

Research on the Value Co-Creation Mechanism of Regional Brand of Agricultural Products under the Rural E-Commerce Ecosystem: A Case Study of Dalian City

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Abstract: Regional public brands of agricultural products are marked by pronounced public-good attributes, and their value creation is embedded within a rural e-commerce ecosystem involving multiple actors. Drawing on value co-creation theory and the theory of rural e-commerce ecosystems, this paper constructs a three-dimensional analytical framework of “actors–resources–environment.” Taking the regional brand of agricultural products in Dalian City as its research object, the study examines the problems encountered in the value co-creation process and, drawing on the experience of the Yanyuan apple regional public brand, proposes optimization pathways for a three-dimensional mechanism encompassing actor synergy, resource integration, and environmental safeguards. The findings reveal that the coupling and interaction of these three dimensions generate a positive cycle of “input–value addition–reinvestment,” offering theoretical grounding and practical reference for enhancing the value of regional brands of agricultural products in Dalian and the broader Northeast China region.

Keywords: Rural e-commerce ecosystem; Regional brand of agricultural products; Value co-creation; Dalian City

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1. Introduction

As the rural revitalization strategy advances in depth, agricultural brand development has been elevated to an unprecedented strategic height. In 2022, the Ministry of Agriculture and Rural Affairs issued the Action Plan for Cultivating Premium Agricultural Brands (2022–2025), explicitly calling for the strengthening of a cohort of regional public brands of agricultural products distinguished by superior quality and strong driving capacity. Liaoning Province and Dalian City have successively rolled out supporting policies to accelerate the pace of regional brand development for agricultural products. Yet despite Dalian’s endowment within

the golden agricultural belt at 39 degrees north latitude, its agricultural products have long been trapped in the predicament of “first-rate quality, second-rate packaging, third-rate premium.” Superior quality has not been effectively translated into market premium, and a conspicuous gap persists between brand influence and resource endowment.

From a theoretical standpoint, the regional and public-good attributes of regional public brands of agricultural products dictate that their development necessarily unfolds within a multi-actor value co-creation system. In recent years, rural e-commerce has exhibited a pronounced ecological agglomeration in the upward distribution of agricultural products, evolving from a mere sales channel into a comprehensive platform integrating brand communication, consumer interaction, and value co-creation. The emergence of this ecosystem provides a novel analytical arena for understanding the value co-creation mechanism of regional brands of agricultural products. Existing studies, however, have predominantly adopted perspectives rooted in traditional agricultural economics or marketing, paying scant attention to the systemic influence of the e-commerce ecosystem on brand value co-creation. Against this backdrop, the present paper constructs a three-dimensional analytical framework of “actors–resources–environment” and, taking Dalian City as its research object, seeks to unveil the intrinsic mechanism and optimization pathways of value co-creation for regional brands of agricultural products within the rural e-commerce ecosystem.

2. Relevant concepts and literature review

2.1. Relevant concepts

2.1.1. Connotation and characteristics of regional public brands of agricultural products

Regional public brands of agricultural products belong to collective members and constitute brand resources shared by producers within a given region. Their defining characteristic resides primarily in their public-good nature, which encompasses non-excludability and non-rivalry—meaning that actors within the region may use the brand without diminishing its availability to others ^[1]. This very attribute, however, tends to breed insufficient motivation among actors participating in brand development, resulting in inadequate exploitation of advantageous regional resources, unsatisfactory quality of regional agricultural products, and rampant free-riding—all of which ultimately circumscribe brand influence ^[2]. Existing research therefore suggests that a regional brand may be regarded as a collective reputation capable of generating positive externalities, yet the positive externalities of a regional public brand dissipate even as they accumulate.

2.1.2. Concept of the rural e-commerce ecosystem and its research applicability

The concept of the rural e-commerce ecosystem was initially proposed by Wang Sheng et al., who argued that given the particularities of its transaction objects and scope, the rural e-commerce ecosystem could be defined separately as a subsystem within the broader e-commerce ecosystem ^[3]. They defined the rural e-commerce ecosystem as an organic whole that takes the Internet as its platform, aims to achieve the flow of materials, capital, and information, and possesses synergistic functions and dynamic adaptability.

The e-commerce ecosystem constitutes a vital organizational form for rural e-commerce development in China. Its fundamental characteristic is that various types of rural e-commerce participants, under platform coordination, engage in diverse innovative activities grounded in complementary resource sharing, centered on participant interaction, and oriented toward symbiotic value creation—thereby expanding and extending value. The regional and public-good attributes of regional public brands for specialty agricultural products

dictate that their development unfolds within a multi-actor value co-creation system. In recent years, rural e-commerce has played a significant role in the upward distribution of agricultural products, exhibiting ecological agglomeration characteristics ^[4]. The rural e-commerce ecosystem has become an important organizational form for China's rural e-commerce development, with coordinated actions among system actors enabling innovative approaches to agricultural product distribution. Consequently, the rural e-commerce ecosystem offers a promising entry point for research on the development pathways of regional public brands for specialty agricultural products.

2.2. Literature review

2.2.1. Economic and social effects of regional brands of agricultural products

Since the central government formally proposed advancing the development of regional public brands for agricultural products, academia has accumulated a substantial body of research on their economic and social effects. The existing literature can be broadly organized along the following dimensions: at the level of premium income generation, agricultural brands leverage differentiation advantages to obtain product premiums, widely regarded as an effective pathway for raising farmers' incomes and narrowing the urban-rural gap ^[5]; at the level of industrial upgrading, brand development tends to compel standardized production and scaled operation, thereby driving efficiency gains and structural optimization on the supply side of agricultural products ^[6]; at the level of factor agglomeration, brand influence helps channel capital, technology, and talent toward agriculture and rural areas, while spurring the growth of related industries such as processing, logistics, and cultural tourism, generating cluster effects ^[7]; and at the level of market operation, the quality reputation accumulated by a brand helps mitigate information asymmetry in agricultural transactions and reduce consumers' search costs ^[8]. Naturally, some studies have also drawn attention to the pervasive free-riding behavior and the risk of brand reputation dilution in public brand governance ^[9].

2.2.2. Actors and pathways in regional brand development for agricultural products

Existing studies have examined the development pathways of regional public brands for specialty agricultural products from either a multi-actor perspective or a stage-based perspective. They identify the primary actors in brand development as local governments, industry associations, agricultural enterprises, cooperatives, and farmers ^[10]. They further explore the processes of industrial revitalization and regional public brand creation from perspectives including comparative advantage selection, industrial policy formulation, standardized guidance and brand shaping, and the interplay among government, market, and society ^[11]. Recommendations have been advanced suggesting that government assume the role of guide and facilitator, enterprises the role of core builders, and consumers the role of evaluators ^[12].

3. The practical foundation for value co-creation of regional brands of agricultural products in Dalian City

3.1. Foundation of brand layout

Dalian City has developed a regional brand configuration for agricultural products centered on geographical indication products. To date, the city boasts 45 geographical indication products, with over 200 enterprises authorized to use the geographical indication emblem, covering 25 varieties across three major categories: fruits, aquatic products, livestock and poultry, and coarse grains. The fruit brand cluster is anchored by the

“Five Golden Flowers,” among which Dalian large cherries attained a brand value of 10.5 billion yuan in the 2025 China Brand Value Evaluation, ranking 33rd on the “Top 100 Regional Brands (Geographical Indications)” list, with production scale ranking first among all prefecture-level cities nationwide and output value exceeding 12 billion yuan. Dalian nectarines registered a brand value of 4.053 billion yuan, while Zhuanghe blueberries achieved an annual output value of 800 million yuan. In the aquatic products category, Dalian sea cucumber ranked 12th nationwide on the “Top 100 Regional Agricultural Industry Brand Influence” list with a score of 922. At the comprehensive brand level, Dalian City launched the “Dalian 39 Fresh” brand promotion campaign, integrating specialty agricultural product resources from the golden production zone at 39 degrees north latitude under government leadership and with enterprises as the principal actors.

3.2. Constituent elements of the rural e-commerce ecosystem

From the actor dimension, Dalian’s rural e-commerce ecosystem has formed a multi-stakeholder participation pattern encompassing government, platforms, leading enterprises, cooperatives and farmers, and service support entities. At the government level, Wafangdian City and Zhuanghe City have successively been approved for national-level comprehensive demonstration projects for e-commerce into rural areas, receiving cumulative financial support from central and provincial sources. At the platform level, JD.com’s “China Specialty · Dalian Specialty Pavilion” has commenced operations, while Pulandian District leverages the Mokua live-streaming base to promote live-streaming sales. At the production level, the city hosts 203 leading agricultural enterprises at or above the municipal level, along with 23,000 farmer cooperatives and family farms.

From the resource dimension, Dalian has established relatively abundant product resources, data resources, talent resources, and brand resources. In terms of data resources, Dalian was the first in the province to launch a geographical indication traceability system, and the Dalian large cherry quality traceability platform has generated 52,600 traceability codes for 80 enterprises. In terms of talent resources, the city has built 20 national-level and provincial-level high-skilled talent training bases, with cumulative training exceeding 83,000 person-times. In terms of brand resources, five regional public brands—including Dalian large cherry and Dalian sea cucumber—have been included in the China Agricultural Brand Catalogue, accounting for half of the province’s total selected brands.

From the environmental dimension, a relatively comprehensive policy support system for brand development and e-commerce growth has taken shape at the policy and institutional level; at the infrastructure level, the city has cultivated 66 cold-chain upstream and downstream industrial projects and 45 live-streaming e-commerce pilot bases; at the market environment level, during the 2025 “Double Eleven” shopping festival, the city’s online retail sales of agricultural products reached 1.26 billion yuan, with live-streaming sales amounting to 1.48 billion yuan.

4. The triple predicament of value co-creation for regional brands of agricultural products in Dalian City

4.1. Predicament of actor synergy

Value co-creation for regional brands of agricultural products involves diverse actors—government, platforms, enterprises, cooperatives, farmers, and service providers—whose goal orientations differ markedly:

government pursues public objectives such as regional economic growth and farmer income enhancement; e-commerce platforms pursue transaction scale expansion and platform service revenue; leading enterprises pursue brand premium and market share; cooperatives and farmers pursue stable sales channels and income growth. Such divergent goals render it difficult for actors' investment willingness and behavioral choices in brand development to converge spontaneously. As noted by the Dalian Supply and Marketing Cooperative at a brand development symposium, prominent problems pervade current brand development, including "brands without products," "insufficient coordinated efforts," and "limited promotional effectiveness."

A deeper-seated problem lies in the persistent erosion of brand reputation by free-riding behavior. The non-excludability and non-rivalry of regional public brands naturally induce free-riding, whereby some producers and operators exploit the regional brand's reputation to sell low-quality products, passing off inferior goods as superior, thereby damaging the brand's overall image—while the costs of brand maintenance are borne by a minority of investors. Research on regional public brands of agricultural products in Liaoning Province has likewise noted that the economic root of free-riding resides in the tension between public-good attributes and the high dispersion of collective members, necessitating governance through digital traceability system development, multi-actor collaborative supervision, and market environment cultivation.

Furthermore, the brand authorization and supervision mechanisms remain incomplete. Although Dalian City has promulgated the Administrative Measures for the Operating Entities of the Regional Public Brand of Geographical Indication Agricultural Product Dalian Cherry (Trial), the mechanisms for brand authorization, routine supervision, and exit remain to be perfected. Some authorized brands languish in neglect, post-authorization quality control lacks a standardized mechanism, and the cost of violations is relatively low, making it difficult to establish effective constraints.

4.2. Predicament of resource integration

Dalian's agricultural products are of superior quality, yet they confront conspicuous bottlenecks in the transformation of market value. Some products suffer from severe packaging homogenization, an absence of regional cultural elements, and a single marketing channel, while the ecological advantage of "39 degrees north latitude" lacks systematic brand expression. The root of this predicament lies in the fact that the full chain of brand value transformation has yet to be connected: at the front end, quality advantages have not been effectively translated into brand stories and value symbols perceptible to consumers; at the midstream, product standardization levels vary widely, with some smallholder farmers not yet incorporated into standardized production systems; and at the back end, brand marketing channels remain undiversified, with scenario-based experiences and digital marketing not yet fully leveraged.

Insufficient depth in the utilization of data resources constitutes another salient shortcoming. Although Dalian was the first in the province to launch a geographical indication traceability system, the application scenarios for data resources remain largely confined to traceability. Valuable resources such as e-commerce platform transaction data, user reviews, and search behavior have not been sufficiently extended into deeper value creation, including production decision optimization, precision marketing, and consumer insight. Capital flow, logistics flow, and information flow lack effective integration, and the "information silo" problem remains prominent. Concurrently, a structural shortage of interdisciplinary talent constrains brand value transformation. Existing e-commerce training is concentrated more at the level of basic skills,

lacking systematic cultivation of interdisciplinary competencies such as brand operations, content creation, and supply chain management. The supply of talent who “understand agriculture, understand brands, and understand e-commerce” is conspicuously inadequate.

4.3. Predicament of environmental protection

In terms of the standardization system, although Dalian City has issued a series of local standards, existing standards are primarily concentrated on advantageous categories such as large cherries, with insufficient standardization coverage for other geographical indication products. Smallholder farmers and some small and medium-sized production entities have yet to be incorporated into standardized production systems, making it difficult to guarantee product quality stability. At the quality supervision level, problems remain prominent, including non-standardized production by scattered households, insufficient testing capacity at the grassroots level, and bottlenecks in cross-departmental collaborative supervision. The last mile in moving standardization from “paper” to “field” has yet to be traversed.

Cold-chain logistics and last-mile delivery exhibit conspicuous shortcomings. Some remote production areas lack pre-cooling facilities and mobile cold storage, and losses of fresh agricultural products in the “first mile” remain high, with the cold-chain loss rate for large cherries reaching as high as 12%. The stability of rural express delivery last-mile services also requires improvement. Regional imbalances in cold-chain logistics capacity make it difficult for high-quality agricultural products from certain remote areas to achieve brand premiums through e-commerce channels.

In terms of brand protection, although the Regulations of Dalian City on the Protection and Promotion of Intellectual Property Rights have incorporated geographical indications into the scope of intellectual property protection, the enforcement intensity of the system and the efficiency of cross-departmental coordination remain to be enhanced. The procedures for determining infringement, collecting evidence, and safeguarding rights for geographical indication products are complex, and small and medium-sized production entities face high costs and lengthy timelines in rights protection. The boundaries of responsibility among departments such as agriculture and rural affairs, market supervision, and commerce in brand protection are not sufficiently clear, and a normalized mechanism for information sharing and joint law enforcement has yet to be fully established.

5. Optimization of the value co-creation mechanism for regional brands of agricultural products in Dalian City under the rural e-commerce ecosystem

Before proposing optimization pathways, it is instructive to briefly reference the experience of the Yanyuan apple regional public brand. Yanyuan County, located in Liangshan Prefecture, Sichuan Province, was once a deeply impoverished county. Yet since the introduction of apple cultivation in 1958, through decades of sustained effort, it successfully created a nationally recognized regional public brand whose reputation ranks among the top of more than a thousand geographical indication public brands. Its core experience can be summarized in three points: first, the government engaged in “contingent decision-making” and precise gap-filling at key nodes of industrial development—from reform of the contracted operation system to full-chain construction, from association formation to brand maintenance, the government consistently played an irreplaceable guiding and gap-filling role; second, it resolved the quality control challenges arising from dispersed smallholder operations through organization and standardization, achieving stable and controllable

quality via the “Eight Unifications” standardized production system; and third, it constructed a four-in-one brand maintenance system of “standards–self-discipline–law enforcement–judiciary,” effectively curbing free-riding through industry self-discipline, multi-department joint law enforcement, and strong judicial punishment. These experiences hold significant reference value for Dalian in overcoming its value co-creation predicament.

5.1. Optimization of the actor synergy mechanism

First, the government’s coordinating and guiding functions should be strengthened. A joint conference system for brand development should be established, led by the municipal government’s designated leader, with the Agriculture and Rural Affairs Bureau taking specific charge and departments including market supervision, commerce, and finance coordinating in support—integrating brand functions dispersed across departments into a unified force for action. The strategic objectives of brand planning should be decomposed into annual actionable tasks, forming a propulsion mechanism of “planning guidance–annual decomposition–quarterly scheduling–year-end assessment.” Differentiated policy tools should be designed in response to the differing needs of various actors: for leading enterprises, emphasis on brand operation support; for cooperatives and farmers, emphasis on standardized production subsidies; and for e-commerce platforms, emphasis on traffic support and production-marketing matching incentives.

Second, the regulatory and service functions of industry associations should be activated. The functional positioning of industry associations in brand authorization and routine supervision should be clarified, authorizing them to undertake quality inspections, credit evaluations, and early warnings of violations for brand-using entities. Quality credit files should be established for member enterprises, with tiered management implemented: enterprises meeting standards receive policy preferences and priority in brand promotion, while violators face industry sanctions—thereby forming a self-purification mechanism within the industry.

Third, a mechanism for linking farmers’ interests and constraining their behavior should be established. The organizational model of “leading enterprise + cooperative + farmer” should be promoted, and a distribution mechanism combining floor-price purchasing with profit sharing should be established, enabling farmers to genuinely share in the dividends of brand value addition. Brand maintenance clauses should be incorporated into cooperative charters and purchase-sale contracts, with explicit liability for breach stipulated for violations such as unauthorized brand use or quality degradation, thereby forming contractual behavioral constraints.

Fourth, the value loop of consumer feedback should be connected. A mechanism for collecting and analyzing consumer evaluation data should be established and refined, using user review data from e-commerce platforms to promptly understand consumer feedback on product quality, packaging, and service, forming a rapid response channel of “consumer-end feedback–production-end improvement.” Leveraging the real-time interactive advantages of live-streaming e-commerce, the production environment, production processes, and quality control should be visually presented to consumers, constructing a “seeing is believing” brand trust mechanism.

5.2. Optimization of the resource integration mechanism

First, the standardization and brand re-engineering of product resources should be advanced. The coverage

of existing local standards should be expanded from large cherries to major categories including blueberries, apples, and nectarines, progressively achieving full coverage of “one variety, one standard.” Relying on cooperatives and village collective economic organizations, smallholder farmers should be incorporated into standardized production systems, and unified product grading standards and quality testing systems should be established. The “39 degrees north latitude” should be upgraded from a geographical concept to a brand super-symbol; a matrix brand architecture should be established with “Dalian 39° Fresh” as the parent brand and various category sub-brands; and a unified brand visual identity system and packaging specifications should be formulated.

Second, data resources should be elevated from “recording” to “driving.” Data barriers between traceability data and e-commerce platforms should be dismantled to achieve a closed loop of “traceability + e-commerce,” whereby consumers scanning a code can not only view origin information but also place orders directly. Transaction data, user reviews, and search behavior data from e-commerce platforms should be integrated, and big data analytics should be employed to gain precise insights into consumer demand, guiding upstream variety selection, quality optimization, and pricing strategies to achieve “production determined by sales.” A data model for brand value assessment should be established, with regular publication of brand value reports to provide data support for brand decision-making.

Third, the interdisciplinary cultivation of talent resources should be accelerated. Training content should be extended from basic e-commerce skills to interdisciplinary competencies including brand operations, content creation, and supply chain management. A tiered and categorized training system should be established: for farmers, emphasis on standardized production and e-commerce fundamentals; for new-generation farmers, emphasis on live-streaming operations and brand communication; and for management personnel, emphasis on brand strategy and supply chain management. Relying on universities and vocational colleges in Dalian, industry-education integrated training bases should be established to provide sustained talent supply for brand development.

5.3. Optimization of the environmental safeguard mechanism

First, in terms of the institutional environment, the implementation of standardization and the strengthening of brand protection should be advanced. A closed-loop management mechanism of “standard formulation—publicity and training—implementation supervision—feedback revision” should be established, incorporating smallholder farmers into standardized production systems through cooperatives. The brand authorization and exit mechanisms should be refined, with authorization criteria detailed and exit conditions clarified, establishing a dynamic management mechanism of “able to enter and able to exit.” A cross-departmental joint law enforcement mechanism involving agriculture and rural affairs, market supervision, public security, and courts should be established, forming a collaborative protection configuration of “administrative law enforcement + criminal justice.” Relying on the geographical indication traceability system, a brand infringement monitoring and big-data evidence collection platform should be established to reduce the rights protection costs of small and medium-sized production entities.

Second, in terms of the infrastructure environment, the “first mile” shortcomings should be addressed. Pre-cooling facilities, mobile cold storage, and primary processing centers should be deployed in major production areas, with priority given to remedying cold-chain infrastructure deficiencies in remote production areas. On the basis of consolidating express delivery coverage in villages, the stability and standardization of

last-mile services should be enhanced. Live-streaming e-commerce pilot bases should be transitioned from “being built” to “being utilized,” strengthening their composite functions in brand incubation, supply chain integration, and talent training.

Third, in terms of the market environment, channel expansion and brand communication should be advanced in a coordinated manner. Strategic cooperation with mainstream e-commerce platforms should be deepened, and brand promotion activities should be continuously carried out. New channels of live-streaming e-commerce and content e-commerce should be expanded, constructing a marketing loop of “origin live-streaming + brand story communication + instant order placement.” The integrated development of “offline experience + online sales” should be promoted, with brand experience stores and direct sales windows established in first-tier cities, forming a brand effect of mutual traffic diversion and synergistic amplification between online and offline channels.

5.4. Synergistic operation of the three-dimensional mechanism

The optimization of the three-dimensional mechanism—actor synergy, resource integration, and environmental safeguard—does not proceed independently but constitutes an organic whole characterized by mutual support and synergistic evolution. Actor synergy is the core driving force: only when diverse actors, including government, enterprises, and farmers, form a collaborative co-creation configuration can resource integration possess impetus and environmental optimization possess direction. Resource integration is the foundation of value creation: only when resources such as products, data, talent, and brands are effectively integrated can actor synergy yield tangible value, and only then can brand premium become the ultimate outcome of actor synergy. Environmental safeguard is the support for sustained operation: a sound institutional environment reduces transaction costs, well-developed infrastructure diminishes value loss, and a mature market environment provides channels for value realization.

The coupling and interaction of these three dimensions generate a positive cycle: government investment in the institutional environment and infrastructure lowers the thresholds and costs for enterprises to participate in brand development, attracting more market actors to enter; the agglomeration of market actors brings accelerated accumulation and optimized allocation of resources such as products, data, and talent, driving continuous enhancement of brand value; and the enhancement of brand value in turn strengthens the government’s willingness to invest and the participation enthusiasm of various actors, forming a self-reinforcing cycle of “input–value addition–reinvestment.” This cycle constitutes the intrinsic mechanism of value co-creation for regional brands of agricultural products under the rural e-commerce ecosystem.

6. Conclusion

Taking the regional brand of agricultural products in Dalian City as its object, this study draws on the theory of rural e-commerce ecosystems and value co-creation theory, constructs a three-dimensional analytical framework of “actors–resources–environment,” and systematically investigates the value co-creation mechanism of regional brands of agricultural products. The findings reveal that Dalian City has developed a brand configuration centered on geographical indication products, and the actor, resource, and environmental framework of the rural e-commerce ecosystem has been basically established. Nevertheless, it still confronts a triple predicament: at the actor dimension, the interest demands of diverse actors are fragmented, free-

riding erodes brand reputation, and authorization and supervision mechanisms remain incomplete; at the resource dimension, the structural contradiction of “first-rate quality, second-rate packaging, third-rate premium” is prominent, data application remains confined to traceability, and the supply of interdisciplinary talent is inadequate; and at the environmental dimension, standardization implementation is insufficient, the “first mile” of cold chain has shortcomings, and cross-departmental coordination efficiency in brand protection is low. These three predicaments are interrelated and mutually reinforcing.

Based on the above analysis, this paper proposes optimization pathways to overcome the predicament: in terms of actor synergy, a five-in-one configuration of “government guidance + association supervision + enterprise leadership + farmer participation + consumer feedback” should be constructed, forging a collaborative co-creation force through interest linkage and behavioral constraints; in terms of resource integration, product standardization and brand re-engineering should be advanced, data resources should be elevated from “recording” to “driving,” systematic cultivation of interdisciplinary talent should be accelerated, and a parent-subsidiary brand matrix of “Dalian 39° Fresh” should be established; and in terms of environmental safeguard, the implementation of standardization and the strengthening of brand protection should be promoted, cold-chain shortcomings at production origins should be remedied, and new channels of live-streaming e-commerce and content e-commerce should be expanded. The three-dimensional mechanism supports one another, forming a positive cycle of “input–value addition–reinvestment.”

The theoretical contribution of this study lies in embedding value co-creation theory within the specific context of the rural e-commerce ecosystem, constructing a three-dimensional analytical framework of “actors–resources–environment,” and extending the application of value co-creation theory to the field of agricultural brands. At the practical level, the research conclusions provide actionable pathway references for enhancing the value of regional brands of agricultural products in Dalian City and the broader Northeast China region. The limitation of this study is its predominantly single-case design; future research could undertake multi-case comparative studies and introduce quantitative methods to empirically test the synergistic effects of the three-dimensional mechanism.

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