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2025 Volume 3, Issue 5
Lecture Notes in Education, Arts, Management and Social Science
ISSN(Online): 2705-053X

The Selection of High-quality Development Path for Daqing's Agricultural Industry Chain Driven by New Agricultural Quality Productivity

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Abstract: Against the backdrop of accelerating the reconstruction of the global economic pattern with new quality productivity, the high-quality development of the agricultural industry chain has become an important breakthrough for the industrial transformation of resource-based cities. Taking Daqing City as the research object, this study systematically examines the bottlenecks and breakthrough paths for the high-quality development of the agricultural industry chain in Daqing City. It has been discovered that Daqing City is currently facing four core bottlenecks. By building an intelligent+skill element upgrading system to solve the mismatch of elements,designing a new paradigm of three chain integrated industrial governance to enhance the control index of the industrial chain, implementing intergenerational transition technology strategies to increase the contribution rate of technological progress, and innovating the "three dimensions" collaborative promotion mechanism, leading enterprises in agricultural industrialization can promote the high-quality development of the agricultural industrial chain.

Keywords: New quality productivity; Agricultural industry chain; Leading enterprises; Digital agriculture

Online publication: June 26, 2025

1. Introduction

New quality productivity, as a new form of productivity characterized by technological innovation as its core and efficiency transition in factor allocation, is reconstructing the value creation logic of the agricultural industry chain. The report of the 20th National Congress of the Communist Party of China clearly put forward the strategic goal of "accelerating the construction of a strong agricultural country", emphasizing the deep integration of biotechnology, digital technology, and green innovation to break through the development dilemma of "high input low efficiency" in traditional agriculture. This strategic orientation has special significance in Heilongjiang Province, which not only bears the rigid responsibility of ensuring national food security, but also faces the practical challenges of tightening resource and environmental constraints and a single industrial structure[1].As a typical resource-based city, Daqing's agricultural industry chain presents five characteristics: full chain integration, cluster development, intelligent driving, brand empowerment, and policy guidance. However, although Daqing has entered the fast lane of agricultural industry chain development, high resource consumption, high carbon emission intensity, low processing conversion rate, and low total factor productivity also constrain its development speed and quality. This "resource dependent" development model is no longer suitable

for the requirements of agricultural modernization under the "dual carbon" goal. Previous studies have shown that new quality productivity can break through the traditional law of diminishing marginal returns of factors and achieve "creative destruction" of the agricultural industry chain through collaborative changes in technology, organization, and institutions[2,3]. However, existing research has mostly focused on the economic effects of technology at a single point, and the exploration of regional adaptation paths is clearly insufficient. At the level of technological application, there are institutional environmental differences between the smart agriculture system constructed by the European Union through the CAP policy[4] and China's small-scale agricultural economy foundation. In domestic practice, although the "leading enterprise led" model in Shandong and the "e-commerce empowerment" model in Jiangsu and Zhejiang have achieved significant results, they are difficult to directly replicate in the main production areas of bulk agricultural products. Especially for the cold black soil region, research is still in the stage of technical feasibility verification, lacking empirical testing of the dynamic mechanism of "technology diffusion organizational response institutional matching"[5], leading to cognitive biases in policy design that often fall into the "technology omnipotence theory" or "institutional determinism".

Based on this, proposing differentiated technology diffusion plans and institutional innovation lists for the agricultural industry chain in Daqing City to assist in the construction of a national agricultural high-tech industry demonstration zone is a key research topic that needs to be focused on[6].

2. In depth analysis of the current situation of the agricultural industry foundation

2.1. Farmland Resources and Planting Structure

Among the 13.9673 million acres of arable land in Daqing City, 11.2931 million acres of permanent basic farmland have been constructed with an ecological pattern of "fields forming squares, forests forming networks, and channels connecting". 6.7335 million acres of high standard farmland have been stabilized in the organic matter content range of 3.2% -3.5% through technologies such as underground pipe irrigation and soil improvement, which is 0.8 percentage points higher than the surrounding areas. It is worth noting that the 30% share of facility agriculture in the "433" planting pattern is mainly concentrated in Zhaozhou and Zhaoyuan counties. Among them, the scale of cold land fruit and vegetable greenhouses in Lindian County has reached 12000, forming a regional brand effect. However, there is still a problem of mixed varieties in the cultivation of miscellaneous grains in economic crops, such as the degradation rate of mung bean varieties in Durbert County reaching as high as 15%.

2.2. Industrial benefits and labor crisis

In the total agricultural output value of 51.55 billion yuan in 2023, animal husbandry, as a pillar industry, contributes 38%, but its stability is significantly constrained by the cyclical fluctuations in feed raw material prices such as corn and soybean meal. Although the total factor productivity maintained a moderate growth of 2.3%, deep-seated contradictions were prominent: the average idle time of expensive agricultural machinery such as large combine harvesters exceeded 90 days per year (idle rate of about 25%), and the traditional method of fertilizer application resulted in a comprehensive utilization rate of less than 40% for nitrogen, phosphorus, and potassium, causing dual pressures of resource waste and non-point source pollution. The problem of imbalanced labor structure is particularly acute, with 61.7% of agricultural workers aged 55 and above, and a gap phenomenon of "post-70s leading field operations" in grain producing areas such as Chaoyanggou Town in Zhaozhou County. The continuous migration of young and middle-aged labor force to urban service industries directly leads to the delay in the promotion of modern agricultural technologies such as precision irrigation and intelligent plant protection, forming a vicious cycle of "aging - low efficiency - poor returns - talent loss".

2.3. Quantitative analysis of infrastructure shortcomings

In terms of cold chain logistics, the existing cold storage capacity can only meet the storage demand of 493000 tons of agricultural products, which is seriously imbalanced with the annual production of 2.87 million tons of fresh agricultural

products. In the processing stage, traditional oil pressing is still the main method for soybean initial processing, and the application rate of deep processing technologies such as protein extraction is less than 5%. The urban-rural gap in digital infrastructure is more significant, with 5G base station density in rural areas only 1/8 of that in urban areas, resulting in IoT device online rates hovering around 65%.

3. Multidimensional perspective on the structure of the agricultural industry chain

3.1. Specific manifestations of the “spindle shaped” structure

In the agricultural production process, the cost of production materials constitutes the main expenditure of corn planting, accounting for as much as 62%. Specifically, the prices of agricultural inputs such as seeds, fertilizers, and pesticides continue to rise, and it is particularly noteworthy that land transfer costs have shown explosive growth, rising 137% from the 2018 benchmark, which directly increases the production and operation pressure on farmers. The processing stage presents the characteristics of “high agglomeration and low innovation”: as a regional food processing center, the Economic Development Zone has a spatial density of 3.2 enterprises per square kilometer, forming a significant industrial cluster effect; However, in-depth analysis reveals that these enterprises generally suffer from insufficient R&D investment, with an average R&D intensity of only 0.7% of revenue, far below the recommended standard of 2.5% in the agricultural product processing industry. The sales process has exposed the problem of weak value acquisition ability in the production chain - the proportion of direct export of raw grains is as high as 68%, exceeding the provincial average by 12 percentage points, reflecting the low conversion rate of local deep processing; What is more prominent is the lag in brand building, with the terminal selling price of rice of the same quality only reaching 33% of well-known brands in Wuchang City, indicating a significant lack of premium ability for regional agricultural product brands.

3.2. Gradient differences in digital applications

Although 14 digital agriculture demonstration bases with intelligent irrigation, precision fertilization and other functions have been built in the city, due to limited funding and technological barriers, the intelligent terminal equipment rate of small farmers, who account for the vast majority of agricultural operators, is still less than 15%. The digital application shows a clear polarization of “strong demonstration and weak popularization”. Specifically in terms of technical scenarios: IoT technology has been maturely applied in the field of greenhouse vegetables with controllable environments, with an application rate of 82%. It can achieve full process intelligent management such as automatic temperature and humidity adjustment, pest and disease warning, etc; In the field crops planted outdoors, only basic equipment such as meteorological monitoring stations have been deployed, and data linkage with agricultural machinery operations and irrigation systems has not yet been achieved. There is a structural imbalance in the digital penetration of the processing stage. Taking grain drying as an example, although more than 80% of enterprises have installed online monitoring equipment, only 23% of drying towers are connected to intelligent control systems that can automatically adjust parameters, and most are still in the data collection stage, failing to form a closed-loop management of “monitoring analysis decision-making”. This phenomenon of “emphasizing hardware over software, emphasizing data over applications” reflects a significant gap in the depth and effectiveness of digital transformation in various links of the industrial chain.

4. Assessment of the Current Status of New Quality Productivity Applications

4.1. The ‘Island Effect’ of Technology Promotion

In the 1.798 million acres of new technology promotion area, there is a clear phenomenon of resource concentration -78% of applications are concentrated in 20 well-equipped modern agricultural parks, while the participation rate of ordinary farmers is less than 30%, reflecting a structural imbalance in technology promotion. Although the pilot of smart agriculture has established a four level service system covering counties, townships, villages, and households, the problem

of weak grassroots service capabilities is prominent: only 41% of village level information officers have agricultural professional backgrounds, resulting in insufficient precision in technical guidance. Typical case analysis shows that although the intelligent cold chain system adopted by Lianhuanhu Fishery is innovative, due to factors such as incomplete regional logistics support, its cold chain cost per ton of aquatic products is 18% higher than that of Dalian Port. This cost disadvantage seriously limits the scale promotion of advanced models. These phenomena collectively reveal deep-seated contradictions in technology promotion, such as “hot in parks and cold in farmers”, “heavy on hardware and light on services”, and “having pilot projects but difficult to popularize”.

4.2. Structural Contradictions in the Science and Technology Innovation System

Among the 652 high-tech enterprises in the city, the proportion of agricultural enterprises is only 7.3%, which is significantly lower than other technological fields. Further analysis shows that these agricultural enterprises are mainly concentrated in traditional agricultural technology fields such as biological fertilizers, with relatively low technological barriers and a lack of cutting-edge technology layouts with high added value. At the same time, the intensity of agricultural technology research and development investment is only 1.2%, which is significantly lower than the average R&D investment level of 2.8% in the city’s high-tech industries. The uneven allocation of resources not only hinders the deep development of agricultural scientific and technological innovation, but also reflects the structural contradictions in the current scientific and technological innovation system in terms of industrial synergy and policy guidance. For example, the research and development entities in key technology fields such as biological breeding and smart agriculture are still dominated by research institutes, with insufficient participation from enterprises, resulting in a low conversion rate of scientific research achievements and difficulty in forming a complete agricultural science and technology innovation ecosystem.

5. Mechanism analysis of 5 development bottlenecks

5.1. Deep Causes of Locking in Production Factors

In terms of material capital, the slow update of agricultural machinery and equipment is mainly affected by the inadequate implementation of subsidy policies. Specifically, the cumbersome subsidy application process has led to a setback in farmers’ enthusiasm, and there is a lag in the grassroots approval process. The actual subsidy funding rate in 2024 is only 79%, which is 21 percentage points lower than the expected target. In addition, the subsidy standards for purchasing agricultural machinery are disconnected from market prices, further weakening the motivation of farmers to update their equipment.

In terms of the land factor market, there is a significant correlation between the phenomenon of inflated prices and the blind entry of industrial and commercial capital. After the large-scale transfer of non-agricultural capital to agricultural land, there are generally two alienation phenomena: one is that the capital side raises the rental level through “non grain” operation, and the other is that some enterprises hoard land for sale, leading to speculative behavior. A survey conducted in a certain district and county shows that the transfer price of land parcels involving industrial and commercial capital is 42% higher than the average transaction price between farmers, directly pushing up agricultural production costs.

5.2. Dynamic evolution of three chain fragmentation

The problem of innovation chain discontinuity is mainly manifested as the mismatch between supply and demand in scientific research and industry. Specifically, there are obvious deficiencies in the mechanism for initiating agricultural research projects at the municipal level. On the one hand, project applications are mostly led by universities and research institutes, lacking research on the actual technical needs of enterprises; On the other hand, the participation of enterprises continues to be low, with less than 20% of municipal agricultural research projects involving enterprises as cooperative units in the past three years, resulting in a serious disconnect between research and development results and market demand. Taking the 2022 fruit and vegetable preservation technology special project in a certain city as an example,

out of the 7 approved projects, 5 focus on molecular mechanism research in the laboratory stage, only 2 involve actual preservation process improvement, and only 1 technology ultimately achieves industrial application.

The problem of external dependence in the value chain stems from the weak supporting capacity of local industries. According to the survey, the annual production capacity of local agricultural enterprises can only meet 35% of the regional market demand, and the gaps in key production materials such as biopesticides and compound fertilizers reach 62% and 58% respectively. This supply shortage forces farmers to rely on out of town procurement, which not only increases production costs (by an average of 23%), but also leads to a decrease in technological adaptability - the adaptation rate of out of town agricultural products to local soil characteristics is less than 40%, directly affecting crop yield and quality. Taking rice cultivation as an example, the use of fertilizers from other regions resulted in an average reduction of 15.7% in yield per mu compared to locally optimized formulas.

The shortcomings of the supply chain are particularly prominent in the cold chain logistics link. The current coverage rate of rural level cold chain nodes is only 28%, far lower than the level of 92% in urban areas. Specifically, the lack of pre cooling facilities leads to a post harvest loss rate of 18% -25% for agricultural products; Only 31% of vehicles in the transportation process are equipped with temperature control devices; The shortage of village level cold chain storage has reached 150000 cubic meters. Taking the strawberry industry in a certain county as an example, due to the lack of post harvest pre cooling treatment, about 30% of strawberries spoil during transportation each year, resulting in direct economic losses exceeding 20 million yuan. This “last mile” chain breakage phenomenon seriously restricts the premium capacity and market radius expansion of agricultural products.

5.3. Typical manifestations of intergenerational technological discontinuity

Although 544 Yinong Information Societies have been established throughout the county and a preliminary rural information service network has been built, the coverage of intelligent devices is clearly insufficient - only 17 intelligent terminals equipped with remote video diagnosis, AI recognition of pests and diseases, and other functions are deployed, with an average of 1 device shared among every 32 information societies, which is difficult to meet the real-time technical guidance needs of farmers. In terms of blockchain technology application, although the Zhaoyuan Rice Traceability System has achieved the monitoring of planting environment (such as soil temperature and humidity, pesticide use records) and the uploading of warehousing and logistics data, the key data uploading rate is only 60%, especially the core information missing rate of raw material batch association and quality inspection reports in the processing link, which reaches 40%, resulting in significant breakpoints in the trustworthy traceability of the entire industry chain.

5.4. Transmission mechanism of short chain phenomenon

The insufficient driving role of leading enterprises is mainly manifested in three aspects: firstly, in terms of innovation and research and development capabilities, only 21% of agricultural leading enterprises at or above the city level have established specialized research and development institutions, reflecting insufficient investment in technological innovation by enterprises; Secondly, in terms of the mechanism of interest linkage, the cooperation model of “enterprise+farmer” has the problem of ineffective contract execution, specifically manifested as a high default rate of 12.7% in contract agriculture, which seriously affects the stability of industrial organization; Finally, in terms of extending the industrial chain, the deep processing capacity of agricultural products is clearly insufficient. The current ratio of processing conversion value to primary product value is only 1:1.8, which is significantly lower than the 1:3 standard commonly achieved in developed countries. This directly restricts the increase in added value of agricultural products.

6. Breakthrough Paths Based on New Quality Productivity

6.1. Breakthrough Path for Double Locking of Production Factor Allocation

The key to the allocation of agricultural production factors under the new quality productivity lies in achieving innovative

and optimized combinations of factors. For Daqing City, in the process of breaking through the dual lock-in of production factors, we need to start from three aspects: labor factors, labor tool factors, and labor object factors. In terms of labor factors, it is necessary to cultivate high-quality agricultural laborers, improve the literacy of agricultural labor through organizing technical training for farmers, cultivating new types of agricultural management entities, encouraging rural innovation and entrepreneurship, etc., so that they can master the necessary knowledge and skills for modern agricultural development. At the same time, promote the adaptation of labor force to new tools and objects, so that labor force can better match new labor tools and objects, and improve production efficiency and quality. In terms of labor tool elements, we will update traditional labor tools, eliminate traditional agricultural tools, apply advanced technologies such as the Internet of Things and automation equipment to agriculture, reduce labor intensity through technological substitution, break through temporal and spatial constraints, and improve agricultural production efficiency. In terms of labor object factors, expanding the scope of labor objects, coordinating agricultural production layout, and fully developing the agricultural resource potential of Daqing City, such as water surface aquaculture in Zhaoyuan County. At the same time, relying on the advantages of universities such as Heilongjiang Bayi Agricultural Reclamation University in animal and plant breeding, agricultural biopharmaceuticals, and bio fertilizer technology, agricultural technology innovation can be achieved.

6.2. Three Chain Integration Innovation Plan for Industrial Chain Governance

The high-quality development of the agricultural industry chain under the new quality productivity requires the reconstruction of the collaborative relationship between the innovation chain, value chain, and supply chain. In terms of innovation chain, Daqing City should focus on building a closed-loop mechanism of "enterprise problem solving+scientific research and development+market verification", establish industry demand-oriented R&D funds, and promote the transformation rate of scientific and technological achievements. In terms of extending the value chain, we will focus on developing deep processing of agricultural products and building a regional brand system. In terms of supply chain, we should focus on building a three-level system of "origin cold storage+backbone cold chain+smart logistics", and develop a supply chain collaboration platform to reduce logistics loss rates. At the same time, taking advantage of the third batch of pilot cities for digital transformation of small and medium-sized enterprises approved by Daqing City, we will promote the digital transformation of agricultural industrialization enterprises in Daqing City and promote the integrated development of the industrial chain.

6.3. Implementation strategy for intergenerational transition of technological evolution

Crossing the technological generational gap requires the construction of a multi-level innovation system. For Daqing City, the development of agricultural digital technology is difficult, but the introduction and application of technology have become the focus. Daqing City should focus on breaking through the integrated application of digital technologies such as the Internet of Things, big data, and artificial intelligence in agricultural production, and establish a collaborative innovation mechanism of "government industry university research application" in universities in Daqing. At the same time, in response to the uneven network coverage in some rural areas, we will increase investment to achieve the integration of digital information platforms in five districts and four counties, and build a digital infrastructure network covering the entire industry chain. In terms of technological application, we will enhance the existing level of intelligent technology application, organically combine talent introduction, technology application, intelligent equipment maintenance and upgrading, and promote the high-quality development of the agricultural industry chain.

6.4. Short chain cracking mechanism of industrial organization

The solution to the short chain of industrial organization requires improving the efficiency of industrial organization and attracting more agricultural operators to participate in the construction of the industrial chain. Daqing City has a good foundation for agricultural industrialization, and the development of new agricultural management entities is rapid, but

small farmers are still the main body of agricultural management. Therefore, promoting the development and growth of new agricultural management entities is a prerequisite, which requires innovative interest linkage models. In response to the actual situation in Daqing City, implementing the distribution mechanism of "guaranteed income+secondary dividends" can enhance the organizational level of small farmers. Secondly, the extension of the industrial chain should leverage Daqing's fundamental advantages in "grain production, agriculture, and labor", and focus on the deep processing of livestock products, miscellaneous grains, and high-quality rice. Build agricultural product processing park clusters based on e-commerce industrial parks in various counties and districts. Finally, by constructing a modern industrial organization system of "leading enterprises+cooperatives+family farms", a development pattern of complementary advantages and shared risks will be formed.

Funding

Key Project of Philosophy and Social Sciences Planning in Daqing City in 2025, "Research on the High Quality Development of Agricultural Industry Chain in Daqing City Driven by Agricultural New Quality Productivity", Phase Achievement (Project No.: DSGB2025009)

Disclosure statement

The author declares no conflict of interest.

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