Postprint: Evaluation and Spatial Distribution Patterns of New-type Agricultural Modernization Service Organization System in Henan Province

Authors: Gao Yanjun

Date: 2017-11-09T00:00:00+00:00

Abstract

Based on the "three orientations" requirements for agricultural development proposed by the central government in 2014, this paper constructs an evaluation model for a new agricultural modernization service organization system comprising the "four major organizations" of land transfer, resource allocation, information service, and industrial management. Taking 18 cities in Henan Province as the basic units, it evaluates the comprehensive development level of the service organization system and explores its spatial distribution patterns. The results indicate that the overall development level of the new agricultural modernization service organization system in Henan Province is relatively low, with only three cities (Zhengzhou, Jiyuan, and Luohe) classified as Category I or II, while the remaining 15 cities are concentrated in Categories III, IV, V, and VI. The spatial distribution demonstrates certain regularities: western Henan exhibits a relatively high overall level, with Luoyang, Jiyuan, Jiaozuo, and Sanmenxia all falling into Category II or III; followed by central Henan, where Zhengzhou and Luohe have entered Categories I and II respectively, yet Xuchang and Pingdingshan both remain in Category V; next is northern Henan, where Hebi has reached Category III, while Xinxiang, Anyang, and Puyang are still in Categories IV and V; then southern Henan, where Nanyang, Xinyang, and Zhumadian are all in Category V; and finally eastern Henan, where Shangqiu and Zhoukou are both in Category VI, and Kaifeng has only attained Category IV. The study suggests that Henan Province should establish and improve its new agricultural modernization service organization system, guide large-scale agricultural land transfer, enhance the organizational level of production and operation, promote transformation of agricultural development modes, and ensure both quality and quantity safety of agricultural products, representing an inevitable choice for accelerating agricultural modernization development.

Full Text

Preamble

Evaluation on the system of service organization for new agricultural modernization in Henan Province and its rules of spatial distribution*

GAO Yanjun[1],[2]

(1. School of Economics, Henan University of Science and Technology, Luoyang 471023, China; 2. Research Center for High Education and Regional Economic Development, Henan University of Science and Technology, Luoyang 471023, China)

Abstract: Based on the requirements of agricultural development in line with the "Three Orientations" strategy presented by China' s Central Government in 2014, an evaluation index system on the system of service organization for new agricultural modernization was established. With Henan Province as the case study, the paper explored the development level and the rules of spatial distribution of service organization system, aiming to provide references for its further improvement. The index system consisted of 16 indexes included in 4 criteria layers, which were development indexes of rural land circulation organization, resources allocation organization, information service organization and industrial management organization.

Then using 18 cities in Henan Province as the basic units, the comprehensive development level of service organization system, and the related rules of spatial distribution were determined. The results showed that the comprehensive development level of service organization system was low in Henan Province. Only Zhengzhou, Jiyuan and Luohe were in District I and II, and all the other 15 cities were in District III, IV, V and VI. The rules of spatial distribution of the 18 cities were regular. The development in western Henan was the highest, which included Luoyang, Jiyuan, Jiaozuo and Sanmenxia, all of which occurred under District II or III. The development in the central part ranked the second, where Zhengzhou and Luohe occurred under District I or II, while both Xuchang and Pingdingshan occurred under District V. The development in the northern part ranked the third, where Hebi occurred under District III and then Xinxiang, Anyang and Puyang all were under District IV or V. The development in the southern part ranked fourth, where Nanyang, Xinyang and Zhumadian were under District V. The development in the eastern part was the lowest, where both Shangqiu and Zhoukou were in District VI and Kaifeng was in District IV. The research showed that a perfect service organization system for new agricultural modernization should be established in Henan Province to guide large-scale circulation of rural land, increase organizational degree of line operation, promote agricultural transformation development and guarantee quantity and quality of agricultural products. It was an inevitable option to accelerate the development of agricultural modernization in the study area.

Keywords: Henan Province; New agriculture; Modernization development;

Service organization system; Rule of spatial distribution

Agricultural modernization involves equipping agriculture with modern industrial development concepts, advanced science and technology, and scientific economic management methods to transform traditional agriculture into modern agriculture and natural economy into market economy. It represents not only more advanced production conditions and management methods, but also optimized resource allocation patterns and corresponding institutional arrangements [1-2]. In response to new challenges facing domestic agricultural development—including rural labor transfer, agricultural sidelining, resource and environmental constraints of limited land and water, and the severe situation regarding agricultural product quantity and quality safety—the 2014 Central No. 1 Document proposed a new agricultural modernization path with "Three Orientations" as its core: accelerating the construction of a new agricultural management system oriented toward solving the problem of how to cultivate land; deeply promoting the transformation of agricultural development patterns oriented toward addressing resource and environmental constraints of limited land and water; and vigorously developing high-quality and safe agricultural products oriented toward ensuring that people eat well and safely. This represents a top-level design based on China's national conditions and agricultural development status. The "new" in new agricultural modernization lies in greater emphasis on land circulation services, using scaled circulation to accelerate the cultivation of new management entities and promoting transformation of land management patterns through entity transformation [3]. It is also "new" in its greater focus on resource allocation services, shifting from reliance on material factor inputs to reliance on technological innovation and improvement of laborer quality, using innovation to promote transformation of agricultural development patterns [4]. Finally, it is "new" in its greater emphasis on information services and management support, strengthening supply-demand information matching, administrative management, and production management, and using high quality, high yield, ecological sustainability, and safety as orientations to highlight systematic industrial management and ensure "safety on the tip of the tongue" [5].

The advancement of China's new agricultural modernization path requires establishing a corresponding service organization system. Existing research both domestically and internationally has mainly focused on four aspects: land circulation scale benefits and their service organizations [6-8], functions and connotations of agricultural industrial organizations [9-12], construction of information service organization platforms [13-15], and service efficiency and models of agricultural management organizations [16-19]. Most studies have examined land circulation organizations, industrial organizations, information organizations, and management organizations separately, leaving a research gap regarding the service organization system as a whole. To solve the "last mile" problem of agricultural services and achieve "precise service" for cultivating new agricul-

tural management entities, this paper constructs an evaluation model for a new agricultural modernization service organization system comprising four components: land circulation, resource allocation, information services, and industrial management. Using 18 cities in Henan Province as evaluation units, the study explores existing problems in the agricultural modernization service organization system, identifies its spatial distribution patterns, and provides a theoretical basis for functional improvement, content expansion, and capacity enhancement of the organization system.

1. Study Area and Data Sources

Henan Province is located between 110°21 -116°39 E and 31°23 -36°22 N, covering a total area of 167,000 km². It has jurisdiction over 18 cities and can be divided into five regions with Zhengzhou as the center: Central Henan (including Zhengzhou, Luohe, Xuchang, and Pingdingshan), Eastern Henan (including Kaifeng, Shangqiu, and Zhoukou), Southern Henan (including Nanyang, Xinyang, and Zhumadian), Western Henan (including Luoyang, Jiaozuo, Jiyuan, and Sanmenxia), and Northern Henan (including Hebi, Xinxiang, Anyang, and Puyang). The terrain slopes from high in the west to low in the east, with the Taihang Mountains in the northwest, the eastern remnants of the Qinling Mountains in the west, the Tongbai-Dabie Mountains in the south, the Huang-Huai-Hai alluvial plain in the central and eastern parts, and the Nanyang Basin in the southwest. Mountains, hills, and plains account for 27%, 18%, and 56% of the total area, respectively.

Most of the province lies in the warm temperate zone, with the southern part crossing into the subtropical zone, belonging to a continental monsoon climate transitioning from north subtropical to warm temperate. Known as the “Central Plains Granary”and “National Kitchen,”it is an important wheat production area in China, with wheat output accounting for about one-quarter of the national total. It is also a major province for agricultural and sideline products, with oil crops, cotton, milk, and vegetables all ranking among the top in China. The province currently has 8.2 million hectares (123 million mu) of cultivated land, mainly distributed in plains and hilly areas. In 2015, the province’ s total population was 107.22 million, ranking third nationally, with per capita cultivated land of less than 0.087 hectares, below the national average. The prominent contradiction between people and land requires promoting a new agricultural modernization path centered on the “Three Orientations,” accelerating land circulation progress, transforming land management patterns, transforming agricultural development patterns, and strengthening safe production management of agricultural products.

Data for this study mainly came from the *Henan Statistical Yearbook* (2009-2013) and the website of the Henan Provincial Bureau of Statistics, as well as government websites and statistical bureau websites of the 18 cities. Additional missing data were supplemented through industry authorities such as the Henan Provincial Department of Agriculture, Department of Science and Technology,

and the agriculture and science and technology bureaus of the 18 cities.

2. Evaluation Index System for New Agricultural Modernization Service Organization System

The main function of the new agricultural modernization service organization system is to cultivate new agricultural management entities such as specialized large households, family farms, farmer cooperatives, and leading enterprises. The service content covers the entire process from land circulation supply, resource optimization allocation, industrial information release to quality and safety management, connecting small agricultural production with socialized large production, promoting scaled, specialized, and standardized production, and providing organizational support and service guarantees for modern agricultural development.

2.1. Construction of the Evaluation Index System

The new agricultural modernization service organization system is a system comprising multiple sub-modules. Based on understanding and grasping its connotation and combined with influencing factors of agricultural service organizations in Henan Province, this paper divides evaluation indexes into three hierarchical levels (Table 1): the comprehensive criteria layer (A), which is the comprehensive development index of the new agricultural modernization service organization system; the first criteria layer (B), which includes the development index of rural land circulation organization, resource allocation organization, information service organization, and industrial management organization; and the second criteria layer (C), which includes specific indexes that can evaluate first-level indexes from a micro perspective. In selecting indexes, the principles of comprehensiveness, scientificity, comparability, and operability were followed, striving to reflect the content, function, and orientation of new agricultural modernization services and fully embodying integrity and hierarchy.

Explanations regarding second-level index selection are as follows: First, the development index of land circulation organization. Scaled and organized management after land circulation is an important symbol of agricultural modernization, with capital as a key supporting element and industrialization as an important driving force and guarantee. Per capita cultivated land area of primary industry employees reflects the scaled degree of land circulation; the number of specialized farmer cooperatives per 10,000 rural people reflects the organized degree of land circulation; agricultural capital investment per unit area of cultivated land reflects the capital investment guarantee degree of land; and industrialization level reflects the development degree of driving force for land circulation. Second, the development index of resource allocation organization. After land circulation, resources such as organization, technology, capital, and labor need to be allocated in operations. The number of city-level key leading enterprises per 10,000 rural households reflects resource allocation capacity

of organizations; the number of scientific and technical personnel per 10,000 rural people reflects allocation capacity of technological resources; agricultural financial budget expenditure per unit area of cultivated land reflects allocation capacity of financial resources; and output value per capita of primary industry employees reflects industrial capacity allocation. Third, the development index of information service organization. Against the background of "Internet Plus," informatization is a booster for agricultural modernization, integrating information into all links of the industrial chain to reduce information and transaction costs and improve agricultural resource utilization and transaction efficiency. The ratio of internet users reflects the development level of the information market; telecommunication consumption per capita reflects the development level of information demand; the ratio of fixed asset investment in information service industry reflects the level of information infrastructure; and the ratio of employees in information service industry reflects the service capacity level of information resources. Fourth, the development index of industrial management organization. Input level of production materials, product certification standards, product production scale, and product trading platforms are four important symbols of agricultural safety production management. This study selected four indexes: fertilizer consumption, geographical indication product production area, animal meat product yield, and trading market stalls. Fertilizer consumption per unit area of cultivated land reflects the management level of agricultural product quality and safety; the ratio of planting area for geographical indications products reflects the management level of agricultural product certification; animal meat products yield per capita in primary industry reflects the production capacity level of agricultural products; and the number of commodity market stalls over 100 million per unit area of cultivated land reflects the sales management level of agricultural products.

2.2. Determination of Evaluation Index Weights and Evaluation Model

Based on relevant data from 18 cities in Henan Province from 2009-2013, the linear proportional transformation method was used to standardize original data. Specifically, the average value of a set of original data for an index was used as the standard value, and the index was compared with the average value to obtain a proportional coefficient, which became the standardized value of the index. The specific calculation formula is: where X_i is the original data value of the evaluation index, X_i is the average value of the set of original data for that index, and X_i* is the standardized value of the evaluation index.

On the basis of establishing the evaluation index system, an evaluation model for the new agricultural modernization service organization system was constructed as follows: This model includes the comprehensive evaluation model of the new agricultural modernization service organization system and its sub-models, with specific results as follows: where A is the comprehensive evaluation value of the new agricultural modernization service organization system, W_i is the weight

of the comprehensive index for the i-th first-level index, B_i is the calculated value of the first-level index, a_i is the weight of the i-th second-level index, and C_i is the value of the i-th second-level index. Experts from Henan University of Science and Technology, Henan Agricultural University, and Henan Academy of Agricultural Sciences were invited to score the importance of each index, determine the relative importance between indexes, construct judgment matrices based on expert opinions, and use the Analytic Hierarchy Process (AHP) to calculate weights W_i and a_i.

Then, based on the average values of the comprehensive development index and individual organization development indexes of the new agricultural modernization service organization system from 2009-2013, ArcGIS 10.0 software was used to display classification results and explore spatial distribution patterns.

3.1.1. Evaluation of Land Circulation Organization Development

In the average annual development index of land circulation organization from 2009-2013 (Table 2), Jiyuan ranked highest (1.443), followed by Hebi (1.321). These two cities ranked among the top in the province because they scored high on per capita cultivated land area and agricultural capital investment per unit area of cultivated land, contributing most to the evaluation results and demonstrating remarkable achievements in cultivated land protection and agricultural financial support in recent years. In addition, Jiaozuo, Sanmenxia, Luoyang, Zhengzhou, Xinxiang, and Xinyang also exceeded the provincial average level. The remaining ten cities—Luohe, Kaifeng, Pingdingshan, Anyang, Puyang, Xuchang, Nanyang, Zhoukou, Zhumadian, and Shangqiu—were all below the provincial average. The lowest was Shangqiu (only 0.716), where the large gap in the number of specialized cooperatives per 10,000 people and agricultural capital investment per unit area of cultivated land compared with other cities affected land circulation organization development. Future efforts should focus on improving farmer organization degree and increasing capital investment.

Based on the evaluation results of land circulation organization development indexes, the 18 cities can be divided into five categories: >1.4 as Category I, 1.2-1.4 as Category II, 1.0-1.2 as Category III, 0.8-1.0 as Category IV, and <0.8 as Category V. Overall (Table 2), the 18 cities are concentrated in Categories III and V, with only two cities (Jiyuan and Hebi) in Categories I and II, indicating that the overall development level of land circulation organization in Henan Province is medium to low. From a spatial distribution perspective (Table 2), Eastern Henan shows weak development, with Zhoukou, Kaifeng, and Shangqiu all in Category V; Western Henan shows better development, with Luoyang, Jiaozuo, Jiyuan, and Sanmenxia all exceeding the provincial average development level; cities in Central and Southern Henan are concentrated in Categories III and IV; Northern Henan shows large development disparities, with Hebi and Xinxiang in Categories II and III respectively, but Anyang and Puyang both in Category IV.

3.1.2. Evaluation of Resource Allocation Organization Development

In the average annual development index of resource allocation organization from 2009-2013 (Table 2), seven cities exceeded the provincial average level, with the top two being Luohe (2.168) and Zhengzhou (2.103), both reaching about twice the provincial average level. Food processing is a pillar industry in Luohe, with a good foundation for agricultural industrialization. The city leads in the number of leading enterprises per 10,000 households, and its agricultural financial budget expenditure per unit area of cultivated land is significantly higher than the provincial average, providing strong momentum for resource allocation organization development. However, its weakness lies in the low number of scientific and technical personnel per 10,000 people, requiring attention to investment in scientific and technological talent factors. Zhengzhou, as the provincial capital and a strong industrial city, has a good economic foundation, numerous universities and research institutions, and higher agricultural financial capital investment and scientific and technological investment as support, making its resource allocation organization development level significantly higher than other cities. The lowest was Zhoukou (0.430), only 43% of the provincial average and approximately one-fifth of Luohe and Zhengzhou. The main reason was the small number of leading enterprises per 10,000 rural people, making it difficult to drive farmers, and the large gap in investment in scientific and technological elements and financial capital compared with other cities.

Based on the evaluation results of resource allocation organization development indexes, the 18 cities can be divided into five categories: >2.0 as Category I, 1.5-2.0 as Category II, 1.0-1.5 as Category III, 0.5-1.0 as Category IV, and <0.5 as Category V. Overall (Table 2), the development level of each city presents an olive-shaped structure with "small at both ends and large in the middle," with few cities in Categories I, II, and V, and many in Categories III and IV. From a spatial distribution perspective, Central Henan performs best but with large inter-city differences: Zhengzhou and Luohe are in Category I, while Xuchang and Pingdingshan are in Categories III and IV respectively. Western Henan ranks second, but with unbalanced development among cities: Jiyuan is in Category II, Jiaozuo and Sanmenxia in Category III, and Luoyang in Category IV. Northern Henan performs poorly, with only Hebi in Category III and Xinxiang, Anyang, and Puyang all in Category IV. Southern Henan also performs poorly, with Nanyang, Xinyang, and Zhumadian all in Category IV. Eastern Henan shows the worst development, with Zhoukou ranking last in the province, and Kaifeng and Shangqiu only in Category IV.

3.1.3. Evaluation of Information Service Organization Development

In the average annual development index of information service organization from 2009-2013 (Table 2), eight cities exceeded the provincial average, with Zhengzhou (2.644) and Luoyang (1.430) ranking top two. Zhengzhou has a strong economic foundation and absolute advantages in the ratio of internet users and fixed asset investment in information service industry, demonstrating

remarkable achievements in information infrastructure construction and capital investment. Although Luoyang ranks second in the province, its excessively low ratio of information service personnel has become a prominent weakness affecting subsequent development. The lowest was Shangqiu (0.619), only 61.9% of the provincial average. As one of the traditional agricultural areas, the city has weak informatization foundations, with its ratio of internet users, telecommunication consumption per capita, and fixed asset investment ratio in information service industry all far below other cities. Insufficient investment in information services, lagging informatization infrastructure construction, and inadequate utilization of information resources have become the main reasons hindering the development of information service organizations.

Based on the evaluation results of information service organization development indexes, the 18 cities can be divided into six categories: >1.5 as Category I, 1.3-1.5 as Category II, 1.1-1.3 as Category III, 0.9-1.1 as Category IV, 0.7-0.9 as Category V, and <0.7 as Category VI. In terms of spatial distribution (Table 2), Western Henan shows better development: except for Jiaozuo in Category IV, Luoyang and Jiyuan are in Category II, and Sanmenxia in Category III. Northern Henan also shows good development: except for Hebi in Category V, Anyang, Xinxiang, and Puyang are in Categories III and IV respectively. Central Henan shows the largest development disparities, with Zhengzhou in Category I, Luohe in Category IV, and Pingdingshan and Xuchang in Category VI. Southern Henan shows relatively weak development, with Xinyang and Nanyang in Category V and Zhumadian in Category VI. Eastern Henan is the most backward, with only Kaifeng in Category III, while both Shangqiu and Zhoukou are in Category VI.

3.1.4. Evaluation of Industrial Management Organization Development

In the average annual development index of industrial management organization from 2009-2013 (Table 2), eight cities exceeded the provincial average. Among them, Luohe (2.546) ranked highest as the only Category I city in the province, with absolute advantages in animal meat products yield per capita and a higher number of commodity market stalls over 100 million per unit area of cultivated land than the provincial average, demonstrating remarkable achievements in agricultural sales organization management. Kaifeng (2.029) ranked second in the province, having started early in geographical indications agricultural product certification and production, with Qixian garlic, Kaifeng chrysanthemum, and Bianliang watermelon being the earliest agricultural products to enter the geographical indications list in the province. The city also controlled fertilizer consumption per unit area of cultivated land well, indicating strict supervision of production material input. Its development shortcomings lie in animal meat products yield per capita and the number of commodity market stalls over 100 million per unit area of cultivated land, suggesting that future efforts should strengthen the development of agricultural product deep processing industry,

expand marketing channels, and extend the industrial chain backward. The lowest was Shangqiu (index only 0.381), less than half of the provincial average. Although the city is primarily agricultural, it started late in geographical indications agricultural product certification and production, has small-scale agricultural product processing industry, and lags in large trading market construction.

Based on the evaluation results of industrial management organization development indexes, the 18 cities can be divided into six categories: >2.5 as Category I, 2.0-2.5 as Category II, 1.5-2.0 as Category III, 1.0-1.5 as Category IV, 0.5-1.0 as Category V, and <0.5 as Category VI. Overall (Table 1), Henan Province' s agricultural management level is relatively low, with only Luohe, Kaifeng, and Zhengzhou in the top three categories, and the remaining 15 cities concentrated in Categories IV, V, and VI. In terms of spatial distribution, Central Henan shows large disparities: Luohe and Zhengzhou entered the top three categories, but Pingdingshan and Xuchang are in Categories V and VI respectively. In Western Henan, except for Jiaozuo in Category V, Jiyuan, Sanmenxia, and Luoyang are all in Category IV. In Eastern Henan, except for Kaifeng with relatively good development level in Category II, Zhoukou and Shangqiu are both in Category VI with lagging development. The three cities in Southern Henan—Zhumadian, Xinyang, and Nanyang—show balanced development but the lowest overall level, all in Category V. In Northern Henan, Hebi and Xinxiang are in Category IV, while Anyang and Puyang are in Category VI.

3.2. Comprehensive Development Evaluation of New Agricultural Modernization Service Organization System

Based on the evaluation results of the comprehensive development index of the new agricultural modernization service organization system (Figure 1a [Figure 1: see original paper]), this paper divides the 18 cities into six categories: >1.5 as Category I, 1.3-1.5 as Category II, 1.1-1.3 as Category III, 0.9-1.1 as Category IV, 0.7-0.9 as Category V, and <0.7 as Category VI. Overall, the comprehensive development level of the new agricultural modernization service organization system in Henan Province is relatively low, with only Zhengzhou in Category I, only Luohe and Jiyuan in Category II, only Sanmenxia, Hebi, Luoyang, and Jiaozuo in Category III, and the remaining 11 cities concentrated in Categories IV, V, and VI. In terms of spatial distribution patterns (Figure 1b), Western Henan shows the best and most balanced overall development, with Jiyuan in Category II and Luoyang, Sanmenxia, and Jiaozuo all in Category III. Central Henan ranks second, but with large gaps between cities: except for Zhengzhou (Category I) and Luohe (Category II) with better development, Xuchang and Pingdingshan have lower levels, both in Category V. Northern Henan ranks third, with uneven development among cities: Hebi entered Category III, Xinxiang is in Category IV, and Anyang and Puyang are in Category V. Southern Henan ranks fourth, with overall low development levels: Nanyang, Xinyang, and Zhumadian are all in Category V. Eastern Henan is the most backward,

with Shangqiu and Zhoukou both in Category VI, and Kaifeng only in Category IV.

Category I includes only Zhengzhou. As the capital of Henan Province, Zhengzhou has relatively balanced development across all indexes, ranking among the top in the province: land circulation organization ranks 6th, resource allocation organization ranks 2nd, information service organization ranks 1st, and industrial management organization ranks 3rd. The city needs to strengthen land circulation service organization construction.

Category II includes Jiyuan and Luohe. Jiyuan has relatively balanced development across organizations, ranking 1st in land circulation organization, 3rd in both resource allocation organization and information service organization, and 5th in industrial management organization. Future efforts should enhance comprehensive development capacity to advance to Category I. Luohe shows outstanding development in resource allocation organization and industrial management organization, both ranking 1st in the province, with information service organization ranking 8th, but land circulation organization development ranks only 15th in the province, placing it in the lower stream. As land circulation organization is the foundation of the new agricultural modernization service organization system and the core of cultivating new agricultural management entities, the city needs to strengthen this aspect.

Category III includes Sanmenxia, Hebi, Luoyang, and Jiaozuo. Sanmenxia is the best developed in Category III, with all organizations basically maintained at 4th or 5th place in the province. It should maintain this good development momentum and strive to enter Category II. Hebi' s advantage lies in its better land circulation organization development, ranking 2nd in the province and contributing greatly to improving overall development level, but information service organization is its shortcoming, ranking only 13th, requiring promotion of informatization construction. Luoyang shows outstanding development in information service organization, ranking 2nd in the province, while the other three organizations are at upper-middle levels, with relatively low resource allocation organization development level. It should start with promoting agricultural industrialization to improve comprehensive development level. Jiaozuo is also prominent in land circulation organization, ranking 3rd in the province, while the other three organizations are relatively average, all at middle levels.

Category IV includes Xinxiang and Kaifeng. Kaifeng entered Category IV due to lagging land circulation organization development, ranking second to last in the province, because of too low agricultural capital investment per unit area of cultivated land. Its resource allocation organization development level is also very low, ranking third from bottom in the province, with gaps in the number of leading enterprises per 10,000 households and the number of scientific and technical personnel per 10,000 people compared with other cities. It needs to strengthen resource allocation organization construction, focus on increasing investment in scientific and technological elements, and cultivate new agricultural management entities. Xinxiang has relatively balanced development across or-

ganizations, all at middle levels, but without prominent advantages.

Category V includes Puyang, Anyang, Xuchang, Xinyang, Pingdingshan, Nanyang, and Zhumadian. Puyang has a relatively low industrial management organization development level because it started late in geographical indications agricultural product certification, lags in deep processing, and has slow large trading market construction. Anyang has good information service organization development, ranking 4th, but its industrial management organization ranks third from bottom in the province, indicating that agricultural product deep processing and sales channel expansion are not yet in place. Xuchang' s best-developed organization is resource allocation organization, because its number of leading enterprises per 10,000 households leads the province, significantly contributing to industrialization level improvement. However, its fixed asset investment ratio in information service is too low, and the ratio of information service personnel also has gaps with other cities. The city lags in promoting agricultural product deep processing and geographical indications agricultural product certification, resulting in backward information service organization and industrial management organization. Pingdingshan has low development levels in land circulation organization and information service organization due to the small number of specialized farmer cooperatives per 10,000 people, low farmer organization degree affecting land circulation, and low fixed asset investment ratio in information service requiring increased financial support. Nanyang' s development shortcoming is resource allocation organization, mainly due to insufficient investment in agricultural scientific and technological elements. Xinyang and Zhumadian have all organizations at lower-stream levels and urgently need further improvement.

Category VI includes only Shangqiu and Zhoukou. Both are traditional agricultural areas. Shangqiu ranks 14th in resource allocation organization but last in the other three organizations. It should promote integration of industrialization, informatization, and agricultural modernization based on land circulation organization and strengthen agricultural industrial management. Zhoukou ranks last in the province in resource allocation organization, with the other three organizations also at lower-stream levels. It should strive to improve industrialization level, increase agricultural output value, and promote transformation from traditional agriculture to modern agriculture.

4. Conclusions and Discussion

The overall comprehensive development level of the new agricultural modernization service organization system in Henan Province is relatively low. Among the 18 cities under its jurisdiction, only three are in Categories I and II, while the remaining 15 are concentrated in Categories III, IV, V, and VI.

The spatial distribution of comprehensive development levels of the new agricultural modernization service organization system in Henan Province follows certain patterns. Western Henan shows higher levels with relatively balanced

development: Jiyuan is in Category II, and Luoyang, Jiaozuo, and Sanmenxia are all in Category III. Central Henan ranks second, but with large gaps between cities: Zhengzhou is in Category I, Luohe entered Category II, but Xuchang and Pingdingshan are both in Category V. Northern Henan ranks third, with uneven development among cities: Hebi is in Category III, Xinxiang in Category IV, but both Anyang and Puyang are in Category V. Southern Henan follows, with overall low levels: Nanyang, Xinyang, and Zhumadian are all in Category V. Eastern Henan is the most backward, with some gaps between cities: Kaifeng entered Category IV, but both Shangqiu and Zhoukou are in Category VI.

The overall development level of new agricultural modernization service organizations in Henan Province is relatively low. The reasons are as follows: First, by the end of 2014, a total of 2.262 million hectares of land had been circulated in Henan Province, accounting for only 34.8% of family-contracted land. Land circulation faces three major contradictions: mismatch between land supply and demand between farmers and new agricultural management entities, inconsistency between farmers' expectation of stable income and the risks of agricultural production, and unequal distribution of financial subsidies between farmers and new agricultural management entities [20]. A land circulation service organization system with "information officers at the village level, service centers at the township level, and service networks at the county level" has not yet been established. Second, agricultural development still mainly relies on the three internal entities of enterprises, specialized cooperatives, and farmers, while external entities such as scientific research, finance, and technology participate weakly. The interest linkage mechanism between industrial entities is not tight, resulting in resource allocation that cannot meet actual needs and affecting modern agricultural development [21]. Third, the informatization gap between urban and rural areas is obvious, and severe segmentation between departments makes it difficult to integrate, share, and utilize valuable information resources, greatly reducing informatization effectiveness. Fourth, certification management of the "Three Products and One Indication" (pollution-free agricultural products, green food, organic food, and geographical indications agricultural products) lags behind, ranking only 15th nationally in 2014, which does not match its status as a major agricultural province.

It should be noted that land circulation is the foundation of new agricultural modernization development and the core of cultivating new agricultural management entities [22]. Only after land circulation can scaled, intensive, organized, and socialized management trigger demand for allocation of resources such as technology, talent, finance, and intermediaries. Only with economies of scale can the comprehensive costs of land circulation, resource allocation, information services, and industrial management be afforded. The construction of new agricultural modernization service organization systems in Henan cities should follow this law, strengthening the construction of the "four major organizations" of land circulation, resource allocation, information services, and industrial management, expanding service content, strengthening service functions, improving service capacity, and accelerating the development process of new agricultural

modernization.

Acknowledgments

Graduate student Huang Jiexun contributed significantly to data processing and mapping. Special thanks are extended for this contribution.

References

[1] Kong X Z, Zhou Z. "Three Orientations" and the road of new agricultural modernization[J]. Jianghan Tribune, 2014, (7): 42-49
[2] Zhang Z B, Duan Z Y, Xu P, et al. Development strategy for food security and modern agriculture in Anhui Province[J]. Chinese Journal of Eco-Agriculture, 2016, 24(9): 1161-1168
[3] Luo S M. Agroecology transition and suitable pathway for eco-agricultural development in China[J]. Chinese Journal of Eco-Agriculture, 2017, 25(1): 1-7
[4] Zhang Y X, Min Q W, Wang W Q, et al. Impact of household social-economic characteristics on the willingness to grow crops: A case study of jasmine growers in Fuzhou based on conservation of the agricultural heritage system[J]. Chinese Journal of Eco-Agriculture, 2016, 24(12): 1714-1721
[5] Zhang Z B, Xu P, Duan Z Y. Food security should be the ultimate goal of agricultural modernization in China[J]. Chinese Journal of Eco-Agriculture, 2015, 23(10): 1215-1219
[6] Yujiro Hayami, Vernon W. Ruttan. Agricultural Development: An International Perspective[M]. Guo X B, Zhang J M, Trans. Beijing: China Social Sciences Publishing House, 2000: 42-45
[7] Wei Y. The experience and enlightenment of foreign rural land circulation[J]. Reformation & Strategy, 2015, 31(5): 165-167
[8] Wang Z Z, Lan J. On cultivating and developing intermediary organizations of rural land[J]. Journal of Nanjing Party Institute of CPC, 2010, (1): 64-69
[9] Wen X C. A game analysis of China' s rural land bank' s generation based on the theory of intermediary organization[J]. Journal of Jiangsu University: Social Science Edition, 2015, 17(1): 87-92
[10] Schultz T W. Transforming Traditional Agriculture[M]. Liang X M, Trans. Beijing: The Commercial Press, 1987: 35-38
[11] Reardon T, Barrett C B. Agroindustrialization, globalization, and international development: An overview of issues, patterns, and determinants[J]. Agricultural Economics, 2000, 23(3): 195-205
[12] Wang A E, Bao Y Z. Review on agricultural industrial organization and performance[J]. Journal of Huazhong Agricultural University: Social Sciences Edition, 2014, (4): 70-75
[13] Zhang L. Development and innovation of organization of agricultural operation in Hebei Province[J]. People' s Tribune, 2014, (35): 226-228
[14] Yang H W, Ji J W, Li X H. Research on agricultural informatization service innovation system in Liaoning Province and its development[J]. Hubei Agricultural Sciences, 2016, 55(2): 532-535

[15] Zhao H L. Construction and implementation of agricultural information service platform based on resource integrated[D]. Shenyang: Shenyang Agricultural University, 2012: 25-28
[16] Lee H L, Billington C. The evolution of supply-chain-management models and practice at Hewlett-Packard[J]. Interfaces, 1995, 25(5): 42-63
[17] Oger R, Krafft A, Buffet D, et al. Geotraceability: An innovative concept to enhance conventional traceability in the agri-food chain[J]. Biotechnologie, Agronomie, Société et Environnement, 2010, 14(4): 633-642
[18] Li S L. Discussion on innovation of China' s agricultural administrative management system[J]. Agricultural Economy, 2016, (3): 32-33
[19] Song X D. Discussion on the agricultural security problem in systematic view[J]. Journal of Hebei University of Economics and Business, 2016, 37(5): 121-125
[20] Zhang H P, Qu T T. Agricultural land management rights transfer and development of new agricultural management entities[J]. Journal of Nanjing Agricultural University: Social Sciences Edition, 2014, 14(5): 70-75
[21] Cheng X Y, Xin G X, Chen R R, et al. Impact of farmland transfer on agro-ecosystem[J]. Chinese Journal of Eco-Agriculture, 2016, 24(3): 335-344
[22] Chen X W. Agricultural development situation and the related challenges in China[J]. Rural Economy, 2015, (1): 3-7

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