# A Study on the Development Model of Hebei Cangzhou National Agricultural Science and Technology Park (Postprint)

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## Abstract

Since the construction of China' s national agricultural science and technology parks commenced in 2001, they have achieved remarkable development. Over more than a decade of growth, numerous national agricultural science and technology parks have emerged as regional agricultural science and technology innovation bases, demonstration platforms for new varieties, technologies, and models, and transformation centers for advanced agricultural achievements, contributing significantly to regional grain production increases, agricultural efficiency enhancement, and farmer income growth. However, due to disparities in construction backgrounds, foundational conditions, and development orientations, different national agricultural science and technology parks have evolved distinct development models, each confronting specific challenges. Drawing upon previous research findings, this paper analyzes the various development models of existing national agricultural science and technology parks and their inherent problems, and integrates these insights with the overall planning of the Hebei Cangzhou National Agricultural Science and Technology Park to articulate its planning rationale and development model from perspectives including construction background, planning concepts, development objectives, functional positioning, industrial development analysis, functional zoning, and implementable development strategies. The development model of the Hebei Cangzhou National Agricultural Science and Technology Park is structured across three dimensions: organizational development, technical operation, and spatial layout. Specifically, it employs an organizational model characterized by government guidance, association participation, and enterprise (farmer) primacy; a three-tier parallel technical operation model centered on professional cooperatives, family farms, and technology demonstration households; and a spatial layout model based on concentric zoning comprising a core area, demonstration zone, and radiation zone. Organizationally, the park establishes a management committee under government leadership with association and enter-

prise participation, formulates corresponding policies, and assumes responsibility for unified planning, construction, and operation. In technical operation, the park develops and introduces advanced technological achievements through its science and technology innovation park, and subsequently conducts technical training and demonstration extension for various operating entities—including professional cooperatives, family farms, and technology demonstration households—via technical stations, base stations, and science and technology special commissioners. Finally, the park establishes a spatial layout with the Nanpi Bohai Granary Experimental Demonstration Zone as the core area, the entire Cangzhou municipality as the demonstration zone, and the Bohai Rim region encompassing Hebei, Shandong, Liaoning, and Tianjin ( “three provinces and one municipality” ) as the radiation area.

## Full Text

# Development Mode of Cangzhou National Agricultural Science and Technology Park in Hebei Province, China

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### Abstract

National agricultural science and technology parks in China have achieved substantial development since their initial construction in 2001. Over more than a decade of growth, many parks have become regional hubs for agricultural science and technology innovation, demonstration of new crop varieties and technologies, and transformation of advanced agricultural achievements, making important contributions to regional grain yield increases, agricultural efficiency improvements, and farmer income growth. However, different parks exhibit various development modes due to differences in construction backgrounds, basic conditions, and development orientations, each facing distinct challenges. Building upon previous research and through analysis of existing development modes and their associated problems, this paper elaborates on the planning concepts and development model for the Cangzhou National Agricultural Science and Technology Park in Hebei Province, integrating its master plan from perspectives including construction background, planning philosophy, construction goals, functional positioning, industrial development analysis, functional zoning, and implementable development modes. The park’ s development model comprises three dimensions: organizational development, technological operation, and spatial layout. Specifically, it adopts a government-guided, association-participated, and enterprise/farmer-centered organizational model; a three-tier

parallel technological operation model based on professional cooperatives, family farms, and technology demonstration households; and a concentric-circle spatial layout model encompassing core, demonstration, and radiation zones. Organizationally, the government leads by establishing a park management committee with association and enterprise participation to formulate policies and oversee unified planning, construction, and operation. Technologically, the innovation park develops and introduces advanced technologies, which are then disseminated through technical stations, base stations, and special science commissioners to provide training and demonstration for various operational entities including professional cooperatives, family farms, and technology demonstration households. Spatially, the park establishes the Nanpi Bohai Granary experimental demonstration zone as its core area, Cangzhou City as its demonstration zone, and the "three provinces and one municipality" of Hebei, Shandong, Liaoning, and Tianjin surrounding the Bohai Sea as its radiation zone.

**Keywords:** National agricultural science and technology park; Development mode; Crop farming; Bohai Granary Project; Cangzhou

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Agricultural science and technology parks are modern agricultural development models characterized by intensive agricultural high-tech applications, focusing on scientific and technological development, demonstration, radiation, and extension, driven by institutional and mechanism innovation, and aimed at promoting regional agricultural structural adjustment and industrial upgrading [1]. Since China launched its first batch of national agricultural science and technology parks in 2001, these parks have achieved remarkable effectiveness [2] and become an important force in advancing agricultural science and technology progress, a vital window for showcasing modern agriculture, and a crucial carrier for promoting the transformation and demonstration of agricultural scientific and technological achievements [3].

Numerous scholars have conducted case analyses and explorations of agricultural science and technology park planning theories, organizational systems, and operational modes [4–8]. Planning theories for these parks include human-land relationship theory, new urbanization theory, agricultural location theory, spatial structure theory, agricultural multifunctionality theory, and industrial cluster theory. Chen et al. [1] proposed planning theories such as constructing hierarchical park development systems with core, demonstration, and radiation zones based on agricultural location theory, and conducted case analyses of parks in Honghe, Yunnan and Xuchang, Henan. Liu [9] examined the Beihai National Agricultural Science and Technology Park, proposing a development mode featuring repositioned government-enterprise management functions and demonstration-driven mechanisms among park constituents. Hou et al. [10] explored operational mechanisms of national agricultural science and technology parks from land science and agricultural economics perspectives, evaluating the economic, social, and ecological benefits of land use. Since the 18th National Congress of the Communist Party of China, China' s economic development has

shifted from high-speed to medium-high-speed growth, no longer one-sidedly pursuing economic growth rates, with prominent issues concerning food and agricultural product security and land ecological environment improvement [11]. Against this backdrop, the Cangzhou National Agricultural Science and Technology Park in Hebei, characterized by "technology support, grain yield increase, resource efficiency, and ecological cycling," was approved for construction in 2015.

The Cangzhou National Agricultural Science and Technology Park was developed based on the "Bohai Granary Technology Demonstration Project,"focusing on enhancing staple grain production capacity, increasing farmer income, and improving resource efficiency. The park emphasizes scientific and technological support, resource efficiency, economic rationality, market orientation, and ecological sustainability in crop farming development, while promoting the integrated development of primary, secondary, and tertiary industries. However, previous national agricultural science and technology park constructions lacked development models and construction experiences for parks focused primarily on crop farming. Therefore, based on analyzing existing development mode characteristics and integrating the specific features of the Cangzhou National Agricultural Science and Technology Park, this paper examines its construction and planning proposals and explores its development model to provide references for agricultural science and technology park planning and construction under resource constraints.

## 1. Analysis of Development Modes for National Agricultural Science and Technology Parks

Most national agricultural science and technology parks have been planned and constructed on the foundation of previously established agricultural science and technology parks. Although national parks have clear guidelines regarding guiding ideology, development goals, construction principles, functions, and development priorities, different development modes still exist due to regional variations in agricultural development levels, agricultural science and technology capacity, economic development, and farmer education. Scholars have explored these development modes from various perspectives, suggesting multiple classification approaches. Based on extensive literature review, previous research, and field investigations, we propose classifying development modes into three categories: organizational development mode, operational development mode, and spatial layout mode.

### 1.1 Organizational Development Mode

Agriculture is a fundamental industry of the national economy with dual characteristics: agricultural technology research, demonstration, and extension have public welfare attributes, while production and operation have profit-oriented features. Consequently, agricultural science and technology park development

must reflect both government guidance and market regulation. With the emergence of various intermediary organizations such as associations in recent years, these entities, together with government and market forces, jointly regulate agricultural development. Therefore, organizational modes for agricultural science and technology parks can be divided into three types: government-guided, enterprise-centered, and association-based. The government-guided mode emphasizes government roles in park management, with government-established management committees responsible for planning, construction, and operation. The enterprise-centered mode is driven by leading enterprises with primary corporate investment and profit-centered operation. The association-based mode involves one or multiple professional cooperatives jointly constructing, developing, and operating the park as mutual-aid organizations that coordinate relationships between farmers, government departments, and markets.

### 1.2 Operational Development Mode

Operational development modes are classified based on differences in high-tech extension and application within parks and their linkage mechanisms with farmers. Agricultural technologies can be divided into three categories: high technologies, advanced applicable technologies, and integrated supporting technologies. Jiang and colleagues [12–13] analyzed four operational modes: "facility agriculture + corporatization," "agricultural technology extension innovation," "agricultural science and technology enterprise incubation," and "characteristic agriculture + leading enterprise + professional association + farmer," while summarizing four technology docking patterns: "expert + farmer," "expert + agricultural intermediary + farmer," "expert + leading enterprise + farmer," and "expert + market + farmer." The "facility agriculture + corporatization" mode relies on scientific and technological development with leading enterprises as operational entities, implementing corporatized operation. The "agricultural technology extension innovation" mode adopts the approach of "investor proprietorship, corporate operation, technology contracting, and farmer linkage contracts," using scientific and technological development as support, agricultural high-tech demonstration and extension as breakthroughs, leading enterprises as operational entities, farmer participation as linkage, and technology dissemination as the main thread, implementing corporatized operation, market-oriented management, technology extension innovation, and information-based radiation. The "agricultural science and technology enterprise incubation" mode establishes incubation bases to provide services in social, institutional, cultural, financing, risk management, and market aspects for agricultural high-tech enterprises, reducing transaction costs during enterprise growth and making the park an important agricultural science and technology research and incubation base. The "characteristic agriculture + leading enterprise + professional association + farmer" mode adapts to local conditions, emphasizes local resource characteristics, integrates resources, introduces and promotes new technologies and varieties, comprehensively assembles and applies domestic and international agricultural high-tech, and develops characteristic agriculture through farmer

professional associations linking with farmers.

### 1.3 Spatial Layout Mode

The spatial layout of national agricultural science and technology parks can be divided into core, demonstration, and radiation zones based on three functional levels: technology research and development, technology demonstration, and technology diffusion. The core zone focuses on technology R&D, high-level technical training, achievement transformation, and primary technology demonstration. The demonstration zone conducts secondary demonstration of new varieties, technologies, and facilities and equipment, serving as a transformation base for agricultural scientific and technological achievements. The radiation zone primarily produces diffusion and traction effects on surrounding regions. Spatial layout modes can be categorized as rectangular layout, circular layout, concentric-circle layout, and park-within-park layout.

## 2. Planning of the Cangzhou National Agricultural Science and Technology Park

### 2.1 Park Construction Background

The Cangzhou National Agricultural Science and Technology Park, approved in 2015, is one of 41 parks in the sixth batch designated by the Ministry of Science and Technology of China. Developed from the "Bohai Granary" Nanpi Agricultural Science and Technology Park and built upon the "Bohai Granary Technology Demonstration Project" in its birthplace of Nanpi County, Hebei Province, the park addresses critical issues in the Bohai Rim region: freshwater resource scarcity, saline-alkali soil infertility, constraints on grain production capacity improvement, and threats to regional food security. The park aims to break through key technical bottlenecks in soil, fertilizer, water, and seed to comprehensively enhance regional grain production capacity and promote agricultural industrial development.

### 2.2 Overall Planning Concept

Based on core concepts from agricultural location theory, spatial structure theory, and industrial cluster theory, and following principles of comparative advantage and adapting to local conditions, the park' s development functions are determined according to local natural and social conditions. Centered on wheat and maize breeding, medium-low yield field improvement, efficient multi-water-source utilization, and grain crop production, the park constructs a circular industrial chain integrating crop farming, agricultural product deep processing, animal husbandry, and modern agricultural services. It innovates the "Bohai Granary" brand, improves the market system, upgrades local characteristic industries, develops emerging industries, and promotes synchronized development of industrialization, informatization, urbanization, and agricultural modernization.

### 2.3.1 Overall Park Planning

The park is constructed with a three-tier regional structure comprising core, demonstration, and radiation zones [Figure 1: see original paper]. The core zone is prioritized for construction, featuring a functional division of "two parks, three areas, two networks, and one route." The agricultural science and technology innovation park serves as a base for high-tech R&D, while the improved variety breeding area, high-yield and efficient crop planting area, and ecological livestock and poultry breeding area serve as transformation and application bases for developed technologies. The industrial agglomeration park clusters agricultural product deep processing industries. Water resource control networks and big data agricultural information networks provide support, while an ecological tourism and sightseeing route develops leisure agriculture, increases farmer income, promotes local farmer employment transfer under new urbanization, drives regional agricultural development, and advances rural economic progress, becoming the technological support and demonstration window for the "Bohai Granary" project. Based on successful models in the core zone, demonstration and extension are conducted in the demonstration and radiation zones, with Cangzhou City as the demonstration zone and the "three provinces and one municipality" of Hebei, Shandong, Liaoning, and Tianjin surrounding the Bohai Sea as the radiation zone covering similar region types.

### 2.3.2 Core Area Construction Planning

The core area develops according to the pattern of "two parks, three areas, two networks, and one route."

1) **Two Parks**: The agricultural science and technology innovation park, centered on the Nanpi Eco-agricultural Experimental Station of the Chinese Academy of Sciences, and the agricultural industrial agglomeration park, centered on the Nanpi Economic Development Zone. The innovation park leverages CAS advantages in talent, science and technology, and information to focus on park services and training, integrating R&D, office, training, and service functions. The industrial agglomeration park expands to establish four major science and technology service centers: industrial development center, park management center, park training center, and park service center.

2) **Three Areas**: Wheat and maize improved variety breeding area, high-yield and efficient crop planting area, and ecological livestock and poultry breeding area. These areas focus on breeding superior stress-resistant wheat and maize varieties, demonstrating efficient production, and developing characteristic animal husbandry.

3) **Two Networks**: The water resource control network and the agricultural big data information network. The water resource control network includes management of surface water (rainfall-flood, diverted water, reclaimed water), utilization of saline groundwater, and management of salt-

water extraction and freshwater replacement processes, strengthening basic farmland water conservancy infrastructure to achieve interconnected canals and ditches that enhance comprehensive production capacity for agriculture, forestry, animal husbandry, and fisheries. The agricultural big data information network builds upon existing agricultural information networks to construct agricultural market information and farming condition big data, improving production transparency and market discourse power while enhancing scientific decision-making in agriculture.

4) **One Route**: The leisure agriculture sightseeing and tourism route. This route excavates Nanpi' s historical and cultural resources, integrates them with modern agricultural cultural connotations, develops agricultural services, increases farmer income, and promotes local farmer employment transfer.

#### 2.3.3 Demonstration and Radiation Area Planning

**Demonstration Area Planning**: Covering the entire Cangzhou City, the demonstration zone focuses on constructing three representative sub-zones: the Nanpi brackish water irrigation demonstration zone, the Huangyu rain-fed dry farming demonstration zone, and the Haixing saline-alkali land improvement and utilization demonstration zone. These promote transformation and transfer of park achievements, drive related industrial development, and facilitate integration of primary, secondary, and tertiary industries along with synchronized development of industrialization, informatization, urbanization, and agricultural modernization.

**Radiation Area Planning**: The radiation zone includes the "three provinces and one municipality"of Hebei, Shandong, Liaoning, and Tianjin in the low plain areas surrounding the Bohai Sea. Through various R&D platforms, financing platforms, and agricultural information and brand construction, the park will radiate and drive agricultural production throughout the Bohai Rim low plain region, truly becoming a radiation source for agricultural science and technology.

### 2.4 Issues in Development Models

**2.4.1 Unclear Government Role Positioning** Clear measures remain undefined for how government can co-construct parks with enterprises to achieve win-win outcomes in organizational development modes. Local governments lack corresponding supporting measures and methods for providing services to park enterprises and achieving separation of government and enterprise functions, clear property rights, and distinct responsibilities. Further research and planning are needed on how government can conduct strict assessment, evaluation, and acceptance of park enterprises and agricultural associations.

**2.4.2 Ineffective Linkages in Operational Development Mode** How to achieve transformation of high-tech achievements within agricultural science

and technology parks reflects the effectiveness of benefit distribution among park constituents. The linkages among government, research departments, demonstration bases, enterprises, and farmers need strengthening to achieve rapid transformation of science and technology into productive forces.

**2.4.3 Spatial Layout Mode Requires Strengthening** Effective linkages between core, demonstration, and radiation zones to promote rapid transformation of scientific and technological achievements and form a viable operational mechanism remain deficient. Market-based promotion of superior varieties and efficient planting technologies on large scales, as well as technology localization, require standardization. Agricultural industries in spatial layouts need to form healthy competition and synergistic forces to promote regional agricultural development.

## 3. Development Model for the Cangzhou National Agricultural Science and Technology Park

### 3.1 Organizational Development Mode

Through analysis of development modes for crop farming-centered agricultural science and technology parks, the Cangzhou National Agricultural Science and Technology Park should adopt a government-guided, association-participated, and enterprise/farmer-centered organizational development mode. Crop farming, particularly wheat and maize, faces challenges including water shortages, frequent climate disasters, low comparative benefits, and poor farmer production enthusiasm. Therefore, local government must directly invest in or coordinate investment to strengthen park infrastructure, leverage agricultural industrial agglomeration effects, and promote transformation of advanced technological achievements. Associations or enterprises then demonstrate and drive farmers while guiding crop farming development from extensive to intensive modes, transforming traditional agriculture into modern agriculture. In this model, government is responsible for implementing policies, providing a favorable development environment, steering park development direction, and delivering technical services, while enterprises and farmers manage park operations and construction.

### 3.2 Operational Development Mode

The park' s science and technology innovation park, based on the Nanpi Eco-agricultural Experimental Station of the Chinese Academy of Sciences, conducts technology R&D, demonstration, and extension. Since its establishment in 1987, the station has accumulated rich experience, obtained numerous innovative scientific and technological achievements, and now possesses a high-level research team led by Academicians Li Zhensheng and Liu Changming, demonstrating strong scientific and technological innovation capacity and original agricultural technology creation capability. Combined with established base technical sta-

tions, special science commissioners, and three distinct groups including professional cooperatives, family farms, and technology demonstration households within the core zone, a three-tier operational development mode has been established [Figure 2: see original paper].

### 3.3 Spatial Layout Development Mode

The Cangzhou National Agricultural Science and Technology Park should develop a concentric-circle layout mode according to industrial composition, layout, and brand construction.

**Core Zone**: Located along both sides of Zhenggang Road in Nanpi County, extending from the Nanpi Eco-agricultural Experimental Station of the Chinese Academy of Sciences in the west to the Nanpi Economic Development Zone in Wumaying, Nanpi in the east, with a planned area of 18,700 hectares.

**Demonstration Zone**: Centered on the entire Cangzhou City region, focusing on three representative sub-zones: the Nanpi brackish water irrigation demonstration zone, Huangyu rain-fed dry farming demonstration zone, and Haixing saline-alkali land improvement and utilization demonstration zone to promote achievement transformation and drive related industrial development.

**Radiation Zone**: Including the "three provinces and one municipality"of Hebei, Shandong, Liaoning, and Tianjin in the low plain areas surrounding the Bohai Sea.

The development model for the Cangzhou National Agricultural Science and Technology Park should follow principles of adapting to local conditions and characteristic development. The appropriate model comprises a government-guided, enterprise-centered organizational operation mode, a three-tier parallel technological operation development mode, and a concentric-circle spatial layout mode. Through discussion of park characteristics and operational modes, this paper clarifies the park' s development model. To ensure healthy and efficient park operation, demonstration mechanisms compatible with the operational model and supporting guarantee mechanisms must be established. Specifically, government needs to establish corresponding guidance mechanisms, strengthen talent mechanisms, efficient agricultural information utilization mechanisms, investment and financing mechanisms, and technology innovation and diffusion mechanisms, improve industrial chains, form benefit linkage mechanisms, and perfect risk guarantee mechanisms.

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*Note: Figure translations are in progress. See original paper for figures.*