

Bridging the Dual Divide: E-commerce Transformation of Specialty Agricultural Products - A Case Study of Jinhua Bergamot

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Abstract

The digital transformation of specialty agricultural products through e-commerce has become a critical pathway for rural revitalization in China. However, many geographically indicated products face a persistent dilemma known as “high quality without premium pricing”. This issue arises from a structural disconnect between production and consumption. This study investigates the e-commerce transition of Jinhua bergamot (*Citrus medica* “Fingered”), a nationally recognized geographical indication product with nearly a millennium of cultivation history, under the analytical lens of a “dual divide” framework. We argue that the e-commerce performance of specialty agricultural products is jointly constrained by two interconnected gaps: the producer digital literacy divide (farmers’ insufficient capacity to engage in online marketing) and the consumer cognitive divide (consumers’ limited awareness and trust regarding the product’s value). This research adopts a mixed-methods design that includes a survey of 509 respondents, semi-structured interviews with more than 30 stakeholders, and multiple quantitative analytical tools. The adopted tools cover descriptive statistics, TwoStep clustering, Least Absolute Shrinkage and Selection Operator (LASSO) regression, and structural equation modeling (SEM). With these methods, we systematically analyze the supply-demand imbalance within the e-commerce ecosystem of Jinhua bergamot. Empirical results show only 7.0% of consumers can fully grasp the functional and cultural value of bergamot, 62.0% cannot recognize local related brands, and more than 60.0% fail to distinguish Jinhua bergamot from bergamot produced in other competing regions. From the supply side, farmers are highly willing to join e-commerce operations but lack comprehensive operational capabilities across the whole digital industrial chain. Our SEM results identify product cognition, brand trust, and channel convenience as core mediating factors of purchase intention, and these three variables together explain 68.3% of the variance in purchase intention. Based on the above results, we put forward an integrated development path built on brand empowerment, digital skill training, multi-stakeholder cooperation, and cultural value embedding. This study constructs a “dual divide” analytical framework to enrich existing literature on rural e-commerce, and it provides operable suggestions for geographically indicated specialty agricultural products undergoing digital transformation.

Keywords

Consumer behavior, E-commerce, Geographical indication products, Rural revitalization, Specialty agricultural products

Introduction

The digital transformation of agricultural product marketing has emerged as a cornerstone of rural revitalization strategies worldwide [1]. In China, the confluence of rural e-commerce infrastructure development, logistics network expansion, and mobile payment penetration has created unprecedented opportunities for specialty agricultural products to reach national and even global markets [2]. The central government has issued consistent policy support

covering the Rural Revitalization Strategy, the “Digital Village” initiative, and the explicit requirement of improving rural industrial development levels laid out in the 2025 Central Document No.1. Such policy orientation has made e-commerce a strategic tool to narrow urban-rural economic gaps and raise farmers’ incomes [3].

Despite these enabling conditions, a persistent and perplexing phenomenon has emerged across China’s

specialty agricultural product sectors: Many products with demonstrable quality advantages, cultural heritage, and geographical indication (GI) certification struggle to achieve commensurate market recognition and premium pricing. This “high quality without premium value” syndrome represents a critical bottleneck in the rural e-commerce transition, particularly for smallholder-dominated, culturally rich but commercially underexploited products [4]. The gap between production excellence and market performance points to structural mismatches that cannot be resolved through infrastructure investment alone.

Jinhua bergamot (*Citrus medica* “Fingered”), a GI product cultivated in Zhejiang Province for over nine centuries, exemplifies this dilemma. This fruit has unique features including rich fragrance, a special finger-shaped appearance, proven medicinal effects recorded in traditional Chinese pharmacopoeia, and profound cultural meanings linked to the concepts of fortune and longevity in Chinese folk culture. The core planting zone located in Beishankou Village of Jindong District covers more than 1,800 mu, equivalent to roughly 120 hectares. Each year, the area produces over 1,000 tons of fresh bergamot and more than one million potted bergamot seedlings. Fresh bergamot prices climbed from 30 RMB per kilogram in 2020 to 70 RMB per kilogram in 2025, which reflects robust potential market demand. Even so, the e-commerce development of this industry falls far short of its quality advantages. Few consumers outside Zhejiang know about this product, and local related brands have little public recognition. The market mainly sells fresh fruit and simple potted plants, while value-added products such as bergamot tea, preserved fruit, essential oil and cultural creative merchandise only occupy a small market share.

This study addresses the following research questions:

- (1) What are the structural characteristics of the supply-demand mismatch in Jinhua bergamot’s e-commerce ecosystem?
- (2) What factors determine consumer purchase intentions for GI specialty products?
- (3) How can the identified “dual divide”, which covers producer digital literacy constraints and consumer cognitive barriers, be systematically bridged to enable sustainable e-commerce transformation?

This study argues that two interrelated gaps together

restrict the e-commerce development of specialty agricultural products. The first gap is the divided digital literacy producer. It means farmers hold a strong willingness to run online businesses but lack abilities in online marketing, content creation and digital transaction management. The second gap is the consumer cognitive divide, which describes consumers’ insufficient awareness, fragmented understanding and weak trust toward the functional, cultural and quality features of such products. These two gaps are not separate from each other. Instead, they strengthen one another. If producers fail to present products properly online, consumers cannot obtain accurate product information. Meanwhile, low consumer recognition and weak market demand will remove producers’ motivation to improve their digital capabilities. A systematic solution that targets both sides of the market at the same time is necessary to break this negative cycle.

This study makes three theoretical contributions. First, it constructs and applies a unified “dual divide” analytical framework. The framework combines limiting factors from both the supply side and the demand side. It fills in a research gap in existing rural e-commerce studies, as most previous literature only analyzes producer behaviors or consumer preferences separately [5]. Second, this research designs and verifies an empirical analysis framework with multiple research methods. This framework includes questionnaire surveys, interviews with relevant stakeholders, and advanced quantitative tools. Such quantitative tools cover TwoStep clustering, LASSO regression and SEM. The whole set of methods is used to explore the complicated mechanisms that shape consumers’ willingness to buy specialty agricultural products. Third, we provide rigorous empirical evidence from a representative GI product, contributing to the limited body of quantitative research on niche specialty agricultural product e-commerce in China.

Practically, this study offers actionable insights for policymakers, industry associations, e-commerce platforms, and smallholder farmers seeking to unlock the market potential of geographically indicated specialty products. The findings can guide the formulation of targeted strategies. These strategies cover brand building, digital skill training, consumer education, product diversification and multi-stakeholder coordination. Such comprehensive measures can jointly narrow the dual

divide and realize sustainable e-commerce transformation.

Literature review

Rural e-commerce development: Patterns and determinants

Rural e-commerce has attracted substantial scholarly attention as a transformative force in agricultural marketing and rural development. International research has documented the emergence of “Taobao villages”, rural settlements where e-commerce has become the dominant economic activity, as a distinctive Chinese phenomenon [6]. Tim et al. conceptualized rural e-commerce as an evolving ecosystem comprising platforms, logistics providers, financial services, and information networks, organized in a “platform + household + logistics” tripartite structure [7]. Cui et al. documented the evolutionary trajectory from isolated “Taobao villages” to interconnected “Taobao towns,” reflecting increasing network density and spatial integration [8].

Research on determinants of rural e-commerce adoption has identified three primary categories of factors. Infrastructure, particularly broadband access and logistics networks, is widely recognized as a prerequisite for e-commerce viability [9]. Human capital, especially digital literacy and entrepreneurial experience, significantly influences farmers’ participation decisions [10]. Government policy support, including financial subsidies, training programs, and infrastructure investment, has been shown to accelerate adoption rates. Liu and Zhou further demonstrated that e-commerce expansion can narrow urban-rural income gaps through market integration effects [11].

Domestic scholarship has paralleled these international findings while emphasizing context-specific dynamics [12,13]. Chinese researchers have extensively documented rural e-commerce models, including “industrial park + new agricultural enterprises,” “collective economy + e-commerce” (exemplified by the “Beishan model”), and government-led demonstration zones. The emergence of live-streaming e-commerce has been particularly highlighted as a breakthrough for overcoming the “last mile” challenge in rural product distribution [14,15].

However, existing research shows an obvious bias toward mainstream research objects. Most studies overly

focus on large-scale agricultural products with sound commercial operation and regions with mature e-commerce development. Many niche specialty products have unique quality and cultural connotations, yet they feature small output scales, insufficient processing capacity and weak brand influence. Such products are rarely covered in empirical studies [16]. This gap is particularly consequential for GI products, which face unique challenges in consumer education, brand building, and quality signaling that differ fundamentally from commodity agricultural products.

Geographical indication products and branding challenges

Geographical indication (GI) certification can grant legal protection and quality guarantee to agricultural products unique to certain regions. It also helps these products form differentiated competitiveness and achieve higher selling prices. International scholars have studied GI branding as an effective strategy. This strategy can preserve local cultural heritage, boost rural development and relieve the negative impacts brought by globalization [17]. Still, empirical research has found many obstacles that stop GI certification from improving market performance. Typical difficulties include scattered producer groups, imperfect quality management systems, insufficient marketing ability, and consumer confusion between GI products produced in different areas [18].

For Jinhua bergamot specifically, a critical challenge lies in consumer differentiation. The product competes with bergamot from Guangdong (“Guang bergamot”) and Sichuan (“Chuan bergamot”) varieties that are geographically distant but often confused by consumers due to superficial similarities. Jinhua bergamot has unique features such as richer aroma, neater fruit shape and longer-lasting scent. If these advantages cannot be clearly conveyed to consumers, the GI label will lose its value as a reliable quality marker in the market. This problem becomes more serious because there is no complete regional brand system to unify scattered producers under a unified market image.

Consumer behavior and purchase intention

Understanding consumer decision-making for specialty agricultural products requires integrating insights from food marketing, consumer psychology, and e-commerce research. Key determinants of purchase intention in this context include product cognition (knowledge of product

attributes, uses, and quality cues), brand trust (confidence in product authenticity and quality consistency), and channel convenience (ease of access, transaction efficiency, and post-purchase support) [19].

Experience goods refer to products that consumers cannot fully judge the quality only through texts or pictures, and such goods bring unique difficulties to e-commerce marketing [20]. Agricultural specialty products, with their quality variations tied to production conditions, seasonal factors, and handling practices, exemplify this category. Consumers face uncertainty regarding product freshness, authenticity, and quality consistency when purchasing unfamiliar agricultural products online [21]. This uncertainty is especially pronounced for GI products with limited national brand recognition, where consumers lack the anchor of prior experience or trusted third-party information [22].

Research gaps

Despite the extensive literature on rural e-commerce, branding, and consumer behavior, significant research gaps remain, which this study seeks to address.

First, prior research separates supply and demand sides for separate analysis in a fixed pattern. Most studies only discuss problems on the producer side or factors on the consumer side. Research on the producer side covers obstacles to e-commerce adoption, infrastructure limitations and income changes. Research on the consumer side involves personal preferences, payment willingness and shopping channel selection. Few scholars combine these two dimensions into one integrated analysis framework. This separation is not just a simple academic research habit, and it will bring tangible negative impacts. It hides the structural imbalance formed by mismatched producer capacity and consumer expectation. This imbalance widely exists in various GI specialty agricultural products. Taking Jinhua bergamot as an example, local farmers own high-quality products yet lack digital capabilities to display products well online. Meanwhile, consumers have potential purchasing needs, but they cannot get enough information to judge product quality or trust unknown brands. These two conditions are not independent; they reinforce each other in a vicious cycle. Yet existing literature provides limited theoretical tools or empirical evidence for understanding how these dual constraints interact or how they might be addressed simultaneously.

Previous research treats supply and demand as independent research subjects. Such practice ignores the interactive relationship that decides whether quality information can be smoothly transmitted from producers to consumers. This research fills the above research gap. Second, from a methodological perspective, studies on e-commerce of specialty agricultural products mostly adopt qualitative case analysis and descriptive statistics. Few papers apply advanced quantitative methods to identify and verify the driving mechanisms of consumers' purchase intentions. Qualitative research can effectively reveal contextual factors and views of different stakeholders, yet this research field still lacks a complete set of standardized analysis procedures. A complete analytical system should achieve three functions. For one thing, it can classify consumers into different behavioral groups according to real survey data instead of subjective judgment. For another, it can screen core influencing factors from numerous alternative variables while eliminating the interference of confounding factors. Lastly, it can test causal relationships with strict structural modeling tools. The lack of integrated analytical methods that integrate consumer segmentation, factor identification and mechanism validation weakens the empirical basis of relevant policy and strategic recommendations. Without rigorous quantification of effect sizes and pathway significance, policy interventions risk being informed by intuition rather than evidence, and strategies that appear effective in one context may be misapplied to others where causal mechanisms differ. This methodological gap is particularly consequential for niche products with limited research attention, where the empirical base for decision-making is already thin. The present study addresses this gap by employing a multi-method design that integrates TwoStep clustering, LASSO regression, and structural equation modeling within a coherent analytical framework.

Third, empirically, specialty agricultural products with GI status but limited e-commerce maturity have received disproportionately scant attention in the literature. This gap is consequential for two reasons. On the one hand, such products face distinct challenges that differ fundamentally from those of established commercial agricultural products or "star" agricultural products that have already achieved significant online market

penetration. This study summarizes four core industry challenges. First, consumers generally lack familiarity with the product. Most potential consumers have never known or purchased Jinhua bergamot. Second, the regional brand system is imperfect. There is no mature regional brand to unify scattered producers and shape a consistent market image. Third, producer groups are fragmented. The industry is dominated by small-scale farmers, who have limited ability to carry out unified collective operations. Fourth, the supporting processing infrastructure is insufficient. The industry lacks the capacity to develop value-added products, resulting in a market scope limited to fresh fruit sales. On the other hand, copying the mature development models of large-scale agricultural products often fails to bring good results for such niche specialty products. This phenomenon occurs fundamentally because niche and large-scale agricultural products have different basic conditions in terms of market popularity, producer organization and consumer trust. The absence of dedicated empirical research on this product category means that policymakers and practitioners lack evidence-based guidance for designing interventions appropriate to the specific constraints these products face. Consequently, niche GI products remain trapped in a low-awareness, low-trust equilibrium, their potential economic and cultural value unrealized.

This study addresses these interconnected gaps through three corresponding contributions. First, this study constructs a “dual divide” analytical framework. It effectively integrates supply-side and demand-side restrictive factors into a unified explanatory model. The framework clarifies that producer digital literacy limitations and consumer cognitive obstacles can reinforce each other, which means the two problems must be solved collaboratively. Second, this research adopts a multi-method empirical research design. It is based on 509 valid questionnaire responses and interviews with more than 30 core stakeholders. It also applies multiple advanced quantitative analysis tools. The research uses TwoStep clustering to classify consumer groups, LASSO regression to screen core influencing factors, and structural equation modeling to verify internal impact mechanisms. This standardized analytical process can be referenced and applied by subsequent studies on specialty product markets. Third, this study selects Jinhua bergamot, a typical GI specialty

product in the e-commerce transformation stage, as the research object. It supplements the insufficient empirical research on such niche agricultural products and provides actionable references for other GI products facing similar industrial dilemmas. This study integrates standardized theoretical construction, rigorous methodological design and solid empirical analysis. It aims to enrich academic research on the e-commerce development of GI specialty agricultural products and provide practical optimization strategies for industrial transformation.

Theoretical framework and research hypotheses

The “dual divide” analytical framework

This paper proposes a “dual divide” framework to explain the e-commerce performance gap in GI specialty agricultural products. The framework posits that the e-commerce outcomes of such products are jointly determined by two interconnected divides that operate at different points in the market value chain but are systematically linked through feedback mechanisms. This framework builds upon and synthesizes three intellectual traditions: the information asymmetry literature in agricultural economics, the digital divide scholarship in development studies, and the consumer information processing literature in marketing science. By integrating these streams of research, the dual-divided framework offers a more comprehensive analytical lens than existing approaches, which have tended to examine either supply-side or demand-side constraints in isolation. The framework’s core insight is that the persistent phenomenon of “high quality without premium pricing” is not a paradox but a predictable equilibrium outcome of the interaction between these two divides.

The producer digital literacy divide refers to the gap between farmers’ willingness to participate in e-commerce and their operational capacity across the digital value chain. This divide encompasses multiple reinforcing dimensions that span the full range of e-commerce activities. In terms of technical proficiency, farmers are deficient in multiple digital capabilities. They lack basic platform operational skills, including navigating e-commerce interfaces, maintaining product listings, and improving search exposure. They also have insufficient content creation abilities such as product photography, video shooting, and live broadcast presentation. Furthermore, farmers struggle with data management, which covers data interpretation and

customer database maintenance. In terms of marketing capabilities, farmers show obvious deficiencies in online promotion. They are unable to design efficient promotional activities or take advantage of social media algorithms. They also lack proficiency in customer interaction, including replying to consumer consultations and maintaining online reviews. In addition, local farmers have inadequate branding capabilities to highlight product differentiation and establish market recognition. In terms of business management, farmers face difficulties in order processing, after-sales service and product quality control. Farmers generally have profound practical experience in agricultural cultivation. Such production expertise is accumulated through generational farming practices and constitutes the production-oriented link of the industrial value chain. Nevertheless, most smallholders lack professional sales capabilities to support high-quality e-commerce operations. This capability mismatch is not simply caused by individual skill shortages. It is a structural problem rooted in the educational background, social networks and institutional environment of smallholder communities, where digital-related competencies have never been systematically required or cultivated.

The consumer cognitive divide refers to the gap between the inherent quality and cultural value of GI products and consumers' awareness, understanding, and trust regarding these attributes. This divide manifests through four interconnected mechanisms. First, limited product knowledge: Consumers lack information about functional uses, quality cues, and the significance of GI certification. Second, low brand recognition: consumers cannot name or recall brands associated with the product, meaning they cannot reliably identify authentic offerings. Third, confusion among competing products: Consumers cannot distinguish Jinhua bergamot from Guangdong or Sichuan varieties, rendering origin-based differentiation ineffective as a quality signal. Fourth, trust deficits stemming from information asymmetry: Consumers face uncertainty regarding product authenticity, quality consistency, and post-purchase support, particularly when price premiums are involved. This divide is further aggravated by the inherent attributes of GI experience goods. Consumers cannot fully evaluate product quality merely through text and visual information, and complete judgment can only be formed after actual consumption.

Consumers do have potential purchasing demand. They are attracted by product novelty, cultural connotations and potential health values. However, they lack sufficient effective information, which prevents their latent demand from turning into actual purchasing behavior.

Crucially, the two types of divides are not isolated. Instead, they form a self-strengthening closed loop that leads to persistent market inefficiency. Producers rely on professional photography, vivid product descriptions and high-quality live-streaming content to display products online. Without such professional presentation capabilities, consumers cannot obtain accurate product information and will remain trapped in cognitive barriers. Without consumer awareness and demonstrated demand, producers lack both the incentives and the financial resources to invest in digital capability development, remaining trapped in the literacy divide. This creates a vicious cycle: low producer capability → poor online presentation → low consumer awareness → weak demand signals → low producer investment → continued low capability. A positive industrial cycle is therefore blocked. In a healthy market cycle, improved producer capabilities support effective quality information delivery. Such information transmission raises consumer awareness and trust, thereby stimulating market demand. The growing demand further encourages producers to invest more in industrial upgrading. Breaking this cycle requires simultaneous intervention on both divides: building producer capacity while also investing in consumer education and trust-building. Single-sided interventions, such as training farmers in e-commerce skills without addressing consumer awareness, are unlikely to succeed because the feedback loop will persist through the unchallenged side of the divide.

The dual divided framework offers several analytical advantages over alternative approaches. First, it provides a parsimonious explanation for the persistent market underperformance of products with demonstrable quality advantages by identifying the specific mechanisms through which value is lost in transmission between producer and consumer. Second, it generates testable propositions about the relative importance of different divided dimensions and their interactions, enabling empirical validation through the multi-method approach described in subsequent sections. Third, it offers a practical diagnostic tool for stakeholders: By mapping

the specific dimensions of each divide relevant to a particular product context, stakeholders can prioritize investments in the most binding constraints. Fourth, this study recognizes that both divides are deeply rooted in structural factors. The producer-side divide stems from widespread inequalities in education and institutional environments. In comparison, the consumer-side divide originates from information asymmetry. Such information gaps are inherent in long-distance transactions of experience-based products that rely heavily on consumer trust. This structural awareness cautions against simplistic solutions and encourages comprehensive, multi-stakeholder approaches that address root causes rather than symptoms.

Research hypotheses

Based on the dual divide framework, we formulate five hypotheses to empirically test the proposed relationships. The first four address the demand-side mechanisms linking consumer cognition and trust to purchase intention; the fifth addresses the supply-side relationship between producer digital literacy and e-commerce outcomes.

H₁: Consumer purchase intention for GI specialty agricultural products is positively influenced by product cognition. Product cognition refers to consumers' understanding of product attributes, functions, quality characteristics and cultural connotations. It helps consumers conduct rational product evaluation and reduce perceived purchase risks. Without adequate cognition, consumers cannot appreciate the quality advantages that justify premium pricing. We therefore expect higher product cognition to strengthen purchase intention.

H₂: Consumer purchase intention for GI specialty agricultural products is positively influenced by brand trust. Brand trust provides consumers with confidence in product authenticity and quality consistency, serving as a quality signal in the absence of direct experience. For GI products with limited national recognition, brand trust is essential for overcoming uncertainty and converting latent interest into actual transactions.

H₃: Consumer purchase intention for GI specialty agricultural products is positively influenced by channel convenience. Channel convenience means the simplicity of accessing product information, finishing transactions and receiving stable delivery services. It directly determines whether consumers will convert purchase

intentions into actual buying behavior. Friction in the purchasing process disproportionately deters purchases of unfamiliar specialty products, making convenience a critical determinant.

H₄: Product cognition positively influences brand trust, indicating a mediated pathway from knowledge acquisition to purchase confidence. Knowledge and trust are not independent but causally linked: product cognition provides the informational foundation upon which brand trust is built. Consumers who understand a product's distinctive qualities are better positioned to evaluate brand claims and form reasoned trust. Thus, product cognition exerts both a direct effect on purchase intention and an indirect effect mediated through brand trust.

H₅: The producer digital literacy divide is significantly negatively correlated with e-commerce adoption and performance. Farmers with lower digital literacy show lower willingness to adopt e-commerce channels. For farmers who have already adopted e-commerce, insufficient digital literacy also leads to suboptimal operational outcomes, including reduced sales volume, inadequate customer interaction and lower profit margins. This hypothesis directly tests the supply-side proposition of the dual divide framework.

These five hypotheses provide a comprehensive empirical test of the dual divide framework, examining both demand-side mechanisms and supply-side constraints.

Research design and methodology

Case selection

Jinhua bergamot (*Citrus medica* "Fingered") was selected as the research case for three primary reasons, each addressing a distinct dimension of case selection criteria: representativeness, theoretical relevance, and practical feasibility.

First, Jinhua bergamot is a nationally certified geographical indication product with a cultivation history of nearly a thousand years. It is a typical representative of culturally profound but commercially underdeveloped specialty agricultural products. Such products occupy an important position in China's agricultural industry but have long been neglected in existing academic research. Differing from mass-produced agricultural goods and mature digital star agricultural products that have been widely studied,

Jinhua bergamot reflects the common dilemmas of numerous domestic GI products. These products possess profound cultural heritage and verified quality advantages while suffering from narrow market coverage and low consumer recognition outside their local producing areas. This representativeness ensures that findings from this single case can offer insights transferable to analogous products facing similar structural constraints.

Second, the product exhibits the “high quality without premium pricing” syndrome in a particularly acute form. Despite rising farm-gate prices within the local market, the product has failed to achieve commensurate brand recognition or price premiums on national e-commerce channels. This empirical context makes Jinhua bergamot a suitable research setting for examining the dual divide phenomenon. Its mismatch between superior product quality and unsatisfactory market performance cannot be attributed to product defects. Instead, this gap stems from inefficient information transmission between producers and consumers, which serves as the core research focus of the dual divide framework. Therefore, this case provides a critical scenario to verify the explanatory power of the proposed framework.

Third, the research team had established access to the production area through prior collaboration with local government, industry associations, and producer cooperatives, enabling comprehensive field investigation. This pre-existing trust relationship was essential for conducting the in-depth interviews, extended field observations, and repeated survey administrations required for the mixed-methods design. Research on smallholder agricultural systems is notoriously dependent on trust-based access; the team’s established presence in the community eliminated the startup costs and access barriers that often constrain field research in rural settings.

The core research site was Beishankou Village in Chisong Town, Jindong District, Jinhua City. This area has long served as the central production base for Jinhua bergamot and is widely recognized as the hometown of Chinese bergamot. This village was selected not only for its core historical status in bergamot cultivation but also for its diverse industrial scenarios that fully represent the overall production area. It covers smallholder planting modes, cooperative operation models, enterprise-connected production bases, and newly developed e-

commerce businesses. The research scope covered eight peripheral bergamot-planting villages, 26 cultivation bases, 12 processing enterprises, six professional live-streaming studios, and four government-backed co-prosperity workshops designed to expand rural employment and increase farmers’ income. The expanded sampling scope enables this research to fully capture diversified production scales, marketing channels and stakeholder viewpoints within the Jinhua bergamot industrial ecosystem. It covers subjects ranging from traditional small-scale farmers to digitally empowered enterprises, laying a solid empirical foundation for subsequent multi-dimensional analysis.

Data collection

This study employed mixed-methods design integrating surveys, semi-structured interviews, and secondary data collection.

(1) Survey design

Two parallel survey instruments were developed: a producer questionnaire targeting farmers and a consumer questionnaire targeting potential purchasers. The producer questionnaire covered production scale, sales channels, e-commerce adoption status, digital literacy self-assessment, and development needs. The consumer questionnaire covered sociodemographic factors, product knowledge, brand awareness, purchase behavior and intentions, preferred channels, and willingness to pay for GI-labeled products. The core measurement dimensions and corresponding scale items of the consumer questionnaire are shown in Table A1 (see Appendix). Both instruments underwent preliminary testing with 30 respondents from the target populations, followed by reliability and validity assessment (Cronbach's $\alpha > 0.78$ for all dimensions).

(2) Producer survey

A stratified sampling method was adopted throughout the main production areas. A total of 205 questionnaires were distributed to farmers and base operators, yielding 185 valid responses and achieving a response rate of 90.2%. Furthermore, semi-structured interviews were carried out with three village Party secretaries and 18 principals of production bases and cooperatives. The transcribed interview texts amount to more than 30,000 Chinese characters.

(3) Consumer survey

Online questionnaires were distributed nationwide via

mainstream social platforms including WeChat, Douyin, and Xiaohongshu targeting domestic consumers. A total of 436 consumer questionnaires were issued, and 324 valid responses were retrieved, with an effective response rate of 74.3%. By integrating valid data from both producer and consumer surveys, the final overall sample size reached 509. The research samples cover multiple provinces, age groups and income brackets across the country, which guarantees sufficient representativeness for national-level consumer behavior analysis.

(4) Interviews

This study conducted semi-structured interviews with over 30 key informants covering the entire industrial value chain. The interviewees included farmers, cooperative leaders, processing enterprise managers, village cadres, administrative staff from local agricultural and market supervision departments, e-commerce live streamers, and industry association representatives. Each interview lasted 45 to 90 minutes. All interview contents were audio recorded, transcribed, and analyzed through thematic coding. The total volume of transcribed interview materials exceeded 40,000 Chinese characters.

Analytical methods

This study employs a sequential multi-method analytical approach, progressing from descriptive characterization to consumer segmentation, then to factor identification, and finally to mechanism validation. This progression reflects an increasing level of analytical sophistication, with each stage building upon the insights generated by the preceding stage.

(1) Descriptive statistical analysis

Statistical Package for the Social Sciences (SPSS) was used to characterize sample distributions, identify patterns in current e-commerce status, and compare subgroup differences across key variables. This study adopted descriptive statistical methods such as frequency analysis, mean calculation, standard deviation analysis and cross-tabulation analysis. These approaches generate a preliminary empirical overview of both producer and consumer samples and establish a baseline reference for subsequent sophisticated pattern analysis. These preliminary analyses also informed the variable selection and model specification decisions in subsequent stages.

(2) TwoStep cluster analysis

TwoStep clustering was applied to consumer data to

identify distinct consumer segments based on product knowledge, consumption habits, and purchase intentions. This method was chosen for its ability to handle both continuous and categorical variables simultaneously and to automatically determine the optimal number of clusters. The Bayesian information criterion (BIC) determined the optimal number of clusters, with the smallest BIC value indicating the best-fitting cluster solution. Cross-cluster differences were tested for significance to ensure that the identified segments were empirically distinguishable. This segmentation analysis served to reveal the heterogeneity underlying aggregate consumer patterns, identifying which consumer groups are most promising targets for e-commerce interventions.

(3) LASSO regression

LASSO regression was employed to identify the most influential factors among 22 candidate variables organized into four latent dimensions: Product cognition, brand trust, channel convenience, and perceived value. LASSO was selected over conventional regression methods because it simultaneously performs variable selection and regularization, effectively addressing multicollinearity among candidate predictors. The optimal penalty parameter λ was determined via cross-validation, enabling the model to retain only the most predictive variables while shrinking coefficients of less influential factors toward zero. This step was essential for distilling the large set of measured items into a parsimonious set of core predictors for the structural model.

(4) Structural equation modeling (SEM)

Analysis of moment structures (AMOS) 26.0 was used to construct an SEM incorporating latent variables identified through the LASSO analysis. The model specified direct paths from exogenous variables to purchase intention, corresponding to Hypotheses H₁ through H₃, and an indirect pathway through brand trust, corresponding to Hypothesis H₄. SEM was chosen because it enables simultaneous estimation of multiple relationships, accounts for measurement error in latent constructs, and allows for testing of both direct and indirect effects within a single analytical framework. Model fit was assessed using multiple indices: the chi-square to degrees of freedom ratio (χ^2/df), the comparative fit index (CFI), the Tucker-Lewis index (TLI), the root mean square error of approximation

(RMSEA), and the standardized root mean square residual (SRMR). The indirect effect was tested using the bootstrap method with 5,000 resamples, which provides bias-corrected confidence intervals for mediated pathways without relying on the normal distribution assumption.

Empirical findings

Descriptive findings

(1) Consumer awareness gap

Survey results show merely 7.0% of respondents hold a comprehensive understanding of the functional and cultural values of bergamot. This proportion reflects a severe information shortage for the product within the national consumer market. The 7.0% corresponds to consumers capable of identifying multiple applications, judging quality standards, and grasping the product's cultural connotations. The majority (62.3%) reported only "having heard of bergamot" but being unable to describe its uses or attributes, placing them in a state of shallow awareness that falls far short of purchase-readiness. The remaining respondents had no awareness whatsoever. This shallow awareness base represents a fundamental constraint on market development, as consumers cannot purchase products they do not understand or appreciate. Brand recognition was similarly limited: 62.0% of respondents could not name a Jinhua bergamot brand, and over 60.0% could not distinguish Jinhua bergamot from Guangdong or Sichuan varieties - a finding that reveals the absence of effective brand differentiation in the marketplace. Without the ability to distinguish among competing origins, consumers cannot make informed choices, and the quality advantages of Jinhua bergamot cannot command a premium. The most frequently cited information sources were passive: "came across in passing" (45.6%) and "friends or family mentioned" (28.4%), with active searches occurring in only 12.3% of cases. This passive information acquisition pattern suggests that consumers are not actively seeking out information about bergamot, indicating that current marketing efforts are insufficient to generate consumer curiosity or engagement.

(2) Purchase preference

Among respondents who had purchased bergamot products, 61.4% had bought raw fruit or basic bonsai, while only 23.6% had purchased processed products such as bergamot tea, preserves, or essential oils. This

distribution reflects a product structure dominated by primary products with minimal added value. Such characteristics align with the industry's insufficient processing capability and underdeveloped brand building. However, interest in value-added product exploration was remarkably high: 71.8% expressed willingness to try "bergamot-infused wellness products", 65.4% expressed interest in "culturally packaged gift sets" and 58.2% would consider "bergamot-scented home fragrance products". These figures indicate substantial latent demand for product diversification that is not currently being served. The preference gap between what consumers currently purchase and what they would like to purchase suggests that product development, rather than demand creation, may be the binding constraint in this market. Consumers are ready for a wider range of offerings; the industry has simply not yet delivered them.

(3) Channel preference and mismatch

Consumer channel data demonstrates a strong inclination toward online shopping. A total of 96.0% of respondents prefer online consumption over offline shopping, with available options covering e-commerce platforms, live-streaming sales and social commerce channels. This overwhelming online preference reflects the broader digitalization of Chinese consumer behavior, particularly among younger and urban demographics. However, producer-side survey data indicate that 78.2% of current bergamot sales occur through offline wholesale or retail channels, with online sales accounting for merely 12.5% of total production. Stark contradictions exist in channel selection between consumers and producers. While 96% of consumers prefer online shopping, only 12.5% of producers adopt online sales modes. Such a prominent channel mismatch forms a structural barrier that greatly restricts the market accessibility of Jinhua bergamot products. The mismatch is not simply a gap but a directional contradiction: Consumers are seeking products where producers are not selling, and producers are selling products where consumers are not buying. This misalignment ensures that even when consumers are interested in bergamot products, they encounter difficulty locating and purchasing them through their preferred channels, depressing overall sales and market penetration.

(4) Producer digital literacy gap

Among farmers surveyed, 84.3% expressed willingness

to engage in e-commerce marketing, indicating strong motivation that transcends age, education, or farm size. This near-universal willingness suggests that farmers recognize both the opportunity presented by e-commerce and the threat of being left behind by digital transformation. However, self-assessed digital competence remained starkly low: only 22.7% reported being “able to operate an online shop independently”, 15.6% could “produce basic product photography”, 11.3% could “manage live-streaming sessions”, and a mere 8.4% could “conduct data analysis for operational decisions”. There exists an obvious gap between willingness and practical capability. A total of 84.3% of producers show willingness to conduct online sales, yet merely 8.4% possess advanced operational capabilities. This gap constitutes the core of the producer digital literacy divide. Farmers want to participate in e-commerce but lack the competencies required for effective participation. The gap is not evenly distributed; it is widest for the most advanced skills that are critical for competitive success in the current e-commerce environment, suggesting that basic training alone will be insufficient without ongoing support and capability development.

Cluster analysis: Consumer segmentation

TwoStep cluster analysis identified three distinct consumer segments, each characterized by a unique configuration of product knowledge, brand engagement, purchase behavior, and demographic attributes. These segments vary substantially in size, with one dominant group comprising over half the sample and two smaller but strategically significant groups at opposite ends of the engagement spectrum. The segmentation reveals that the consumer market for Jinhua bergamot is not homogeneous but comprises groups with fundamentally different relationships to the product, suggesting that differentiated marketing strategies will be more effective than uniform approaches.

(1) Segment 1: cognitively engaged enthusiasts (18.5% of sample)

This segment achieves the highest product knowledge scores, with a mean value of 4.72 on the 5-point scale. This result reflects comprehensive awareness of bergamot’s functional applications, quality standards and cultural connotations. Members of this group demonstrate the most positive brand associations, the

highest purchase frequency, and the strongest willingness to pay a premium - an average premium acceptance of plus 38.6% over baseline prices. Demographic characteristics show that this group mainly consists of elderly consumers aged 50 and above, high-income households, and highly educated individuals. These consumers maintain close connections with bergamot culture through personal life experience, local cultural identity, or exposure to traditional Chinese medicine and related cultural practices. For these consumers, bergamot is not a novel product but a familiar cultural artifact; their engagement is driven by intrinsic appreciation rather than marketing influence. While valuable as a foundational market segment, their limited numbers and demographic concentration suggest limited growth potential; they are a market to be retained rather than expanded. Their role in the broader market ecosystem may be more strategic as opinion leaders and authentic advocates than as volume drivers.

(2) Segment 2: potential explorers (52.3% of sample)

This segment represents the largest and most strategically significant group. Members possess moderate product knowledge, with an average score of 3.14 on a 5-point scale. They can recognize bergamot yet fail to specify its unique traits or distinguish products from different producing regions. Brand recognition is limited, yet they express strong interest in learning more and trying value-added products. This group responds strongly to information supply and social proof signals. Such signals include endorsements from credible sources, tangible community participation, and transparent product storytelling. Demographically, they span a broad range of ages and income levels but skew toward urban consumers with moderate disposable income and active social media engagement. This segment constitutes the most targetable group for e-commerce intervention because their existing interest provides a foundation for engagement, and their moderate knowledge means that even modest information provision can significantly alter purchase behavior. The size and accessibility of this segment suggest that marketing investments directed at converting potential explorers into active purchasers would yield the highest return. Strategies should focus on education through engaging content, social proof through influencer partnerships and user reviews, and low-friction pathways from interest to purchase.

(3) Segment 3: cognitively unengaged Consumers (29.2% of sample)

This segment records the lowest level of product knowledge, with a mean score of 1.86 on the 5-point scale. Members of this group have almost no brand recognition, low purchasing frequency, and weak willingness to pay premium prices. Members are primarily young, low-income, urban consumers with minimal exposure to specialty agricultural products. For this group, bergamot is not on the radar; they lack both awareness and the contextual knowledge to appreciate its potential value. While they represent a large absolute number in the broader population, they are unlikely to be cost-effective targets for immediate conversion. Nevertheless, broader cultural exposure can serve as an indirect approach to reaching this group. Feasible solutions include embedding bergamot elements into lifestyle content, wellness trends and popular culture. For the short and medium term, passive cultivation constitutes the suitable strategy targeting this segment. Operators should prioritize raising general awareness via low-cost channels instead of carrying out intensive active conversion.

The segmentation results carry important implications for intervention design. The presence of a large, responsive potential explorers segment (segment 2) suggests that significant market expansion is achievable through targeted educational and engagement campaigns. The cognitively engaged enthusiasts (segment 1) provide a foundation of brand ambassadors and quality advocates who can lend authenticity to marketing efforts. The cognitively unengaged (segment 3) should be approached with realistic expectations - not abandoned but not prioritized. The analysis underscores that bridging the consumer cognitive divide requires differentiated strategies for different consumer groups rather than a single, uniform approach. The segmentation also validates the dual divide framework's emphasis on cognition as a key mediating variable: The three segments are essentially ordered along a cognitive continuum, and purchase intention scales predictably with knowledge level. This pattern is consistent with H₁ and provides preliminary support for the hypothesized cognition-intention relationship that will be tested more rigorously through the SEM analysis.

LASSO regression: Factor identification

LASSO regression was employed to identify the most

influential predictors of purchase intention among 22 candidate variables organized into four latent dimensions: product cognition, brand trust, channel convenience, and perceived value. The LASSO method was selected over conventional stepwise regression because it simultaneously performs variable selection and regularization through an L1 penalty, effectively addressing multicollinearity among candidate predictors while preventing overfitting. The optimal model was determined through 5-fold cross-validation, which minimizes the risk of selecting variables that perform well only on the training sample. The final model achieved a mean squared error of 0.217, indicating acceptable predictive accuracy.

The retained variables spanned four dimensions, with coefficients and significance levels varying substantially across predictors, revealing the relative importance of different factors in shaping purchase intention.

(1) Product cognition dimension

Three variables from this dimension were retained. Knowledge of bergamot's health benefits emerged as the strongest cognitive predictor, with a coefficient of 0.084 ($p < 0.01$), reflecting the importance of functional understanding in driving purchase decisions. Consumers with clear knowledge of bergamot's diversified applications tend to recognize its value and generate purchase intentions. Such applications cover medicinal usage, food consumption and aromatic appreciation. Awareness of GI certification followed with a coefficient of 0.071 ($p < 0.05$), indicating that consumers who recognize the quality assurance provided by geographical indication status are more willing to purchase. This finding suggests that the GI designation, when effectively communicated, functions as a quality signal that reduces uncertainty. Understanding cultural symbolism, with a coefficient of 0.055 ($p < 0.05$), was the third cognitive predictor retained. Consumers who appreciate bergamot's association with "fortune and longevity" in Chinese cultural tradition are more inclined to purchase, particularly for gift-giving or ceremonial occasions. This finding highlights the potential of cultural embedding as a marketing strategy.

(2) Brand trust dimension

Two variables from this dimension were retained, and notably, both exhibited the largest coefficients among all predictors. Perceived brand authenticity showed the

strongest overall effect, with a coefficient of 0.112 ($p<0.001$), indicating that consumer confidence in brand genuineness is the single most powerful driver of purchase intention. Confidence in quality consistency followed closely with a coefficient of 0.096 ($p<0.001$). This finding underscores that consumers are not merely purchasing a product; they are purchasing a promise of consistent quality. In the absence of direct experience, brand trust substitutes for direct product evaluation. The magnitude of these coefficients suggests that brand-building efforts may yield higher returns than any other category of intervention.

(3) Channel convenience dimension

Two variables from this dimension were retained. Ease of online search showed a coefficient of 0.063 ($p<0.05$), indicating that consumers who can easily find product information and compare offerings are more likely to purchase. Transaction process efficiency followed with a coefficient of 0.048 ($p<0.05$), reflecting the importance of frictionless purchasing experiences. Although both coefficients are lower than those observed in the brand trust dimension, they are statistically significant. This finding demonstrates that channel design exerts substantial influence on purchase intention. The effect is especially prominent among consumers who have formed an interest in the product. Cumbersome transaction procedures may cause these potential consumers to give up purchases.

(4) Product attribute dimension

Product uniqueness perception was retained with a coefficient of 0.076 ($p<0.01$). Consumers who recognize the uniqueness of bergamot demonstrate stronger purchase willingness. They distinguish the product from common citrus fruits and bergamot products sourced from other producing regions. This finding reinforces the importance of effective differentiation in GI product marketing, suggesting that uniqueness mediates the relationship between GI status and purchase intention. Several variables were eliminated through the LASSO penalty, and their elimination is itself informative. Age and income were eliminated, indicating that demographic characteristics are less predictive of purchase intention than product-specific cognition and trust. This finding suggests that marketing strategies should focus on information provision and trust-building rather than demographic targeting. General e-commerce

familiarity was also eliminated, indicating that consumers' overall comfort with online shopping does not necessarily translate into purchase intention for unfamiliar specialty products. What matters is not whether consumers shop online generally, but whether they have acquired the specific product knowledge and brand trust necessary to make a purchase decision for a novel GI product. This result has implications for intervention design: improving general digital literacy among consumers is less urgent than improving product-specific information availability and brand communication.

The LASSO results provide empirical support for Hypotheses H₁, H₂, and H₃, confirming that product cognition, brand trust, and channel convenience each contribute independently to purchase intention. Among these three, brand trust exerts the strongest influence, suggesting that efforts to build consumer confidence in brand authenticity and quality consistency should be prioritized. The results also confirm that product cognition operates through both direct and indirect pathways, supporting the mediated model specified in H₄. The elimination of general e-commerce familiarity as a predictor indicates that the consumer cognitive divide is not simply a reflection of general digital literacy differences, but a specific informational gap requiring targeted intervention.

Structural equation modeling: Mechanism validation

SEM analysis confirmed the hypothesized pathways with satisfactory model fit across all indices. The chi-square to degrees of freedom ratio ($\chi^2/df=1.870$) falls well below the recommended threshold of 3.000, indicating that the proposed model adequately reproduces the observed covariance structure. The comparative fit index (CFI=0.934) and Tucker-Lewis index (TLI=0.921) both exceed the conventional benchmark of 0.900, suggesting acceptable fit relative to the null model. The root means square error of approximation (RMSEA=0.048) falls below the 0.050 threshold for close fit, indicating that the model's approximation error is minimal. The standardized root means square residual (SRMR=0.036) is well below the 0.08 recommended cutoff, confirming that the model's residual covariance is small. Collectively, these indices indicate that the model provides a good representation of the underlying data structure and that the hypothesized relationships are

statistically credible.

The research model explains 68.3% of the variance in consumer purchase intention. The three core predictive dimensions, namely product cognition, brand trust and channel convenience, collectively account for over two-thirds of the variations in consumers' purchase willingness. This substantial explanatory power suggests that the dual divided framework captures the core determinants of purchase behavior for GI specialty products, leaving limited room for unobserved factors. The remaining unexplained variance may be attributable to individual-level differences in personality, situational factors, or measurement error.

(1) Direct effects

All three hypothesized direct effects were significant. Product cognition exerted the strongest direct effect on purchase intention ($\beta=0.312$, $p<0.001$), confirming H₁. This finding establishes that consumer knowledge is not merely a peripheral consideration but a central driver of purchase decisions. When consumers possess comprehensive understanding of bergamot's functional benefits, quality indicators, and cultural significance, their purchase intention increases substantially. Brand trust also demonstrated a strong direct effect on purchase intention ($\beta=0.287$, $p<0.001$), confirming H₂. This result underscores the critical role of brand authenticity and quality consistency in shaping consumer willingness to purchase GI products. Consumers who trust a brand's claims and quality standards are significantly more likely to convert interest into actual purchase. Channel convenience, while still significant, showed a smaller direct effect ($\beta=0.195$, $p<0.01$), confirming H₃. This finding indicates that while frictionless purchasing processes facilitate transactions, they are less important than product cognition and brand trust in driving purchase intention. In other words, consumers must first know about the product and trust its quality before convenience becomes a decisive factor.

(2) Indirect effect

The indirect effect from product cognition through brand trust to purchase intention was significant (indirect $\beta=0.107$, $p<0.01$), supporting H₄. This finding confirms that product cognition operates through two pathways: a direct pathway (knowledge directly enhances purchase intention) and an indirect pathway (knowledge builds brand trust, which in turn enhances purchase intention).

The indirect pathway accounted for approximately one-third of the total effect of product cognition on purchase intention, indicating that the mediated route is substantial and not merely incidental. The implication is that consumer education campaigns serve a dual purpose: they directly increase purchase readiness and indirectly strengthen brand trust, which further amplifies purchase intention. This dual pathway reinforces the strategic importance of information provision as a foundational marketing activity for GI products with limited consumer awareness.

(3) Model robustness

Model robustness was confirmed through cross-validation with a 70/30 split of the consumer dataset. The model estimated on the training subsample (70.0%) was tested against the validation subsample (30.0%), with no significant degradation in model fit or path coefficients. The stability of the results across subsamples indicates that the findings are not an artifact of sample composition and can be generalized to the broader consumer population. The consistency of the indirect effect across subsamples further supports the reliability of the mediated pathway specified in H₄.

(4) Relative importance of predictors

The magnitude of coefficients supports the ranking of relative importance among the three predictive dimensions. Product cognition generates the strongest total effect on purchase intention, with a direct β of 0.312 plus an indirect β of 0.107 reaching 0.419. Brand trust ranks second with a β value of 0.287, followed by channel convenience whose β equals 0.195. This ordering suggests that interventions should prioritize consumer education and brand-building over channel optimization, though all three dimensions contribute meaningfully to purchase intentions. The prominent predictive power of product cognition, including both direct and indirect effects, suggests that the consumer cognitive gap serves as the primary barrier restricting the market expansion of geographical indication specialty products. Breaking this divide through targeted information provision and educational campaigns is likely to yield the highest returns on investment.

The SEM results collectively validate the dual divide framework's core propositions. The significant direct and indirect effects confirm that the consumer cognitive divide operates through both knowledge deficits and trust

deficits, and that these deficits are causally linked: knowledge shortfalls undermine trust, and trust deficits suppress purchase intention. The results also confirm that channel convenience, while significant, plays a secondary role relative to cognition and trust. These findings offer straightforward guidance for strategic intervention design. Eliminating consumer cognitive gaps requires dual efforts in product education and brand cultivation. Targeted education improves consumer product knowledge, while systematic branding builds consumer trust. The two strategies are mutually reinforcing rather than independent of each other.

Discussion

Theoretical contributions

This study makes three contributions to rural e-commerce and specialty product marketing literature.

First, we propose and empirically validate a “dual divide” analytical framework that integrates supply-side and demand-side constraints within a unified explanatory model. Existing studies have mostly explored producer adoption barriers or consumer preferences separately. By contrast, this research proposes that the e-commerce performance of GI specialty products is jointly shaped by two interrelated bottlenecks. These key constraints correspond to the digital literacy gap among producers and the cognitive gap among consumers. The empirical evidence from Jinhua bergamot confirms that these divides are not additive but multiplicative: The presence of either divide significantly undermines e-commerce outcomes, and the divides reinforce each other through a feedback loop that sustains market failure.

Second, this study develops and validates a multi-method empirical framework to mitigate methodological limitations observed in previous literature. It integrates TwoStep clustering for consumer segmentation, LASSO regression for factor screening, and structural equation modeling (SEM) for mechanism verification. This comprehensive analytical pipeline enables replicable empirical procedures for future research on specialty product markets. Such methodological improvements respond to existing criticisms regarding rural e-commerce research, which has long relied heavily on qualitative case studies and thus lacks sufficient generalizability [23].

Third, this study provides rigorous empirical evidence based on a representative GI specialty product that has

been insufficiently explored in existing literature. This research focuses on Jinhua bergamot, a culturally distinctive and quality-differentiated product with underdeveloped e-commerce performance. The analysis advances current understanding of the “high quality without premium pricing” phenomenon prevalent among numerous Chinese GI products [24]. The findings confirm that this phenomenon does not stem from inferior product quality. Instead, it arises from systematic gaps in producer operational capabilities and consumer product information, which hinder the effective transmission and function of product quality signals.

Practical implications

The findings carry several implications for policy and practice.

(1) Consumer education and cognitive bridging

Our LASSO and SEM results establish product cognition as a primary driver of purchase intention ($\beta=0.312$, $p<0.001$) that also operates indirectly through brand trust ($\beta=0.107$). Consumer education interventions can effectively boost consumers’ direct purchase willingness and strengthen brand trust, which is critical for fostering consumer loyalty and realizing premium pricing. Such educational initiatives focus on popularizing the health values, cultural connotations and GI certification attributes of bergamot products. The segmentation analysis further verifies that potential explorers, accounting for 52.3% of all consumers, are highly susceptible to external information stimulation. Delivering targeted educational content via mainstream social platforms favored by this consumer group, including WeChat, Douyin and Xiaohongshu, can generate remarkable marketing effects.

(2) Producer digital literacy and capability building

The 84.3% to 8.4% willingness-capability gap indicates strong latent motivation but acute skill deficits. Targeted training programs should replace conventional generalized e-commerce training. They need to prioritize core competencies verified through field interviews, which constitute major operational bottlenecks for producers. The required capabilities cover product photography and visual display, cultural value-oriented content creation, live-streaming operation and management, as well as data analysis for operational decision-making. Collaborative training mechanisms involving universities, e-commerce platforms and local

governments can deliver better outcomes than independent individual initiatives.

(3) Brand architecture and quality signaling

Low brand recognition among consumers reflects the lack of effective quality signaling mechanisms for Jinhua bergamot, with 62.0% of respondents unable to name a relevant local brand. This deficiency hinders the product's differentiation from bergamot products originating from other regions. The establishment of a unified regional brand system can integrate scattered individual producers under a unified brand identity and standardized quality certification criteria. Such systematic construction supports collective regional marketing and alleviates consumer identification confusion. Although the GI certification lays a foundational institutional advantage, it cannot serve as a valid quality signal without deliberate and professional brand management.

(4) Product diversification and value-added development

A notable preference discrepancy exists between current market sales and consumer potential demand. Fresh fruit products currently dominate the market with a sales proportion of 61.4%, while more than 65.0% of consumers show interest in wellness and gift-oriented value-added products, revealing great potential for product diversification. The targeted development of diversified products, including bergamot tea, preserves, essential oils, wellness supplies and cultural and creative goods, can effectively capture latent consumer demand. Meanwhile, such strategies reduce market reliance on fresh bergamot fruits, which face limited growth space and high spoilage risks.

Limitations and future research

This study is subject to several limitations. First, although the consumer sample covers diverse geographical distributions, it fails to fully represent all consumer groups, especially users with low digital accessibility. Second, the adoption of a cross-sectional research design prevents this study from capturing dynamic changes in consumer attitudes and purchasing behavior over time. Third, the analysis of producers relies on self-reported behavioral evaluations instead of objective operational indicators, which may lead to social desirability bias. Future research can remedy these deficiencies. Researchers can adopt longitudinal designs to track temporal dynamic changes, integrate platform-

based objective data to measure operational performance, and conduct experimental interventions to verify the practical effectiveness of targeted optimization strategies.

Conclusion

This study explores the e-commerce transformation of Jinhua bergamot, a nationally certified GI specialty product plagued by the persistent “high quality without premium pricing” dilemma. It adopts a mixed-methods research framework that incorporates consumer surveys with 509 valid respondents and in-depth interviews with over 30 key industry stakeholders. Supported by multiple quantitative analytical techniques including descriptive statistics, TwoStep clustering, LASSO regression, and structural equation modeling, this study systematically identifies the structural constraints and internal mechanisms behind the product's unsatisfactory market performance.

This study derives four core conclusions. First, the unsatisfactory e-commerce performance of GI specialty products can be systematically attributed to a “dual divide” mechanism. It consists of the digital literacy gap among producers and the cognitive gap among consumers. In terms of producer characteristics, 84.3% of participants demonstrate adoption a willingness, whereas only 8.4% possess advanced operational capabilities. From the consumer perspective, merely 7.0% of consumers hold comprehensive product knowledge, and 62.0% lack brand recognition. These two interdependent gaps mutually reinforce each other and form a cyclical constraint mechanism, which perpetuates the suboptimal market performance of GI products.

Second, consumer segmentation analysis categorizes respondents into three distinct groups. The groups include Cognitively Engaged Enthusiasts accounting for 18.5% of consumers, potential explorers accounting for 52.3% of consumers, and Cognitively Unengaged Consumers accounting for 29.2% of consumers. Among them, the middle-tier potential explorers constitute the most viable and targetable market for e-commerce optimization interventions.

Third, LASSO regression identifies product cognition, brand trust, and channel convenience as the primary determinants of purchase intention, while SEM confirms that product cognition operates both directly ($\beta=0.312$, $p<0.001$) and indirectly through brand trust (indirect $\beta=0.107$, $p<0.01$). The model explains 68.3% of variance

in purchase intention.

Fourth, bridging the dual divide requires coordinated interventions across four dimensions: consumer education and cognitive bridging, producer digital literacy and capability building, brand architecture and quality signaling, and product diversification for value-added development. These interventions must be designed and implemented through multi-stakeholder collaboration involving farmers, cooperatives, enterprises, local government, e-commerce platforms, and academic institutions.

In conclusion, the e-commerce transformation of GI specialty products is not simply a matter of infrastructure provision or platform access. Addressing the market dilemma of GI specialty products requires systematic optimization focusing on human resources and information transmission dimensions. Specifically, producer operational capabilities and consumer product cognition jointly determine whether inherent quality advantages can be successfully converted into favorable market performance. The dual-divide framework established in this study provides a rigorous analytical perspective to interpret the industry dilemma and delivers practical guidance for targeted marketing and operational interventions. For Jinhua bergamot and numerous homogeneous GI specialty products, this systematic research framework offers a viable and effective path to transform local cultural heritage into sustainable nationwide market competitiveness.

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Conflicts of Interest

The authors declare no conflict of interest.

References

- [1] Luo, G., Yang, Y., Wang, L. (2023) Driving rural industry revitalization in the digital economy era: exploring strategies and pathways in China. *PLoS One*, 18(9), e0292241.
- [2] Zeng, Y., Guo, H., Yao, Y., Huang, L. (2019) The formation of agricultural e-commerce clusters: a case from China. *Growth and Change*, 50(4), 1356-1374.
- [3] Wei, X., Yang, Z., Yan, Y., Sun, J. (2024) Rural e-commerce, Digital finance, and urban-rural common prosperity: a quasi-natural experiment based on China's comprehensive demonstration of e-commerce entering rural areas policy. *Finance Research Letters*, 69, 106237.
- [4] Sun, C., Yu, C. (2025) Study on enhancing consumers' purchase intention in e-commerce agricultural products. *British Food Journal*, 127(6), 2015-2034.
- [5] Zhu, X. (2023) Development problems and countermeasures of rural e-commerce logistics in the context of big data and internet of things. *Journal of Information Processing Systems*, 19(2), 267-274.
- [6] Luo, X., Niu, C. (2019) E-commerce participation and household income growth in Taobao villages. *World Bank Policy Research Working Paper*, 8811.
- [7] Tim, Y., Cui, L., Sheng, Z. (2021) Digital resilience: How rural communities leapfrogged into sustainable development. *Information Systems Journal*, 31(2), 323-345.
- [8] Cui, X., Huang, W., Zhang, J., Deng, W. (2024) Exploring the spatiotemporal evolution mechanism of rural e-commerce: insights from the experience of Taobao towns in China. *Humanities and Social Sciences Communications*, 11(1), 1-13.
- [9] Mogili, U. R., Deepak, B. B. V. L. (2018) Review on application of drone systems in precision agriculture. *Procedia Computer Science*, 133, 502-509.
- [10] Chen, J., Hou, H., Liao, Z., Wang, L. (2024) Digital environment, digital literacy, and farmers' entrepreneurial behavior: a discussion on bridging the digital divide. *Sustainability*, 16(23), 10220.
- [11] Liu, Y., Zhou, M. (2023) Can rural e-commerce narrow the urban-rural income gap? Evidence from coverage of Taobao villages in China. *China Agricultural Economic Review*, 15(3), 580-603.
- [12] Wang, R., Li, X. (2023) Study on the realistic dilemmas and pathways of empowering rural revitalization with digital technology under the goal of common prosperity. *Academic Journal of*

- Management and Social Sciences*, 5(2), 156-162.
- [13] Qiao, C. (2025) Coupling digital inclusive finance and rural e-commerce: a systems perspective on China's urban-rural income Gap. *Systems*, 13(10), 911.
- [14] Liu, W. (2020) Route optimization for last-mile distribution of rural e-commerce logistics based on ant colony optimization. *IEEE Access*, 8, 12179-12187.
- [15] Wu, S., Cheng, H., Qin, Q. (2024) Physical delivery network optimization based on ant colony optimization neural network algorithm. *International Journal of Information Systems and Supply Chain Management (IJISSCM)*, 17(1), 1-18.
- [16] Zeng, Y., Guo, H., Yao, Y., Huang, L. (2019) The formation of agricultural e-commerce clusters: a case from China. *Growth and Change*, 50(4), 1356-1374.
- [17] Ghosh, J. (2024) Geographical indication (GI) as a tool for sustainable society: a policy analysis of India. *Journal of Intellectual Property Studies*, 8, 12.
- [18] Muça, E., Pomianek, I., Peneva, M. (2022) The role of GI products or local products in the environment - consumer awareness and preferences in Albania, Bulgaria and Poland. *Sustainability*, 14(1), 4.
- [19] Jiang, Q. (2024) The impact of specialty agricultural product packaging on consumer purchase intentions: a case study of Hainan's "one village, one product" agricultural products. *Research Review*, 7, 8.
- [20] Beig, F. A., Nika, F. A. (2022) Impact of brand experience on brand equity of online shopping portals: a study of select e-commerce sites in the state of Jammu and Kashmir. *Global Business Review*, 23(1), 156-175.
- [21] Morales, L. E., Ehmke, M. D., Sheridan, A. (2024) Consumer trust and purchase of perishable fresh food online versus in-store: the case of beef. *Journal of International Food & Agribusiness Marketing*, 36(2), 177-199.
- [22] Ju, J., Teo, P. C., Adnan, H. (2025) Navigating the Chinese purchase intent in fresh agricultural product live streaming: anchor features, perceived risk and consumer confidence. *Asia Pacific Journal of Marketing and Logistics*, 37(11), 3348-3366.
- [23] Huang, L., Xie, G., Zheng, Y., Tian, Y., Cai, W. (2023) The configurational paths in BoP rural E-commerce entrepreneurial opportunity: a fuzzy-set qualitative comparative analysis. *IEEE Transactions on Computational Social Systems*, 11(2), 2433-2447.
- [24] Wang, E., Liu, Z., Gao, Z., Wen, Q., Geng, X. (2022) Consumer preferences for agricultural product brands in an e-commerce environment. *Agribusiness*, 38(2), 312-327.

Appendix

Table A1. Questionnaire dimension structure.

Dimension	Items	Response format
Product cognition (6 items)	Knowledge of health benefits, GI certification awareness, cultural symbolism understanding, usage scenarios, quality cues, regional origin knowledge	5-point Likert
Brand trust (5 items)	Perceived authenticity, quality consistency confidence, willingness to recommend, brand reputation, certification trust	5-point Likert
Channel convenience (4 items)	Ease of information search, transaction efficiency, delivery reliability, customer service quality	5-point Likert
Perceived value (4 items)	Value for money, uniqueness perception, social recognition, emotional satisfaction	5-point Likert
Purchase intention (3 items)	Likelihood to purchase, willingness to pay premium, recommendation intention	5-point Likert