on its products (Boardman, 2008). In 2008, French supermarket chains Casino and Leclerc followed suit by incorporating numeric carbon dioxide values on product price tags and receipts (Schaefer and Blanke, 2014). Germany also introduced carbon labeling in 2007 and launched a public carbon footprint labeling scheme in 2008 (Liu *et al.*, 2016). After years of development, the carbon labeling systems in these countries have yielded notable economic and environmental benefits (Yi *et al.*, 2025).

The evolution of carbon labeling in China reflects a gradual institutionalization process, beginning with industrial sectors and later extending to agriculture. In 2009, the China National Institute of Standardization adopted PAS 2050 for carbon footprint assessment and launched a pilot project focused on the industrial manufacturing sector. Since then, China’s carbon labeling system has been initiated (Liu *et al.*, 2016). In 2013, the National Development and Reform Commission issued the Interim Measures for the Management of Low-Carbon Product Certification, establishing a unified certification framework for low-carbon products (Yu and Tian, 2013). This system initially covered seven categories of industrial goods, marking the formal institutionalization of carbon labeling in China. In 2018, the electronics industry joined the effort with its own carbon labeling pilot program (Hou *et al.*, 2019). Notably, China’s early carbon labeling initiatives were concentrated in industrial and electronic products. The application of carbon labels to agricultural products has emerged only in recent years, yet it has garnered significant public attention. For instance, edible bamboo shoots from Hangzhou received the first national agricultural carbon label certification in 2021 (Zhejiang Daily, 2021), followed by grapes from Jiaxing in 2022 (Zhejiang Daily, 2022) and rice from Wuxi in 2023 (People’s Government of Wuxi, 2023). Carbon labeling of agricultural products is expected to enhance environmental sustainability by promoting low-carbon consumption (Lohmann *et al.*, 2022). Moreover, consumer demand for carbon-labeled agricultural goods can incentivize farmers and agribusinesses to adopt low-carbon production practices, thereby accelerating the transformation of agricultural systems and contributing to further reductions in GHG emissions from the production side (Geng *et al.*, 2023).

Previous research has shown that Chinese consumers’ purchase intentions toward carbon-labeled products are influenced by perceptual factors such as the acceptability and credibility of carbon labeling (Sun *et al.*, 2023), as well as personal attributes including age, family structure, region and educational level (Zhao *et al.*, 2018). However, most existing studies examine carbon-labeled products in general, without distinguishing between specific product categories. It is reasonable to assume that consumers’ purchase intentions for carbon-labeled industrial or electronic products may differ substantially from their intentions toward carbon-labeled agricultural products, given the distinct nature of these goods. A limited number of studies have attempted to quantify Chinese consumers’ willingness to pay for carbon-labeled products (Xu *et al.*, 2024a, 2024b, 2024c; Chen *et al.*, 2024). However, purchase intention and willingness to pay represent conceptually distinct psychological constructs and should be empirically measured separately. Purchase intention refers to the degree to which consumers express a willingness to buy a product (Peña-García *et al.*, 2020), whereas

willingness to pay captures the maximum monetary amount consumers are prepared to spend (Kasilingam and Krishna, 2022). Although the influencing factors of these two constructs may be related, empirical validation is still necessary. At present, research on Chinese consumers' perceptions and purchase intentions regarding carbon-labeled agricultural products remains limited. In particular, the psychological mechanisms underlying such behavior require further empirical investigation. To address these gaps, this study employs a consumer survey and pursues three specific objectives:

- (1) to assess Chinese consumers' purchase intention toward carbon-labeled agricultural products;
- (2) to identify and empirically examine the perceptual, attitudinal and policy-related determinants of purchase intention; and
- (3) to translate the empirical findings into evidence-based policy recommendations and actionable directions for future research.

2. Literature review and hypotheses

2.1 Consumption attitudes on purchase intention

The Theory of Planned Behavior (TPB) posits that an individual's attitude toward a behavior is a key determinant of their behavioral intention (Ajzen, 1991). Within consumer behavior research, TPB has been extensively applied to predict both purchase intentions and actual purchasing behavior. Drawing on this theoretical framework, the present study defines consumption attitude as the extent to which a consumer holds a favorable or unfavorable evaluation of purchasing carbon-labeled agricultural products. Purchase intention, in this context, refers to the degree to which a consumer is willing to buy such products. A substantial body of literature supports the role of attitude as a primary predictor of purchase intention. For instance, Eberle *et al.* (2022) and Parashar *et al.* (2023) emphasized the centrality of attitude in shaping consumer intentions. In the domain of low-carbon consumption, empirical studies have consistently found a positive relationship between consumers' attitudes and their purchase intentions (Ghosh *et al.*, 2022; Pandey and Yadav, 2023). Ogiemwonyi *et al.* (2023) further demonstrate that favorable attitudes significantly enhance consumers' intention to purchase environmentally friendly products. Based on this theoretical and empirical foundation, the following hypothesis is proposed:

- H1.* Consumption attitudes have a significant positive influence on consumers' purchase intention toward carbon-labeled agricultural products.

2.2 Perceptions of carbon labeling on consumption attitudes

Nicosia's (1966) model of consumer behavior suggests that consumer attitudes are shaped by underlying perceptions. According to the model, producers and companies disseminate product-related information through various communication channels. Upon exposure to these messages, consumers become aware of product attributes and subsequently form perceptions. These perceptions, in turn, serve as the foundation for attitude formation (Viksne *et al.*, 2016). Building on this framework, the present study defines consumers' perceptions of carbon labeling as their awareness and understanding of carbon labeling as a certification for low-carbon production (Amorim *et al.*, 2025; Roa-Goyes and Pickering, 2024). In line with Nicosia's model, when consumers perceive carbon labeling as a credible indicator of environmentally responsible production, they are more likely to recognize the environmental benefits of carbon-labeled agricultural products. This recognition may foster

more favorable consumption attitudes. Based on this theoretical rationale, the following hypothesis is proposed:

- H2.* Consumers' perceptions of carbon labeling have a significant positive influence on consumption attitudes.

2.3 Perceptions of climate change on consumption attitudes

The agricultural carbon labeling regime is fundamentally designed to mitigate climate change by reducing GHG emissions associated with agricultural production and consumption (Bartzas *et al.*, 2025). In this context, consumers' perceptions of climate change may play a critical role in shaping their attitudes toward carbon-labeled products. Consistent with the earlier definition of consumers' perceptions of carbon labeling, we define consumers' perceptions of climate change as their understanding of climate change and its relationship to GHG emissions. When consumers recognize the link between agricultural practices, GHG emissions and climate change, they are more likely to evaluate carbon-labeled agricultural products favorably. In other words, heightened awareness of climate change may foster more positive consumption attitudes toward products that contribute to climate mitigation. Empirical evidence supports this association. Wong-Parodi and Berlin Rubin (2022) found that perceptions of climate change are positively correlated with pro-environmental attitudes. Similarly, Contu *et al.* (2021) reported that individuals with strong climate change perceptions are more inclined to consume renewable energy sources. Based on this theoretical rationale and empirical support, the following hypothesis is proposed:

- H3.* Consumers' perceptions of climate change have a significant positive influence on consumption attitudes.

2.4 The mediating role of consumers' attitudes

In addition to the direct influence of consumer perceptions on attitudes and subsequent purchase intentions, prior research has emphasized the mediating role of attitudes in shaping purchasing behavior. Attitudes often serve as a psychological bridge between cognitive evaluations and behavioral outcomes. For instance, Wang *et al.* (2023) found that consumer attitudes mediate the relationship between various antecedents and consumers' purchase intention. Similarly, Lavuri *et al.* (2022) demonstrated that attitudes mediate the effect of influencing factors on purchase intentions for luxury organic beauty products. Escobar-Farfán *et al.* (2025) further revealed that health consciousness indirectly affects purchase intentions for healthy foods through consumption attitudes. Drawing on these empirical insights, this study posits that consumers' perceptions of carbon labeling and climate change not only shape consumption attitudes directly but also exert an indirect influence on purchase intentions through the mediation of these attitudes. Accordingly, the following hypotheses are proposed:

- H4a.* Consumers' perceptions of carbon labeling indirectly influence their purchase intention toward carbon-labeled agricultural products through the mediation of consumption attitudes.
- H4b.* Consumers' perceptions of climate change indirectly influence their purchase intention toward carbon-labeled agricultural products through the mediation of consumption attitudes.

2.5 *The moderating role of subsidy policies*

To promote low-carbon lifestyles, the Chinese government has implemented a range of subsidy policies that provide economic incentives to consumers (Li *et al.*, 2024). These subsidy policies refer to financial support mechanisms embedded in governmental programs aimed at encouraging environmentally responsible consumption (Xu *et al.*, 2024a, 2024b, 2024c). Previous studies have examined the direct impact of subsidy policies on consumer purchase behavior across various product categories (Wang *et al.*, 2021; Xue *et al.*, 2023). Beyond these direct effects, Liu and Tsaur (2020) demonstrated that subsidy policies can significantly moderate the relationship between consumption attitudes and purchase intention. In the context of low-carbon consumption, subsidies may enhance consumer awareness and interest by signaling governmental endorsement and support for environmental protection (Dutta and Hwang, 2021). When consumers have already formed positive consumption attitudes toward carbon-labeled products, subsidy policies may reinforce these attitudes and facilitate their translation into actual purchase intentions. In other words, subsidies can serve as a catalyst that strengthens the attitudinal-behavioral link in low-carbon purchasing decisions. Based on this reasoning, the following hypothesis is proposed:

- H5. Subsidy policies significantly moderate the relationship between consumption attitudes and consumers' purchase intention.

2.6 *The moderating role of consumers' willingness to pay a premium*

Price is a critical factor influencing consumer decision-making, particularly in the context of environmentally labeled products (Levrini and Jeffman dos Santos, 2021). For certain goods, higher prices or premiums may deter purchase intention (Li *et al.*, 2017). However, when consumers are willing to pay a premium, price becomes a less dominant barrier and other factors – such as environmental values or product attributes – may take precedence in shaping purchasing decisions. In this study, willingness to pay a premium is defined as the extent to which consumers are willing to pay a price premium for carbon-labeled agricultural products (Zhan *et al.*, 2025a). This construct has emerged as a key moderating variable in consumer behavior research. For example, Munaqib *et al.* (2025) found that willingness to pay a premium significantly moderates the relationship between green purchase intention and factors such as health consciousness, social identity and self-identity. Similarly, Liang (2016) demonstrated that willingness to pay a premium substantially moderates the link between consumer attitudes and purchase intention. In the context of carbon-labeled agricultural products, consumers who are willing to pay a premium may be more likely to translate positive consumption attitudes into actual purchasing behavior. Therefore, the following hypothesis is proposed:

- H6. Consumers' willingness to pay a premium significantly moderates the relationship between consumption attitudes and consumers' purchase intention.

Following the formulation of the seven hypotheses, a conceptual framework was developed to depict the proposed relationships. As illustrated in Figure 1, the framework offers a structured overview of the hypothesized pathways, including key constructs, mediating and moderating effects relevant to consumers' purchase intention toward carbon-labeled agricultural products.

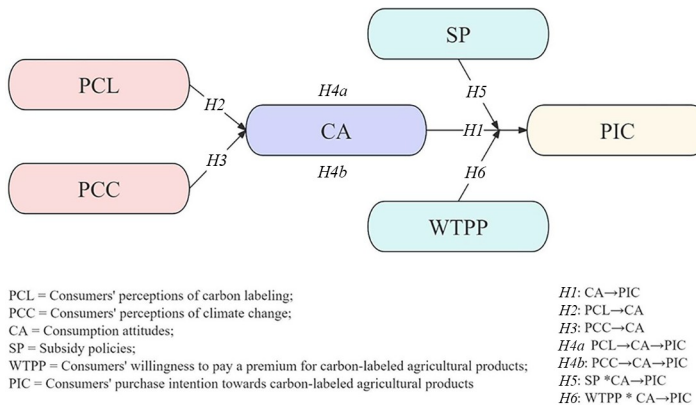


Figure 1. Conceptual framework of consumers' purchase intention toward carbon-labeled agricultural products

Source: Authors' own work

3. Materials and methods

3.1 Data collection

The data for this study were collected through a consumer survey conducted in Shanghai, China. As one of the country's largest metropolitan areas, Shanghai is characterized by high income levels and elevated living standards. In 2023, the city's per capita disposable income reached approximately US\$12,000, ranking first among all Chinese metropolises (Shanghai Municipal People's Government, 2024). Given their higher purchasing power, consumers in Shanghai are more likely to afford eco-friendly products that carry a price premium. The city also hosts a dynamic market for a wide range of environmentally friendly goods (Xu *et al.*, 2023). In addition to economic factors, Shanghai has implemented a series of policy initiatives aimed at promoting low-carbon consumption. Notably, the city pioneered China's first personal carbon credit account system, which quantifies residents' low-carbon behaviors and converts them into individual account credits (Xinhua News Agency, 2023). These institutional and market conditions make Shanghai a suitable and strategic location for investigating low-carbon consumption behaviors. Insights derived from this context may also serve as valuable references for other Chinese cities seeking to cultivate sustainable and low-carbon lifestyles.

The survey instrument comprised three main sections. Section one gathered demographic information from respondents, including age, gender, education level and income. The following section, aligned with the conceptual framework, included items designed to measure key constructs such as consumption attitudes, perceptions of carbon labeling, perceptions of climate change, views on subsidy policies and willingness to pay a premium for low-carbon products. The last section focused on consumers' purchase intentions regarding carbon-labeled agricultural products. To reach a broad and diverse consumer base, the survey was administered via Credamo, a professional data collection platform and one of the largest research service providers in China. The sampling frame was restricted to consumers aged 18 and above residing in Shanghai. Participation in the study required respondents to acknowledge and agree to an informed consent form prior to beginning the questionnaire. In addition, to account for potential unfamiliarity with carbon labeling, a concise introduction to the concept and to carbon-labeled agricultural products was provided

at the outset of the survey to facilitate comprehension and elicit informed responses. A total of 751 questionnaires were distributed to sampled consumers, all of which were successfully returned. To ensure data quality, responses exhibiting uniform answers across all items or completed in less than 90 s were deemed invalid. After data cleaning, 734 valid questionnaires remained for analysis, yielding an effective response rate of 97.7%.

3.2 Variables and measurement

This study incorporates three primary categories of core variables: the outcome variable, predictor variables and moderator variables. The variable types, names, indicators, item statements and measurement scales are detailed in [Table 1](#). The outcome variable is consumers' purchase intention toward carbon-labeled agricultural products. Three key predictor variables were examined. The first is consumption attitudes, a latent construct representing the extent to which consumers hold favorable or unfavorable evaluations of purchasing carbon-labeled agricultural products. Given the close association between such purchases and environmental protection, two indicator items were designed to assess consumers' perceptions of the environmental benefits of buying carbon-labeled agricultural products. The second predictor is perceptions of carbon labeling, measured through three indicators:

- (1) awareness of carbon labeling;
- (2) understanding of its meaning; and
- (3) comprehension of information related to carbon labeling systems.

The third predictor is perceptions of climate change, operationalized through two indicators that capture respondents' understanding of the causes and consequences of climate change. In addition, two moderator variables were included to examine potential moderating effects: subsidy policies and willingness to pay a premium. These variables were selected to explore how external incentives and individual price sensitivity might influence the relationship between predictors and the outcome variable.

3.3 Analytical approach

Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to analyze the data and test the proposed hypotheses. PLS-SEM is particularly suitable for exploratory research and complex models, as it can maximize the explained variance of target constructs even with relatively small sample sizes and without requiring data to follow a normal distribution ([Dash and Paul, 2021](#)). The analysis began with the selection of a path weighting scheme, as recommended by [Hair et al. \(2022\)](#). A PLS algorithm was then applied to assess factor loadings, construct reliability and validity and discriminant validity. To evaluate the statistical significance of factor loadings and structural path coefficients, bootstrapping was conducted using 5,000 subsamples, with 95% bias-corrected and accelerated (BCa) confidence intervals and a two-tailed test approach ([Hair et al., 2021](#); [Hair et al., 2022](#)).

4. Results and discussion

4.1 Sample characteristics and descriptive statistics

A majority of respondents were female (71.4%), and over 90% were between the ages of 18 and 45. The sample was predominantly composed of individuals with higher education levels: 55.2% held a bachelor's degree, whereas 30.5% had attained a postgraduate degree or higher. In terms of income, 64.8% of respondents reported a household monthly per capita income exceeding approximately US\$1,400. According to the [Shanghai Consumer Rights Protection Commission \(2024\)](#), highly educated young adults are emerging as the primary

Table 1. Variable types, names, indicators, item statements, measurement scales and descriptive statistics

Type	Variable name	Indicator	Item statement	Strongly unwilling/ disagree (%)	Somewhat unwilling/ disagree (%)	Uncertain (%)	Somewhat willing/ agree (%)	Strongly willing/ agree (%)	Mean	SD
Outcome variable	Consumers' purchase intention toward carbon- labeled agricultural products	PIC	Would you be willing to purchase carbon-labeled agricultural products?	0.4	1.4	18.0	61.9	18.4	3.96	0.67
	Consumption attitudes	CA1	I agree that purchasing carbon-labeled agricultural products is good for the environment	0.1	0.7	3.4	50.0	45.8	4.41	0.61
		CA2	I agree that the production process of carbon-labeled agricultural products is more environmentally friendly	0.3	1.2	7.8	50.3	40.5	4.29	0.69
Predictor variables	Consumers' perceptions of carbon labeling	PCL1	I have heard about carbon labeling	14.4	28.7	28.9	21.7	6.3	2.77	1.13
		PCL2	I understand the meaning of carbon labeling	3.4	13.8	45.6	29.0	8.2	3.25	0.91
		PCL3	I understand the information related to the carbon labeling system	10.4	41.0	27.9	16.6	4.1	2.63	1.00
Moderator variables	Consumers' perceptions of climate change	PCC1	I understand the main causes of climate change	0.3	2.9	10.1	59.7	27.1	4.10	0.71
		PCC2	I understand the impacts of climate change	0.4	3.1	9.3	62.0	25.2	4.08	0.71
	Subsidy policies	SP	I would be more willing to purchase carbon-labeled agricultural products if there were subsidy policies for them	0.0	0.5	3.5	42.9	53.0	4.48	0.60
	Consumers' willingness to pay a premium for carbon- labeled agricultural products	WTPP	I am willing to pay a premium for carbon-labeled agricultural products	3.4	18.3	27.1	44.6	6.7	3.33	0.96
Note(s): <i>n</i> = 734										
Source(s): Authors' own work										

drivers of low-carbon consumption. Given the demographic profile of the sample, it is reasonable to infer that the surveyed population effectively represents the target consumer segment for carbon-labeled agricultural products.

The descriptive statistics for all variables are also presented in [Table 1](#). The results indicate that 80% of respondents expressed moderate to strong willingness to purchase carbon-labeled agricultural products, suggesting a generally high level of purchase intention among consumers. However, awareness and understanding of carbon labeling remained relatively low. Fewer than 30% of respondents reported having heard of carbon labeling prior to the survey, and only 37.2% indicated at least a moderate understanding of information related to carbon labeling systems. In contrast, perceptions of climate change were notably high. Over 85% of respondents demonstrated an understanding of both the causes and impacts of climate change. Respondents also exhibited favorable consumption attitudes: 95.8% agreed that purchasing carbon-labeled agricultural products benefits the environment, and 90.8% believed that the production process of carbon-labeled agricultural products is more environmentally friendly than that of conventional alternatives. Regarding willingness to pay a premium, only 51.3% of respondents were willing to pay a higher price for carbon-labeled agricultural products. Nevertheless, 95.9% expressed willingness to purchase such products if supported by a subsidy policy, highlighting the potential effectiveness of economic incentives in promoting low-carbon consumption.

The descriptive statistics reveal that consumers exhibit high-level purchase intention for carbon-labeled agricultural products despite low-level perceptions of carbon labeling. This finding is consistent with [Duan et al. \(2023\)](#). Given that China's carbon labeling efforts remain in an exploratory phase and public awareness of carbon labeling began to rise only after China announced its "dual carbon" goals ([Xu and Lin, 2022](#)), consumers may hardly identify carbon labels or interpret their meanings. However, they can infer the potential environmental benefits of carbon-labeled goods from the literal meaning of "carbon labeling" and thus express strong purchase intention. China's promotion of "dual carbon" policies have fostered consumers' pro-environmental values and have cultivated a social trend of low-carbon consumption ([Zhan et al., 2025b](#)). After inferring the potential environmental benefits of carbon-labeled agricultural products, consumers may express strong purchase intention due to the values or social expectations ([Edenbrandt et al. \(2025\); Xu et al., 2024b](#)). This underscores the importance of enhancing public understanding of carbon-labeled agricultural products. While [Jiang et al. \(2023\)](#) emphasized the need to popularize the concept of carbon labeling, this study further argues that such initiatives must also highlight the environmental benefits of carbon-labeled agricultural products to foster informed consumer behavior and support the broader "dual carbon" goals through daily consumption.

4.2 Model estimation

The estimation results of the measurement model are presented in [Table 2](#). All indicators loaded significantly onto their respective constructs ($p < 0.001$), with factor loadings exceeding the recommended threshold of 0.70, indicating strong item-construct relationships. The model exhibited satisfactory reliability, as evidenced by Cronbach's alpha and composite reliability (CR) values for all latent variables, each surpassing the benchmark of 0.70 ([Manley et al., 2021; Wei et al., 2023](#)). Convergent validity was assessed using average variance extracted (AVE), factor loadings and CR. All latent constructs demonstrated AVE values above 0.50, whereas factor loadings and CR values consistently exceeded 0.70, confirming adequate convergent validity ([Manley et al., 2021; Jing and Rasiah, 2025](#)). Discriminant validity was evaluated using the heterotrait-monotrait (HTMT) ratio, and all HTMT ratios

Table 2. Estimation of the measurement model

Latent variables	Indicator	Factor loading	p-value	Cronbach's alpha	CR	AVE
Consumption attitudes	CA1	0.923	0.000	0.815	0.915	0.844
	CA2	0.914	0.000			
Perceptions of carbon labeling	PCL1	0.824	0.000	0.816	0.891	0.731
	PCL2	0.870	0.000			
	PCL3	0.870	0.000			
	PCC1	0.893	0.000			
Perceptions of climate change	PCC2	0.873	0.000	0.718	0.876	0.780

Note(s): CR= composite reliability; AVE= average variance extracted

Source(s): Authors' own work

were below the threshold of 0.85, ranging from 0.133 to 0.527, thereby supporting the presence of discriminant validity. In addition, variance inflation factor (VIF) values for all latent variables were below the commonly accepted cutoff of 5, indicating no multicollinearity concerns.

The structural model demonstrated satisfactory predictive relevance, as evidenced by the blindfolding procedure with an omission distance of 7. The construct cross-validated redundancy (Q^2) values for all endogenous variables exceeded zero, confirming predictive capability (Hair *et al.*, 2020). Specifically, the Q^2 value for consumption attitudes was 0.078, and for purchase intention, 0.352. In addition, the model exhibited acceptable overall fit, with the standardized root mean square residual (SRMR = 0.077) falling below the recommended threshold of 0.08 (Hair *et al.*, 2022).

4.3 Hypotheses test

A bootstrapping analysis using 5,000 subsamples and 95% bias-corrected and accelerated (BCa) confidence intervals was conducted to assess the statistical significance of the path coefficients. Table 3 presents the results of the bootstrapping analysis and hypothesis testing. Consumption attitudes exert a significant positive influence on consumers' purchase intention toward carbon-labeled agricultural products ($\beta = 0.215$, $t = 6.612$, $p < 0.001$),

Table 3. Estimation of the structural model, mediation model and moderation model

Model	Hypothesis	Path	Coefficient (β)	t	p-value	Hypothesis test
Structural model	H1	CA $\rightarrow$ PIC	0.215	6.612	0.000	Accept
	H2	PCL $\rightarrow$ CA	0.201	5.866	0.000	Accept
	H3	PCC $\rightarrow$ CA	0.186	5.295	0.000	Accept
Mediation model	H4a	PCL $\rightarrow$ CA $\rightarrow$ PIC	0.043	4.170	0.000	Accept
	H4b	PCC $\rightarrow$ CA $\rightarrow$ PIC	0.040	4.028	0.000	Accept
Moderation model	H5	SP *CA $\rightarrow$ PIC	0.075	2.118	0.034	Accept
	H6	WTPP * CA $\rightarrow$ PIC	-0.047	1.524	0.128	Reject

Note(s): CA = consumption attitudes; PIC = consumers' purchase intention toward carbon-labeled agricultural products; PCL = consumers' perceptions of carbon labeling; PCC = consumers' perceptions of climate change; SP = subsidy policies; WTPP = consumers' willingness to pay a premium

Source(s): Authors' own work

thereby supporting *H1*. This result is consistent with the research by [Bevan-Dye and Synodinos \(2025\)](#). In addition, perceptions of carbon labeling significantly and positively affect consumption attitudes ($\beta = 0.201, t = 5.866, p < 0.001$), confirming *H2*. This finding is supported by [Edenbrandt et al. \(2025\)](#). Similarly, perceptions of climate change have a significant positive impact on consumption attitudes ($\beta = 0.186, t = 5.295, p < 0.001$), supporting *H3* and aligning with the findings from [Edenbrandt and Lagerkvist \(2022\)](#).

The coefficient of determination (R^2) for the outcome variable – purchase intention toward carbon-labeled agricultural products – was 0.367 ($p < 0.001$), indicating that 36.7% of the variance is explained by the structural model.

Mediating effects were assessed by evaluating the significance of indirect paths, following the procedure outlined by [Tawde et al. \(2023\)](#). [Table 3](#) also presents the results of the mediation analysis and hypothesis testing. The indirect effects of consumers' perceptions of carbon labeling and their perceptions of climate change on purchase intention mediated by consumption attitudes were both significant ($\beta = 0.043, t = 4.170, p < 0.000$; $\beta = 0.040, t = 4.028, p < 0.000$), thereby supporting *H4a* and *H4b*. These results underscore the mediating role of consumption attitudes and align with [Lavuri et al. \(2022\)](#).

Moderating effects were examined by testing the significance of interaction terms, derived from the product of moderator and predictor variables. [Table 3](#) also summarizes the results of the moderation analysis and hypothesis testing. The moderating effect of subsidy policies was significantly positive ($\beta = 0.075, t = 2.118, p < 0.05$). This finding is consistent with [Xu et al. \(2023\)](#). In contrast, the moderating effect of willingness to pay a premium was not statistically significant ($\beta = -0.047, t = 1.524, p = 0.128$). This result aligns with [Bishowkarma and Lohala \(2024\)](#). Accordingly, *H5* is supported, whereas *H6* is not.

The hypothesis test results for *H1–H4b* show that consumption attitudes function both as a direct predictor and as a mediator. This finding aligns with prior research ([Wu and Chiang, 2023](#); [Sun et al., 2023](#)). Targeted government interventions are essential to leverage both the direct and indirect effects of consumption attitudes. Local governments could introduce personal carbon accounts, which could be linked to financial incentives, thereby cultivating favorable consumption attitudes and encouraging the purchase of carbon-labeled agricultural products ([People's Daily, 2024](#)). Moreover, enhancing public awareness of carbon labeling and climate change through educational initiatives can foster eco-conscious attitudes and leverage the indirect effects of consumption attitudes.

The hypothesis test result for *H5* reveals that subsidies enhance the positive effect of consumption attitudes on purchase intention. However, to date, no specific subsidy policy targeting carbon-labeled agricultural products exists in China. This study recommends that policymakers develop targeted subsidy schemes. The effective approaches are to provide cash discounts ([Xinhua News Agency, 2025](#)) and to offer carbon credits. In addition, given the rapid expansion of online groceries in China, subsidies could also be distributed as digital vouchers. While this study did not examine the optimal level of subsidies, this issue merits further investigation in future research.

The hypothesis test result for *H6* reveals that willingness to pay a premium does not exert a significant moderating effect. Despite this, the factor remains practically relevant. Carbon-labeled agricultural products are often priced higher than conventional counterparts ([Zhan et al., 2025a](#)), and consumer behavior in real-world markets is likely influenced by price sensitivity. Therefore, understanding the thresholds and determinants of consumers' willingness to pay a premium is essential for developing effective pricing and marketing strategies. This study recommends that future research focus on quantifying this willingness and identifying its drivers.

5. Conclusions

Consumers' purchases of carbon-labeled agricultural products can contribute to emission reductions in the agricultural sector from the consumption side, thereby supporting broader climate change mitigation efforts. To examine Chinese consumers' purchase intentions toward such products and the factors influencing them, a questionnaire survey of 734 consumers was conducted in Shanghai. The data were analyzed using PLS-SEM to empirically test the hypothesized relationships. The findings reveal three key insights. First of all, while consumers express a generally strong intention to purchase carbon-labeled products, their awareness and understanding of carbon labeling remain limited, indicating a need for targeted educational and promotional interventions. Moreover, purchase intention is shaped by a multifaceted set of factors: consumption attitudes exert a significant direct positive effect ($\beta = 0.215$, $p < 0.001$), whereas perceptions of carbon labeling ($\beta = 0.201$, $p < 0.001$) and climate change ($\beta = 0.186$, $p < 0.001$) significantly influence these attitudes, which in turn mediate their indirect effects on purchase intention ($\beta = 0.043$, $p < 0.001$; $\beta = 0.040$, $p < 0.001$). Subsidy policies significantly moderate the relationship between consumption attitudes and purchase intention ($\beta = 0.075$, $p < 0.05$), amplifying its strength, whereas willingness to pay a premium does not exert a significant moderating effect ($\beta = -0.047$, $p < 0.128$). Finally, the proposed research model explains 36.7% of the variance in purchase intention and supports six of the seven hypothesized relationships, reaffirming established behavioral linkages and offering novel insights into the mediating role of consumption attitudes and the moderating influence of policy incentives in the context of low-carbon agricultural consumption.

This study also makes three significant contributions. To begin with, this study provides one of the first empirical examinations of Chinese consumers' purchase intentions toward carbon-labeled agricultural products, offering timely evidence from an emerging market where such products are still new and unfamiliar. In addition, by integrating perceptual, attitudinal and policy-related factors into a unified model, the study identifies not only the direct drivers of purchase intention but also the mediating role of consumption attitudes and the moderating effect of subsidy policies, thereby extending theories of low-carbon consumption. Furthermore, the findings deliver actionable guidance for policymakers and practitioners by highlighting the importance of raising consumer awareness, fostering positive attitudes and designing effective subsidy policies to promote low-carbon agricultural products.

The conclusions of this study should be interpreted with caution due to several limitations. A pilot study revealed that Chinese consumers generally have limited awareness of the concept of carbon labeling. To address this, a concise explanation was included at the start of the survey. However, this intervention may have inadvertently shaped respondents' perceptions and purchase intentions, introducing potential bias. In addition, while the demographic characteristics of the survey sample broadly align with the target consumer segment for carbon-labeled agricultural products, the findings remain context-specific. Given that the data were collected exclusively in Shanghai, this study should be regarded as a case based on a single urban sample. Notable differences in economic development and household consumption patterns exist between Shanghai and other regions of China. Consequently, the generalizability of the research findings to consumers in other parts of the country – particularly rural areas – may be limited. To address these limitations, future research could benefit from refining the questionnaire design to minimize priming effects and enhance construct validity. Incorporating qualitative methods, such as in-depth consumer interviews or focus groups, would provide richer insights into the cognitive and emotional dimensions of low-carbon

purchasing behavior. Moreover, expanding the geographic scope to include diverse urban and rural regions across China would improve the generalizability of findings and reveal regional variations in consumer attitudes and behaviors. Future studies might also explore purchase intention across different categories of carbon-labeled goods, such as electronics, clothing and household appliances, which may exhibit distinct consumption dynamics. Such comparative and regionally inclusive research would contribute to a more nuanced understanding of consumer engagement with low-carbon products and offer actionable insights for policymakers and businesses seeking to promote sustainable consumption. Ultimately, these efforts would support the broader goal of advancing China's low-carbon transition through informed consumer behavior.

Acknowledgements

The authors express their gratitude to Dr J. Arbuckle of Iowa State University for his valuable feedback during the preparation of this manuscript.

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Further reading

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