

Research on the Construction of an Evaluation System for Agricultural and Rural Modernization Development in Hebei Province

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Abstract: Agricultural and rural modernization serves as an important foundation of Chinese-style modernization, as well as a core measure to solve unbalanced urban-rural development and inadequate rural development. As a major agricultural province in North China, Hebei Province acts as a core guarantee zone for food security, ecological security, and agricultural product supply in the Beijing-Tianjin-Hebei region. Promoting agricultural and rural modernization bears great strategic significance for regional high-quality development. Based on the actual development of agriculture, rural areas, and farmers in Hebei Province, this research follows the principles of scientificity, systematicity, regionality, and forward-lookingness, and constructs an evaluation system for agricultural and rural modernization containing 3 primary indicators, 7 secondary indicators, and 17 tertiary indicators covering economy, society, and ecology. It systematically analyzes the current situation and prominent weaknesses of agricultural and rural modernization in Hebei Province. Combined with provincial development characteristics, this paper builds a high-quality development path adapted to Hebei from six dimensions including technological empowerment, industrial integration, talent cultivation, digital governance, urban-rural coordination, and green development. It provides a practical reference for Hebei Province to accurately judge the progress of rural construction, formulate differentiated revitalization policies, and make up for rural development shortcomings.

Keywords: Agricultural and rural modernization; Evaluation system; Rural revitalization; Urban-rural integration; Hebei Province

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1. Introduction

Agricultural and rural modernization is a systematic transformation project covering industry, talents, ecology, governance, and urban-rural coordination, and a core task of comprehensively promoting rural revitalization and building agricultural power ^[1]. In recent years, the state has continuously strengthened top-level design for agriculture, rural areas, and farmers, and issued a number of policy documents, providing fundamental support for the construction of agricultural and rural modernization in all regions. Located in the North China

Plain, Hebei Province enjoys geographical advantages brought by the Beijing-Tianjin-Hebei Coordinated Development Strategy, abundant cultivated land resources, and a solid agricultural industrial foundation. It is an important grain production base, fruit and vegetable supply base, and ecological barrier in northern China, and rural development occupies a key position in the regional economic pattern.

At present, remarkable achievements have been made in agricultural and rural construction in Hebei Province, yet many shortcomings still exist: the intelligence and scale of agricultural production are insufficient, and the transformation efficiency of technological empowerment is low; the rural industrial structure is single with inadequate deep integration of primary, secondary and tertiary industries; there is a large gap of professional rural talents, and the popularization of digital skills lags behind; the allocation of urban and rural resources is unbalanced, and the gap of public services and income has not been completely narrowed; the utilization efficiency of agricultural ecological resources is low, and the long-term mechanism for rural environmental governance is imperfect. Against such a background, it is urgent to construct a special evaluation system fitting Hebei's provincial conditions to accurately quantify the development level and identify weak links, so as to drive the high-quality development of agriculture, rural areas and farmers across the province. By establishing a multi-level and multi-dimensional evaluation index system and systematically sorting out development pain points, this study puts forward targeted optimization paths, providing scientific support for the construction of agricultural and rural modernization in Hebei Province.

2. Construction of evaluation system for agricultural and rural modernization

2.1. Construction principles of the evaluation system

To ensure the evaluation system is scientific, realistic, and practical, this paper follows four major construction principles. First, the principle of scientificity. All levels of indicators are closely linked to the core connotation of agricultural and rural modernization with clear definitions and unified statistical standards, and reflect the real regional development level objectively, relying on official authoritative data. Second, the principle of systematicity. It fully covers three core fields including economic development, social construction, and ecological protection. Indicators at all levels are interrelated and mutually supportive to form a complete comprehensive evaluation system. Third, the principle of regionality. Based on Hebei's core positioning as a major grain-producing area and ecological barrier for Beijing-Tianjin-Hebei, it focuses on characteristic indicators fitting provincial conditions such as agricultural production efficiency, coordinated urban-rural development, and farmland ecological protection. Fourth, the principle of forward-lookingness. It incorporates modern core indicators such as digitalization, intellectualization, and green, low-carbon development, conforming to the high-quality development trend of agriculture and rural areas in the new era.

2.2. Framework of evaluation index system

Combined with existing research results and the actual development of Hebei Province, this study finally constructs a comprehensive evaluation system consisting of 3 primary indicators, 7 secondary indicators, and 17 tertiary indicators, which fully covers the core fields of agricultural and rural modernity^[2-4]. The specific indicators are shown in **Table 1**.

Table 1. Evaluation system for agricultural and rural modernization in Hebei Province

Primary indicator	Secondary indicator	Tertiary indicator
Modernization Level of Agricultural and Rural Economy	Improvement of Production Efficiency	Comprehensive Agricultural Mechanization Operation Rate
		Intensity of Digital Investment in Agricultural Production
		Contribution Rate of Agricultural Scientific and Technological Progress
	Optimization of Industrial Structure	Conversion Rate of Agricultural Products Processing
		Proportion of Operating Income from Leisure Agriculture
		Output Value Proportion of Agriculture, Forestry, Animal Husbandry and Fishery Service Industry
Modernization Level of Agricultural and Rural Society	Construction of Talent Team	Participation Rate of Rural Labor Force in Digital Skills Training
		Proportion of Agricultural Scientific and Technological Talents Among Agricultural Employees
	Modernization of Rural Governance	Digital Coverage Rate of Village-level Governance
		Improvement Index of Rural Governance Efficiency
Modernization Level of Agricultural and Rural Ecology	Integrated Urban-Rural Development	Ratio of Urban and Rural Highway Density, Ratio of Urban and Resident Income
		Effective Utilization Coefficient of Irrigation Water
	Sustainable Utilization of Resources	Comprehensive Utilization Rate of Crop Straw
		Proportion of Installed Capacity of New Energy in Agriculture
	Control of Environmental Pollution	Comprehensive Utilization Rate of Livestock and Poultry Manure
		Centralized Treatment Rate of Rural Domestic Sewage

2.3. Interpretation of indicator connotations

2.3.1. Modernization level of agricultural and rural economy

Economic modernization serves as the core support of agricultural and rural modernization, reflecting the quality of rural industrial development and the transformation effects of modern agriculture. The dimension of production efficiency improvement includes the comprehensive agricultural mechanization operation rate, digital investment intensity in agricultural production, and contribution rate of agricultural scientific and technological progress, which respectively measure the scale production level of agriculture, application intensity of digital technology, and empowerment effects of scientific and technological innovation, acting as core symbols of the transformation from traditional agriculture to modern agriculture. The dimension of industrial structure optimization covers the conversion rate of agricultural product processing, the proportion of operating income from leisure agriculture, and the output proportion of agriculture-related service industries. They respectively reflect the extension capacity of agricultural industrial chains, development achievements of new rural business forms, and the perfection degree of the agricultural socialized service system, representing the diversified and high-end development level of agriculture.

2.3.2. Modernization level of agricultural and rural society

Social modernization is an important guarantee for stable development and vitality improvement of rural areas. The construction of a talent team includes the participation rate of the rural labor force in digital skills training and the proportion of agricultural scientific and technological talents, which measure the cultivation effects of new professional farmers and the reserve level of high-end agricultural talents, respectively, providing intellectual support for modern agriculture. Modernization of rural governance covers the digital coverage rate

of village-level governance and the improvement index of rural governance efficiency, reflecting the intelligent level and comprehensive governance effects of grassroots governance. Integrated urban-rural development adopts the ratio of urban and rural highway density and the urban-rural resident income ratio to measure the connectivity of urban and rural infrastructure and the balance of urban-rural development, serving as core evaluation indicators to break the urban-rural dual structure.

2.3.3. Modernization level of agricultural and rural ecology

Ecological modernization is the fundamental foundation for sustainable development and livable rural construction. The dimension of sustainable resource utilization adapts to Hebei's feature as a water-deficient northern province. It adopts the effective utilization coefficient of irrigation water, the comprehensive utilization rate of crop straw, and the installed capacity proportion of agricultural new energy to measure the effects of agricultural water conservation, resource recycling, and low-carbon agricultural transformation. The dimension of environmental pollution control includes the comprehensive utilization rate of livestock and poultry manure and the centralized treatment rate of rural domestic sewage, focusing on the governance of breeding pollution and rural living pollution, which are key indicators for evaluating rural ecological governance and livable environment construction.

3. Current situation and problems of agricultural and rural modernization in Hebei Province

3.1. Development status

Since the implementation of the rural revitalization strategy, phased achievements have been made in agricultural and rural modernization construction in Hebei Province. Economically, the coverage of agricultural mechanization across the province keeps expanding, pilot smart agriculture projects are steadily launched, and digital investment in agriculture increases year by year. The deep processing industry of agricultural products develops rapidly, new business forms such as leisure agriculture and rural tourism flourish, and the agricultural socialized service system is continuously improved with steadily rising industrial added value. Socially, special training for farmers is carried out regularly, and the team of new professional farmers keeps expanding. Digital rural governance platforms are gradually popularized to continuously improve grassroots governance efficiency. Relying on the Beijing-Tianjin-Hebei Coordinated Development Strategy, urban and rural infrastructure is continuously optimized, the urban-rural income gap narrows, and integrated development shows a positive trend. Ecologically, water-saving agriculture is fully promoted to steadily improve agricultural water utilization efficiency. A recycling system for straw, livestock, and poultry manure is basically established. The renovation of the rural living environment is deepened, the coverage of domestic sewage treatment expands, and the foundation of green rural development is consolidated continuously.

3.2. Core existing problems

Compared with the construction goal of an agricultural strong province, Hebei's agricultural and rural modernization still has many weaknesses. In terms of economic development, agricultural technological empowerment varies among regions, mechanization and digital equipment are insufficiently popularized in remote counties, and the transformation efficiency of scientific and technological achievements is low. The depth of rural industrial integration is limited, dominated by primary agricultural products with short deep

processing chains. Leisure agriculture suffers from homogenization, and the agricultural socialized service industry lacks professionalism, leading to low overall industrial added value.

In terms of social development, the loss of rural talent is prominent, with a massive outflow of young and middle-aged laborers, and there is a shortage of digital and high-end agricultural technical talent. The implementation effects of digital rural governance are unsatisfactory; digital equipment in some villages lies idle without operation and maintenance, and governance application scenarios are limited. The allocation of urban and rural public services is unbalanced, with insufficient high-quality education and medical resources in rural areas, and the gap in infrastructure between urban and rural areas has not been fully bridged.

In terms of ecological development, agricultural resources are utilized in an extensive way. Some farmlands adopt rough irrigation, resulting in water waste. The quality of agricultural waste recycling is low without sound long-term management mechanisms. Remote villages lack complete sewage and garbage treatment facilities, and agricultural non-point source pollution is not thoroughly controlled. The popularization of agricultural new energy is limited, and the pace of agricultural low-carbon transformation is slow.

4. Construction of high-quality development paths for agricultural and rural modernization in Hebei Province

4.1. Strengthening technological empowerment to improve agricultural production efficiency

Targeting high-efficiency agriculture, all-round technological and digital empowerment shall be promoted. The upgrading of agricultural machinery shall be advanced, and intelligent agricultural machinery adapted to various terrains and planting-breeding industries in Hebei shall be popularized to realize full-process mechanization of grain production. Investment in agricultural digitalization shall be increased. Smart agricultural management and control platforms based on the Internet of Things, big data, and remote sensing technology shall be built to promote intelligent irrigation and precision fertilization. Industry-university-research cooperation in agriculture shall be deepened, and science and technology demonstration bases shall be established to accelerate the transformation and application of technologies such as water-saving agriculture and green planting-breeding, and continuously raise the contribution rate of agricultural science and technology, so as to boost agricultural quality and efficiency via scientific innovation.

4.2. Deepening industrial integration to optimize rural industrial structure

Relying on Hebei's agricultural industrial advantages, promote in-depth integration of primary, secondary and tertiary industries. Extend agricultural industrial chains, support leading enterprises and cooperatives to develop intensive processing of agricultural products, and transform primary agricultural products into high-end categories such as prefabricated dishes and health agricultural products to raise product added value. Differentiated new rural business forms shall be cultivated; leisure agriculture, rural health care, and farming experience projects shall be developed, combined with local farming culture and pastoral scenery to avoid homogenization. Improve the agricultural socialized service system, cultivate professional service enterprises to provide full-chain services including seedling cultivation, agricultural machinery operation, cold chain logistics and brand marketing, and build a diversified integrated modern agricultural industrial system.

4.3. Focusing on talent cultivation to consolidate rural intellectual support

Build an integrated rural talent system covering cultivation, introduction, and retention. Regular special training

for farmers shall be carried out, focusing on digital agriculture, e-commerce operation, and intelligent planting-breeding to expand the coverage of digital skills training and cultivate new professional farmers. Support policies for rural talents shall be issued to precisely introduce high-end talents in agricultural scientific research and technology promotion as well as rural governance, and optimize the structure of rural talent teams. Improve talent incentive and entrepreneurship support mechanisms, perfect salary guarantee and entrepreneurship subsidy policies, build rural innovation and entrepreneurship platforms to retain local talents and attract external talents to start businesses in rural areas.

4.4. Promoting digital empowerment to improve rural governance efficiency

Upgrade grassroots rural governance via digitalization and refinement. Accelerate the full coverage of gigabit networks, intelligent monitoring, and digital government platforms in villages to realize online handling and dynamic supervision of village-level affairs. Enrich application scenarios of digital governance, integrate livelihood services, dispute mediation, environmental supervision, and industrial services to build an integrated rural governance platform, simplify handling procedures, and raise governance efficiency. Integrate digital governance with grid-based grassroots governance, perfect regular mechanisms for rural civilization and living environment renovation, and build a new rural governance pattern featuring co-construction, co-governance, and shared benefits.

4.5. Deepening urban-rural coordination to boost urban-rural integrated development

Rely on the Beijing-Tianjin-Hebei Coordinated Development Strategy to break urban-rural dual barriers. Optimize the layout of urban and rural infrastructure such as highways, water supply, and communication, and promote the integrated construction and interconnection of urban and rural infrastructure. Push high-quality urban education, medical care, and pension resources to sink into rural areas to make up the shortage of rural public services and realize equalization of public services. Broaden farmers' income channels through industrial employment, share dividends, and policy support, continuously narrow the urban-rural income gap, and promote equal exchange and balanced allocation of urban and rural factors.

4.6. Adhering to green development to consolidate rural ecological foundation

Stick to the ecological priority concept and promote green and sustainable development of agriculture and rural areas. Vigorously popularize water-saving irrigation, precision fertilization, and green planting-breeding technologies to improve the utilization efficiency of farmland water resources. Perfect the industrial chain of straw recovery, processing and utilization to realize recycling and commercialization of agricultural waste. Accelerate the low-carbon transformation of agriculture, popularize the application of solar energy, biomass energy and other new energy in agricultural production and rural life, and build a low-carbon agricultural development model. Deepen comprehensive renovation of rural environment, perfect the recycling system of livestock and poultry manure, establish regular treatment mechanisms for rural sewage and garbage, and improve long-term ecological management systems to build green villages suitable for living and working.

5. Conclusion

Agricultural and rural modernization is a systematic project of coordinated economic, social, and ecological development, and a core goal of comprehensive rural revitalization in the new era ^[5]. Combined with Hebei's

provincial conditions, this paper constructs a three-dimensional and multi-level evaluation system adapted to regional development characteristics, and accurately sorts out prominent weaknesses in agriculture, rural talents, grassroots governance, urban-rural integration, and ecological construction of the whole province. Targeted multi-dimensional promotion paths, including technological empowerment, industrial integration, talent cultivation, digital governance, urban-rural coordination, and green development, are put forward, which can effectively support the quality improvement of agricultural and rural modernization in Hebei Province. In the future, the evaluation index system can be continuously optimized, combined with policy updates and new industrial forms. Relying on the advantages of Beijing-Tianjin-Hebei Coordinated Development, new models of rural modernization can be explored to help Hebei realize the development goals of high-efficiency agriculture, livable villages and affluent farmers, and provide practical reference for rural revitalization construction in major agricultural provinces of northern China.

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Disclosure statement

The authors declare no conflict of interest.

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