Academic Journal of Management and Social Sciences
ISSN: 2958-4396 | Vol. 13, No. 2, 2025

Regional Layout and Development Opportunities of Sichuan School Pre-prepared Food Industry under the Perspective of Gradient Transfer Theory: A Case Study of Anjing Food

Junshuo Yang [1], Yi Hou [2], Feng Xiao [1]

[1] Sichuan University of Light Industry and Chemical Technology, Yibin, Sichuan, 644000, China
[2] Sichuan University of Light Industry and Chemical Technology, Zigong, Sichuan, 643000, China

Abstract: As a rapidly growing sector in the food industry, the development of ready-to-eat meals faces challenges in overcoming regional capacity barriers. Achieving sustainable growth requires systematic capacity reallocation. While the market remains concentrated in eastern China, western regions have experienced capacity outflow without establishing structured frameworks. This study examines Anjing Food Co., Ltd. as a case study, analyzing its successful capacity reallocation model to provide actionable strategies and reference frameworks for the industry. The research aims to facilitate coordinated regional capacity transfers in the ready-to-eat meal sector, ultimately advancing sustainable development across China's food supply chain.

Keywords: Ready-to-eat Meals; Gradient Transfer Theory; Anjing Foods.

1. Introduction

The official definition of ready-to-eat meals by the China Hotel Association comes from the group standard "Classification and Evaluation of Ready-to-Eat Meal Products" (T/CHA 023-2022). This standard was publicly released by the association at the "China International Ready-to-Eat Meal Brand Summit" held in Hangzhou in 2022, defining ready-to-eat meals as "industrialized pre-processing and reheated ready-to-eat" finished products in the catering supply chain [1]. Currently, ready-to-eat meals have grown into a major market worth 610 billion yuan. The Sichuan-style sector, leveraging its advantages in raw materials and costs, accounts for 18% of national production but remains at a low gradient in "production—raw materials": its invention patents and R&D intensity are less than half of those in Guangdong and Shandong; the local supporting rate for packaging and cold chain is below 40%, and the average registered capital per household is only 41% of that in Shanghai, Shenzhen, and Fuzhou[2]. High-gradient regions lock the "R&D—brand" high ground with high proportions of patents, R&D expenditures, and gross margins, but face pressures from land premiums, doubled labor and environmental costs, and saturated market penetration, leading to increased capital migration to the west. Sichuan, Chongqing, and Hunan are seizing this window to absorb production capacity, planning to invest over 18 billion yuan from 2024 to 2026, yet exposing risks of low-end lock-in: the regional homogeneity rate is 65%, and the planned production capacity of Sichuan-style ready-to-eat meals in the three cities has already exceeded the national demand growth by 1.2 times[3]; the invention patents per 10,000 employees are only 42% of the national average, and the high-gradient technology spillover channel is blocked. This study proposes: Under the dual constraints of cost and policy, how can western regions overcome limitations in supporting infrastructure and R&D underdevelopment to attract high-skilled professionals, patents, and standards to relocate in tandem, rather than merely accepting low-end production capacity? How can they establish differentiated industrial clusters and capacity management mechanisms to prevent homogenized competition from eroding the benefits of regional industrial upgrading? These are the critical challenges this research aims to address.

Current research on gradient transfer theory remains limited in the ready-to-eat food sector. Anjing Food (603345) implemented its "Eastern R&D + Sichuan-Chongqing Manufacturing" dual-center strategy from 2022 to 2024, adding 950,000 tons of Sichuan-style production capacity in Ziyang and Hechuan with a 5.8 billion yuan investment—marking the industry's largest single gradient transfer[4]. The company fully transferred its "zero preservative freshness-locking" patent and 120 corporate standards to the Sichuan base, while establishing a "company-cooperative-fund" partnership with 17,000 farmers. By offering 15% premium raw materials, it pioneered a "light-asset knowledge-sharing, heavy-asset collaboration, and local ecosystem co-construction" model, demonstrating exemplary value for high-gradient enterprises relocating westward.

The "Extended Flying Geese Paradigm" was not proposed by a single scholar in one go, but gradually took shape in the 1980s-1990s. Building upon Akira Kuriyama's "Flying Geese Formation Theory," it was developed by Japanese regional economists like Ippei Yamazawa through their analysis of Asia's transnational investment and redivision of labor. Yamazawa formally incorporated the dynamic mechanism of "keeping high-end segments in home countries while sequentially spillovering production stages" into the flying geese model, creating an extended version that balances "innovation lock-in" and "low-end diffusion." The theory suggests that when high-gradient regions maintain absolute advantages in innovation, branding, and standards, while primary factors like land, environmental protection, and labor approach tipping points, leading enterprises will shift production to low-gradient regions. Simultaneously, they retain control over the value chain through patent licensing, standard exports, and supply chain embedding, forming a layered transfer pattern of "high-end lock-in + low-end diffusion."

2. Analysis of the Gradient Pattern and Transformation Motivation of Sichuan-Style Pre-Prepared Food Industry

2.1. Current Situation of Industrial Gradient Pattern

High Gradient Core Area: The "Headquarters-R&D Triangle" of Shanghai, Guangdong, and Fuzhou. In 2023, the top ten cities for patented inventions in ready-to-eat meals accounted for 35.6% of the national total (1,047 patents in Shanghai, 513 in Guangzhou, and 635 in Fuzhou), while their production share was merely 11.8%. This significant gap between innovation density and market scale highlights their strategic positioning in "R&D-brand" high-end development. During the same period, 76.4% of the 13.06 billion yuan R&D expenditure in the A-share ready-to-eat meal sector flowed into listed companies headquartered in these three cities, demonstrating strong capital-technology synergy. Fuzhou Anjing led or participated in formulating 14 national standards and 27 industry standards from 2022 to 2024, ranking first in standard output. Enterprises in Shanghai, Fuzhou, and Guangzhou achieved an average gross margin of 32.1% for vacuum slow-cooking and low-temperature preservation products, surpassing the national average by 9.4 percentage points. Their premium pricing power solidifies their position as the core gradient hub.

The "low-gradation hinterland" of Sichuan, Chongqing, and Hunan: The "production-material supply corridor" reveals a typical "high capacity-low technology" gradient distribution. In 2023, the three regions produced 11.65 million tons of ready-to-eat meals, accounting for 28.9% of China's total output, with invention patents representing merely 4.1%. By June 2024, these areas had registered 19,200 enterprises (21.7% of the national total), averaging 6.12 million yuan in capital per enterprise—less than 41% of the combined average in Shanghai, Guangzhou, and Fuzhou. Their fragmented scale contrasts sharply with the 2023 R&D expenditure of 1.94 billion yuan by large-scale enterprises, which accounted for 0.91% of total revenue (below the national average of 1.68% and significantly lower than Shanghai's 2.74% and Guangzhou's 2.68%). This innovation investment gap reinforces their low-end market positioning.

2.2. Application and Verification of Gradient Transfer Theory in the Field of Pre-Prepared Food

This study employed the Euclidean distance method to calculate the gradient difference between Fujian and Sichuan provinces in the pre-prepared food sector for 2023, using data indicators such as output value, export volume, and online sales. Based on the formula, the results were compared with 10 randomly selected non-adjacent provincial control groups. The findings confirmed the existence of a gradient difference between Fujian and Sichuan, with Fujian demonstrating stronger industrial spillover potential than other provinces.

$$D = \sqrt{\sum_{i=1}^{6} (S_{福i} - S_{川i})^2}$$

2.3. The Internal Motivation of Gradient Transfer

Table 1. Core Indicators of the Pre-prepared Food Industry's Gradient Structure and Migration Drivers

Indicator category	High gradient area (Shanghai, Shenzhen, Rong)	Low gradient area (Sichuan, Chongqing, Hunan)	Source (Published in 2024)
The proportion of invention patents in China	38.40%	4.10%	State Intellectual Property Office
R&D expenditure as a percentage of revenue	2.7% (Shanghai) / 2.9% (Shenzhen)	0.91%	Wind, Provincial Bureau of Statistics
Gross profit margin of high value-added products	32.50%	22.7 %	China Food Industry Association
Average price of industrial land	3800–4500 yuan/m²	384–445 yuan/m²	Land price monitoring of the Ministry of Natural Resources
Average monthly wage in food manufacturing	9.8 k yuan	6.9 k yuan	Ministry of Human Resources and Social Security wage level
Environmental protection cost increase (zero preservatives)	180–220 yuan/t	90–110 yuan/t	Investigation by the Ministry of Ecology and Environment
Family penetration rate (2023)	68–71 %	49 %	iMedia Consulting
2020-2024 cold storage annual growth rate	9.70%	18.20%	China Cold Chain Logistics Alliance
Cold chain damage rate	1.2 %	0.80%	China Internet of Things Cold Chain Committee
Policy subsidy intensity	—	10% of the equipment investment, up to 20 million yuan	Chongqing Municipal Commission of Economy and Information Technology, Sichuan Provincial Department of Finance

As shown in the above table, the internal reasons for promoting the gradient transfer of industries can be divided into three parts:

(1) Thrust: Eastern Cost-Competitive Dilemma. Three factors—land scarcity, labor costs, environmental regulations, and saturated demand—collectively drive the eastward industrial relocation. In 2024, industrial land prices in Shanghai's Fengxian District and Guangzhou's Pingshan District reached 4,500 yuan/m² and 3,800 yuan/m² respectively, 11.5 and 9.7 times higher than Chengdu's 390 yuan/m². Core cities' food manufacturing monthly wages hit 9,800 yuan, 42% above the Chengdu-Chongqing-Zhuzhou-Xiangtan region. Starting 2025, Guangdong and Jiangsu will enforce VOC emission standards for ready-to-eat meals, adding 180-220 yuan/t in environmental costs—twice the Sichuan-Chongqing region's rate. With household adoption rates in the Pearl River Delta and Yangtze River Delta regions reaching 68%-71%, expansion opportunities are shrinking, collectively constraining corporate westward migration.

(2) Competitive Edge: Fourfold Advantages of Western Raw Materials, Costs, Markets, and Policies. Sichuan, Chongqing, and Hunan leverage raw materials, production factors, markets, and policy support to create a strategic industrial hub. Sichuan and Hunan rank first and third nationally in vegetable production, with Chongqing peppers accounting for 32% of the total. The 100-kilometer procurement radius saves 150-200 yuan per ton in transportation costs. Industrial electricity rates at 0.42 yuan/kWh are 70% lower than Jiangsu-Zhejiang and 65% lower than Guangdong. Industrial land prices average 384-445 yuan/m², just 1/10 of Shanghai and Guangzhou levels. Despite an urbanization rate of 59.2% in eight western provinces, per capita disposable income grew at 8.1% annually over five years, 1.3 percentage points higher than the national average, demonstrating strong demand elasticity. Sichuan's 5 billion yuan industrial fund and Chongqing's 10% equipment subsidy cap of 20 million yuan directly reduce implementation costs.

(3) Bridge: The refinement of cold chain logistics technology reduces transfer friction, while the expansion of cold chain networks diminishes spatial constraints. From 2020 to 2024, eight western provinces and municipalities added 7.95 million tons of new cold storage capacity and 21,000 refrigerated vehicles, achieving average annual growth rates of 18.2% and 22.4% respectively. The capacity gap with eastern regions narrowed from 1:2.8 to 1:1.6. The Chengdu-Shanghai and Chengdu-Guangzhou railway cold chain trains now complete 38-hour delivery cycles, 12 hours faster than road transport, with freight cost reductions of 18%. With 98.5% online temperature monitoring and a 0.8% cargo damage rate—outperforming the national average of 1.2%—the "western production—eastern sales" model has achieved economic reliability.

3. The Practice and Strategic Logic of Gradient Transfer of Anjing Food

Anjing Food's "High Gradient" Attributes: Four-Dimensional Advantages of Technology, Capital, Brand, and Management

Technical dimension: Anjing Food leads the industry in R&D intensity, with expenses accounting for nearly 2% of revenue in 2024. With more than 100 valid patents and more than 30% of inventions, the patent density is about twice that of the industry, and it has established a national technology center and a post-doctoral workstation.

Capital Strength: Maintaining Leading Profitability and Cash Flow. From 2022 to 2024, the company's net profit attributable to shareholders grew at a compound annual rate of 16.5%. In 2024, it achieved a net profit margin of 10.1%, with operating cash flow reaching 1.87 billion yuan and cash reserves totaling 3.84 billion yuan. The debt-to-asset ratio stood at 46.2%, approximately 10 percentage points below the industry average. With ample and well-structured equity, the company ensures sustained financial support for its cross-regional expansion.

Brand strength: The company has built a competitive moat through nationwide distribution channels and premium pricing. With 39 billion-yuan bestsellers, its fresh-locking product line delivers a 38.5% gross margin. Operating 2,031 dealerships across 97% of prefecture-level cities, the brand's modern channel revenue accounts for 52% of total income, boasting a premium index of 1.35 – significantly outperforming industry peers.

Management dimension: Deep integration of digitalization and supply chain. The headquarters fully implemented the SAP-ERP+MES system, achieving an output value of 1.83 million yuan per employee, 42% higher than the industry average. With 460 self-operated cold chain vehicles, the cargo damage rate was maintained at 0.6%. The information system and cold chain coordination ensured rapid replication of facilities across different locations while maintaining consistent quality.

Table 2. Anjing Food Capability Transfer Table

Transfer Module	Headquarters output content	Ziyang base acceptance method	Expected local effect
technology	127 patents granted + 14 national standards	Copy 8 "zero preservative lock fresh" process lines	Product average premium +18%
manage	SAP-ERP+MES system + 6σ lean model	100% cloud deployment, 40% of key positions rotate through headquarters training	The per capita output value is 1.78 million yuan, 50% higher than the local industry
standard	120 enterprise standards are open	Implement a closed-loop system of "access, certification, and continuous improvement" for 35 local suppliers	The local compatibility rate is 60%, and the quality accident rate is less than 0.3‰

Implementation of the "Westward" strategy: A case study of Ziyang production base in Sichuan

(1) Motivation: cost-raw material-market-policy four-dimensional combination

Situated along the Chengdu-Chongqing dual economic circle's core axis, Ziyang Base boasts six major geographical raw material zones including Pixian Douban within a 1-hour drive radius. This strategic location reduces raw material transportation costs by 180 yuan per ton. The 38-hour direct rail cold chain service to Shanghai lowers freight rates by 12% compared to Xiamen. Combined with Sichuan Province's "10% equipment investment subsidy + up to 20 million yuan" policy and a feed-in tariff of 0.35 yuan per kWh, the base achieves optimal cost efficiency across four dimensions: production costs, raw materials, logistics, and government incentives.

(2) Model: Transfer of complete set of capabilities in technology, management and standards

The data from Anjing Food's "Ziyang Base Feasibility Study Report" supports the table above, demonstrating that the company's "westward expansion" transcends mere production relocation. It involves systematically embedding three high-level capabilities—technology, management, and standards—into Sichuan-Chongqing, creating a quantifiable local upgrade path. The complete export of patents and national standards boosted Ziyang Base products 'average premium by 18%, swiftly addressing the brand's western market gap. Through SAP+MES cloud replication and headquarters training programs, per capita output value rose from the local average of 1.18 million yuan to 1.78 million yuan, proving digital management's plug-and-play adaptability in low-tier regions. With 120 corporate standards open to 35 local suppliers, the company achieved 60% local supply chain coverage and maintained a quality incident rate below 0.3‰, demonstrating how high-standard spillover can rapidly reshape supply chain quality benchmarks. Overall, this model drives growth through dual engines— "light-asset knowledge transfer + heavy-asset production decentralization" —locking in raw material and cost advantages while enhancing local technical capabilities, establishing replicable "capability transfer" paradigms for future Guangdong and Yangtze River Delta enterprises.

(3) Effect: Fourfold spillover effects of agriculture, employment, taxation, and industrial chain

The Anjing Project has secured 170,000 mu of raw material bases through contract farming, enabling 17,000 farming households to sell their produce at a 15% premium, with an average annual income increase of 3,200 yuan per household. The first phase has absorbed 2,200 local workers, and upon full production capacity in 2026, it will directly create 4,000 jobs while generating 6,000 related employment opportunities. It is projected to contribute 410 million yuan in taxes to the local government from 2025 to 2027. Meanwhile, six supporting enterprises have invested 840 million yuan, forming a 200 km supply chain network that reduces regional logistics costs by 8% per ton. This establishes a localized production system achieving mutual benefits among enterprises, farmers, and local finances.

4. Development Opportunities and Related Countermeasures in Western China under Gradient Transfer

4.1. Major Development Opportunities of Pre-Prepared Food

The Sichuan-Chongqing-Hunan region leads China in raw material abundance, with vegetable, pork, and Sichuan pepper production accounting for 11.3%,8.7%, and 32% of national output in 2023 respectively. However, the initial processing rate remains below 35%, significantly lower than the 60% level in high-value-added regions. Transforming 10% of raw materials into ready-to-eat meals locally, with a 1.8x markup, could generate an additional 42 billion yuan in output value—equivalent to 6.1% of the three provinces 'total agricultural output—demonstrating immense value-added potential in the Sichuan-Chongqing region. From 2024 to 2026, eastern industry leaders including Anjing, Guoquan, and Guolian will deploy 2.85 million tons of production capacity locally, with a total investment of 18.2 billion yuan. This initiative is expected to attract 120 supporting enterprises, forming a 200-kilometer supply chain network. The Anjing Ziyang base alone generates 5.5 billion yuan in annual revenue and 410 million yuan in taxes, accounting for 9% of the High-Tech Zone's fiscal revenue, establishing itself as the core of the specialty cluster. The contract farming model increases farmers' raw material premiums by 15%-20%, with average household income rising by 3,000-4,000 yuan. By the end of 2024, the three provinces have established 38 "ready-to-eat meals + rural revitalization" demonstration parks, creating 216,000 jobs, lifting 43,000 people out of poverty, and achieving an 11.2% annual increase in wage income. These efforts effectively promote the integration of primary, secondary, and tertiary industries while advancing rural revitalization.

4.2. Real Challenges Facing the Development of Western Pre-Prepared Food

Table 3. Comparison of industrial chain supporting maturity

Supporting links	Average supporting rate of Sichuan, Chongqing and Hunan (%)	Guangdong (%)	Shandong (%)	gap (%)
packing material	38	72	70	32–34
Seasonings	42	68	65	23–26
Cold Chain Logistics	34	65	70	31–36

The relocation of Anjing Food to western China reveals three critical constraints hindering the growth of regional ready-to-eat meals. First, supply chain gaps undermine economies of scale: At the Ziyang facility, procurement rates for packaging materials, composite seasonings, and cold chain services remain below 40%, forcing long-distance transportation that increases logistics costs by 8%. This highlights the absence of a closed-loop system covering "raw

materials, packaging, and cold chain" at 38%,42%, and 34% of supply chain nodes, exposing supply chain vulnerabilities despite the company's leading production capacity. Second, insufficient R&D capacity limits technological spillover: While Anjing holds 127 patents and 41 invention patents that could instantly authorize production bases, regional enterprises in Sichuan, Chongqing, and Hunan maintain only 0.91% R&D intensity. With 5.8 invention patents per 10,000 employees—half the Guangdong-Shandong average—local suppliers struggle to adopt advanced processes, creating risks of isolated industrial clusters through high-gradability "light-asset exports." Third, homogenized competition narrows upgrade opportunities: The three cities' 14th Five-Year Plan targets 5.8 million tons of Sichuan-style ready-to-eat meals, exceeding national demand growth by 1.2 times. With 65% product overlap, Anjing's differentiated "fresh-locking + Sichuan-flavor" strategy remains underdeveloped. Regional expansion continues along the "low-price—repetitive construction" path, potentially diluting premium pricing advantages and deterring investment in supporting enterprises.

5. Countermeasures and Suggestions: The Path of Industrial Undertaking and Upgrading in Western China

5.1. Government Level

The central government has established the "Western Prefabricated Food Technology Adaptation Fund" to address bottlenecks in technology transfer. The Ministry of Industry and Information Technology (MIIT), in collaboration with the National Rural Revitalization Administration, will allocate 2 billion yuan annually to subsidize "Eastern Patent + Western Transformation" projects. These projects must demonstrate that patents have undergone secondary development and open-source process packages have been released in Sichuan, Chongqing, and Hunan. Subsidies will be revoked if these requirements are not met, with the goal of creating an iterative public technology repository.

Provincial governments: Local authorities in low-gradability regions may implement innovative mechanisms like the "supply chain buffer" system. Drawing inspiration from land reserve strategies, this policy mandates a three-year lock-up period for 15% of newly developed industrial parks' land use and 10% of energy consumption quotas. Access is restricted to projects with high supporting infrastructure ratios (≥60%), compelling local governments to prioritize infrastructure development and prevent production capacity fragmentation.

Municipal and county governments: In addition to supporting higher-level authorities, the Chengdu Municipal Government may establish a "Sichuan Cuisine Ready-to-Eat Meal Production Capacity Early Warning Exchange". Drawing inspiration from carbon trading mechanisms, this platform would initially allocate planning quotas and enable competitive bidding. When demand declines, enterprises could sell surplus quotas, with the proceeds allocated to technological upgrades. Through market-oriented approaches, this mechanism would balance peak and off-peak demand while curbing homogenized expansion.

5.2. At the Industry Level

The China Food Industry Association, as the primary entity, operates the "Western Prefabricated Food Supply Chain Exchange". It leads the development of an online platform that breaks down packaging, cold chain logistics, and compound seasoning requirements into standardized modules. By tendering these components to global suppliers, the association provides winning enterprises with three-year half-rent vouchers for Western industrial parks, achieving precise order targeting and increasing supply chain coverage to over 60%. Additionally, it publishes the "Sichuan Cuisine Prefabricated Food Flavor Differentiation Map", utilizing flavor chemistry and sensory evaluation to identify underdeveloped subcategories of Sichuan cuisine with origin labeling. A three-year ban on identical naming prevents product duplication while guiding enterprises to develop differentiated offerings. The backend establishes a "Patent Pool + Defensive Alliance" system, collecting idle patent projects from eastern industry leaders and implementing a free cross-licensing mechanism. New entrants must either contribute their latest patents or pay substantial entry fees, effectively accelerating technology diffusion while preventing low-end replication.

5.3. Enterprise Level

Drawing from Anjing Food's successful capacity expansion model, we propose establishing "Light-Availability Technology Hubs" where industry leaders like Anjing set up compact shared labs at 10,000 TEUs production milestones. These hubs would provide local suppliers with access to testing facilities, prototype development, and pilot production lines through cost-sharing arrangements, thereby accelerating innovation cycles and addressing R&D gaps. The supply chain initiative implements a "Supplier Equity-for-Orders" program, offering 5%-10% equity stakes in key packaging and cold chain partners in exchange for five-year contracts. This mechanism ties suppliers' return on equity (ROE) to leading manufacturers' capacity utilization rates, securing long-term partnerships while sharing premium pricing, thus reducing redundant infrastructure. Additionally, through collaborative projects like the "Sichuan Cuisine Digital Twin" initiative, enterprises are partnering with universities to create a Sichuan flavor database. This open-source aroma fingerprint profiles of 30 core ingredients (including chili peppers and Sichuan peppercorns) empower small and medium-sized manufacturers to develop differentiated products using AI-driven formula tools, effectively curbing homogenized competition.

6. Concluding Remarks

Research indicates that the cost-performance gap in pre-prepared meals has triggered a "cost-institution" window period. The 5.8 billion yuan Sichuan-Chongqing project by Anjing Food demonstrates that integrating "patent-standard-management" systems can achieve 18% product premium and 60% local supply chain integration in western China, while creating employment for local farmers and accelerating rural revitalization. If cold chain circulation rates increase from 34% to 55%, Sichuan, Chongqing, and Hunan could generate an additional 42 billion yuan in output value with 3.8% higher average profit margins. Future efforts to address infrastructure gaps, R&D deficiencies, and production capacity optimization—through a policy package combining "technology adaptation funds, production capacity exchanges, and flavor digital twins" —could shift focus from capacity relocation to value chain co-construction, providing sustained momentum for rural revitalization and regional common prosperity in western China.

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