

Study on Spatial Distribution Characteristics and Economic Effect of County Cooperatives in Underdeveloped Agricultural Area

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Abstract

The farmers' professional cooperatives take agriculture as the link between industry and market, provide employment opportunities for the broad masses of rural labor force, on the reduction of urban and rural gap between the allocation of resources, stable population of rural labor force, improve the characteristic agricultural product awareness, and improve the quality of products and so on, play an important role, it is also the important factor to promote the development of less developed agricultural economy. Therefore, combined with the relevant data of 819 specialized farmer cooperatives in 14 townships of Ningling County and the data obtained from the questionnaire interview from January 20th to February 10th, 2020, this study used the methods of kernel density analysis, mean nearest neighbor analysis, spatial autocorrelation, and linear regression analysis. The spatial distribution characteristics and economic effects of farmer specialized cooperative point mode are analyzed. The results show that: (1) The farmers' professional cooperatives in Ningling County are mainly distributed uniformly in space, and the random distribution is auxiliary. There is aggregation phenomenon in local areas, and the number of cooperatives decreases from the center to the periphery. (2) The number of farmers' professional cooperatives in towns affects the agglomeration center; (3) The rural cooperatives in Ningling County are mainly planting industry, followed by aquaculture industry, and the number of forestry cooperatives is the least. (4) Agricultural cooperatives in Ningling County account for 78.99%, and the number of agricultural cooperatives has a significant impact on the average income of households in the study area.

Keywords

Farmers' professional cooperatives; Spatial distribution; Ningling; Economic effect; Less developed agricultural areas.

1. The Introduction

Published on February 4th, 2018, the central file No.1 - "the central committee of the communist party of China, the State Council about the opinions of the implement the strategy of rejuvenating the country", made clear that prosperous industry is the country revitalization of the source of the fundamental and basic premise, farmers' professional cooperatives as an important form of organization of rural economic development, the industry has played a considerable role [1]. Since the 1990s, professional farmer cooperatives have developed rapidly. High-quality professional farmer cooperatives have become the basic main body that drives farmers to enter the market. Especially in the implementation of targeted poverty alleviation policies in recent years, underdeveloped agricultural areas have even treated farmers professionally. Cooperatives as an important poverty alleviation method to increase the

village collective economy and drive poor families [2, 3]. The state has also provided various preferential policies, subsidies and support policies for the development of specialized farmer cooperatives [4, 5]. However, because the development of rural cooperatives is long-term, professional and land-dependent, the sensitivity of cooperatives in different agricultural areas to market feedback and the sustainability of economic growth are also different.

The issues concerning agriculture, rural areas and farmers are the fundamental issues related to the national economy and people's livelihood, and has always been the focus of attention of Chinese scholars [6-8]. In terms of spatial analysis, Sun Xin et al. used spatial analysis tools to explore the distribution law of specialized farmer cooperatives in small watershed in poor mountainous areas, and used geographical detector model to explore the dominant factors of their distribution, and found that there were regional differentiation [9, 10]. Taking the first batch of peasant specialized cooperatives as the research object, Liu Shuai et al. analyzed factors such as resource constraints, transaction costs and market demand, and made a regression analysis of cross-section data by using weighted least square method with the help of Eviews 8.0 software to study the distribution characteristics of Chinese peasant specialized cooperatives [11]. In terms of economic efficiency, formal economic research on agricultural cooperatives began in the 1940s [12]. However, scholars mainly study farmer specialized cooperatives from the perspectives of economic policy, management mode and internal operation mechanism, and the quantification of relevant benefits and models is still rare [13]. Compared with the developed countries, the rural cooperatives in China started late.

In view of rural cooperatives, domestic and foreign scholars have carried out a lot of research from many perspectives. In terms of research scale, it is common to carry out research at the national scale and provincial scale [14-17], but it is rare to discuss it from the perspective of the underdeveloped rural areas in China. Therefore, the study on the spatial agglomeration phenomenon of county cooperatives in underdeveloped agricultural areas and its economic effects is of great significance to understand how specialized farmer cooperatives play their role, to explore the best development mode of rural cooperatives, to improve the economic outlook of underdeveloped agricultural areas, and to put forward some reference suggestions for realizing a well-off society in an all-round way in China.

2. Overview of the Study Area

Ningling County is located in the southeast of Henan Province, under the jurisdiction of Shangqiu City. By the end of 2020, there were 14 townships, 364 administrative villages, 159,400 rural households, 609,100 rural population and 40,607 ha of cultivated land in the county. In 2012, Ningling County was listed as one of the key poverty-supporting counties at the national level. After several years of development, Ningling County has become the national commodity grain base county, the national high-quality cotton breeding base, and the national key oil development county. There are a large number of farmer cooperatives in the county. In this survey and visit, there are 202 cooperatives in the breeding industry, 436 in the planting industry, 72 in the service industry, 9 in the forestry industry and 100 in other categories. (Table 1) Therefore, the study on the spatial distribution and economic effect of farmers' cooperatives in Ningling County is of great significance to the study area.

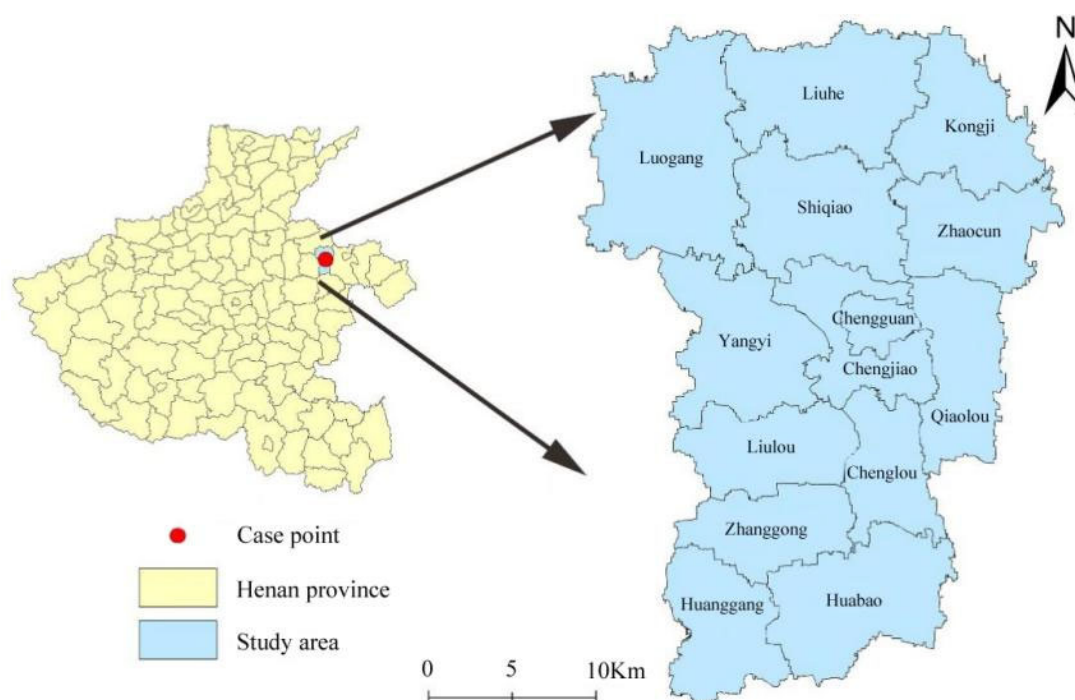


Figure 1. The location of study area

3. Data Sources

Map data: In 2020, the vector map of the national 1:4 million basic database provided free of charge by the National Center for Basic Geographic Information was updated. (2) Research data: Relevant data of 819 specialized farmer cooperatives in 14 towns and townships of Middle Ningling County in the research area, including Chengguan Town and Suburbia Town, were provided by Ningling County Administration for Industry and Commerce through interviews with relevant county departments; The data of agricultural economic development in the village were obtained by the research team through a questionnaire interview on January 20 solstice and February 10, 2020. The data mainly included the number, types, investment capital, population scale, average income level of each village, population status, cultivated land area, water conservancy facilities, etc. It provides real and reliable data support for quantitative research on the economic benefits of rural specialized cooperatives, and at the same time, it also provides data support for future related research. (3) Official data: Shangqiu Statistical Yearbook -2020.

4. Research Methods

The professional cooperatives were abstracted as point elements, the collection method of coordinate picking was adopted, and the types were divided according to the functional properties of cooperatives obtained from field research. Based on ArcGIS spatial analysis and geographical statistical analysis methods and related theories, the spatial characteristics and economic benefits of the distribution of cooperatives were explored at the county scale.

4.1. Point Pattern Analysis, PPA

Spatial point pattern analysis is a technique to reveal the spatial distribution law of the research object by studying the spatial position of point elements. The nearest neighbor index and kernel density estimation are usually used to study the spatial distribution of point elements from two aspects of dispersion and aggregation [18].

4.1.1. Kernel Density Estimation, KDE

Kernel Density Estimation (Kernel Density Estimation) is used to study the distribution characteristics of points by investigating the spatial variation of the point density in the study area, which is suitable for visualization of spatial point patterns [9, 19]. The mathematical formula is as follows:

$$f_n(x) = \frac{1}{nh} \sum_{i=1}^k k\left\{\frac{x-x_i}{h}\right\} \quad (1)$$

x_n is the sample point; $F(x)$ is the estimate at point x ; $K()$ is the kernel function; Bandwidth $h > 0$; $x-x_i$ is the estimated distance between point x and sample x_i .

When the kernel density estimation method is used, the selection of search window width h has a great influence on the analysis results. With the increase of h , the spatial change of point density becomes smoother, but the structure of density will be concealed. When h decreases, the estimated point density changes abruptly. In practical application, different h values need to be set to test, so as to better reflect the spatial effect. After comprehensive comparison and analysis, it is found that the default window width automatically generated in ArcGIS can well reflect the spatial structure characteristics of cooperatives.

4.1.2. Nearest Neighbor Index, NNI

By comparing the average distance of the nearest neighbor pairs in the study area in the random distribution mode, the deviation degree of the random distribution can be calculated [20, 21]. The mathematical formula is as follows:

$$NNI = \frac{\overline{D_0}}{\overline{D_E}} \quad (2)$$

$$\overline{D_E} = \frac{1}{2\sqrt{A/N}} \quad (3)$$

$\overline{D_0}$ is the average observation distance; $\overline{D_E}$ is the expected average distance; A is the area of the study area; N is the number of the study area.

It is generally believed that $NNI \geq 1.5$ and $NNI \leq 0.5$ indicate that spatial point elements are uniformly distributed and aggregated. If $0.5 < NNI \leq 0.8$, is present aggregation-random distribution. If $0.8 < NNI < 1.2$ is a random distribution. If $1.2 < NNI < 1.5$, is random-discrete distribution. The reliability of the results is generally judged by Z test.

4.2. Linear regression Model

Linear regression model can express the relationship between economic effect and influencing factors in an intuitive and convenient way. The main body of this paper is the influence of farmers' specialized cooperatives on the underdeveloped agricultural areas, so the choice of the dependent variable of the regression model is particularly important. In the existing data, this paper first chooses the change of users' average income to reflect the economic effect and influence of farmers' cooperatives. In terms of impact factors, this paper analyzes the type and scale of farmers' cooperatives. The scale of farmers' cooperatives includes many aspects, such as the number of members and the total amount of assets. The total amount of assets is an important indicator of the scale of farmers' cooperatives. However, the final results show that the linear relationship of the impact factors is not significant, and the error interference is large, so it can not well reflect the correlation.

According to the research data of this paper, in terms of different classification of cooperatives, the total number of agricultural cooperatives accounts for 78.99% of the total number of cooperatives, which can better reflect the economic situation of the region. Therefore, this paper finally decided to take the average income of agricultural households as the dependent variable and agricultural cooperatives as the independent variable to conduct linear regression analysis. The linear regression equation is as follows:

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad (4)$$

The dependent variable Y represents the average income of agricultural households, and the independent variable X represents the number of agricultural cooperatives. β_0 is a constant, β_1 is the coefficient of the independent variable, reflecting the relationship between the independent variable and the dependent variable, ε is the random error, representing the interference of other factors.

5. Analysis and Discussion

ArcGIS software was used to estimate the kernel density of distributed rural cooperative points, and the kernel density map of rural cooperative in Ningling County was derived (Figure 2). The output pixel size and bandwidth are the default size. On the whole, the rural cooperatives in Ningling County present a multi-core aggregation distribution, and the distribution density gradually decreases from the center to the periphery. It is concentrated around the township points and the county center, with the highest degree of concentration. The number of concentrated centers is roughly equal to the number of towns, and a small scale agglomeration hotspot is formed at the border of the county. It can also be seen from the summary table of the number of rural cooperatives in towns and villages (Table 1) that the number of rural cooperatives in Luogang, Liuhe and Shiqiao towns is the most direct in the kernel density map, and the agglomeration phenomenon is relatively obvious.

Table 1. Summary of Rural Cooperatives

Name of the town	Aquaculture	Service industry	crop farming	Forestry	other	Total number of cooperatives
Chengguan	4	2	2	0	0	8
Chengjiao	14	2	14	1	4	35
Chenglou	18	2	38	0	2	60
Huabao	23	10	15	1	12	61
Huanggang	5	10	15	1	7	38
Kongji	8	3	19	1	12	43
Liulou	10	5	23	0	6	44
Liuhe	24	6	54	0	9	93
Luogang	21	5	62	0	14	102
Qiaolou	19	2	40	3	7	71
Shiqiao	14	8	61	1	5	89
Yangyi	9	6	31	1	2	49
Zhanggong	16	6	42	0	8	72
Zhaocun	17	5	20	0	12	54
Sum	202	72	436	9	100	819

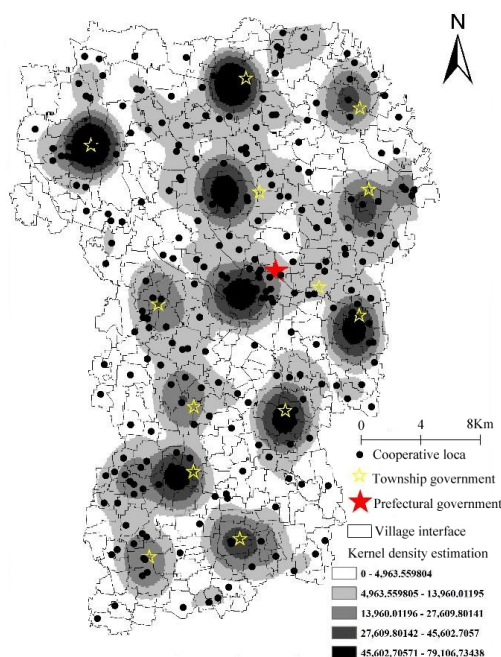


Figure 2. Kernel density of Rural Cooperatives in Ningling County

From the distribution map of cooperatives (Figure 3), we can see that there are a large number of rural cooperatives in Ningling County with a wide distribution area. Shangqiu, where Ningling County is located, is an important commodity grain base in China. The number of planting cooperatives is more than that of other cooperatives. Secondly, the number of forestry cooperatives is the lowest in aquaculture industry. It can be seen that the types of cooperatives are related to the natural and social elements in the study area.

Based on the scale of towns and villages, the spatial analysis of rural cooperatives in Ningling County was carried out again. The mean nearest neighbor method was used. In this paper, the correlation analysis was carried out using ArcGIS software. With regard to the nearest neighbor analysis, ArcGIS software is used to conduct the nearest neighbor statistical analysis on the rural cooperatives in Ningling County by using the spatial statistical tools [analysis mode] - [mean nearest neighbor]. It can be seen from the data that rural cooperatives in Ningling County are uniformly distributed in space as a whole.

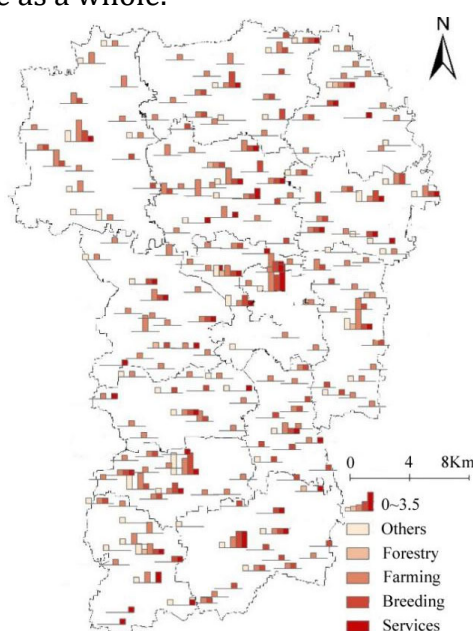


Figure 3. Distribution of Cooperatives

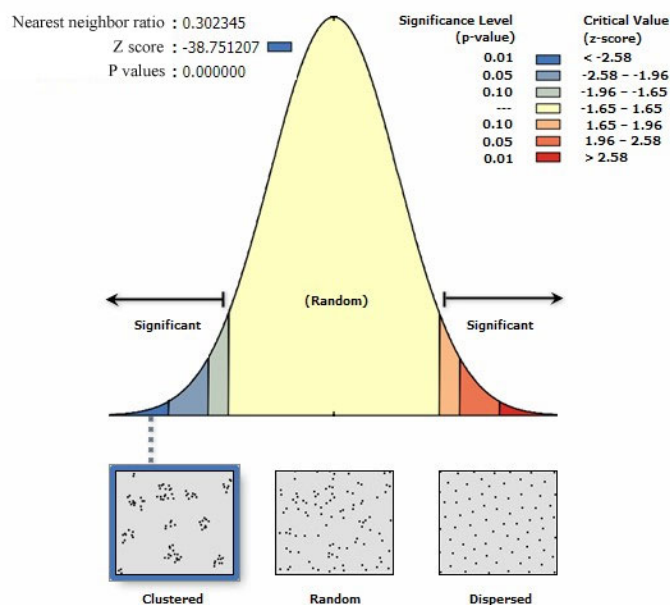


Figure 4. Tatistical feature values of the nearest neighbor distance

Linear regression analysis shows the relationship between the average income of agricultural households and agricultural farmer cooperatives. In general, with the increase of the number of agricultural cooperatives, the average income of farmers gradually increases, from 8,000 yuan to about 13,000 yuan. Linear regression relationship (Figure 5).

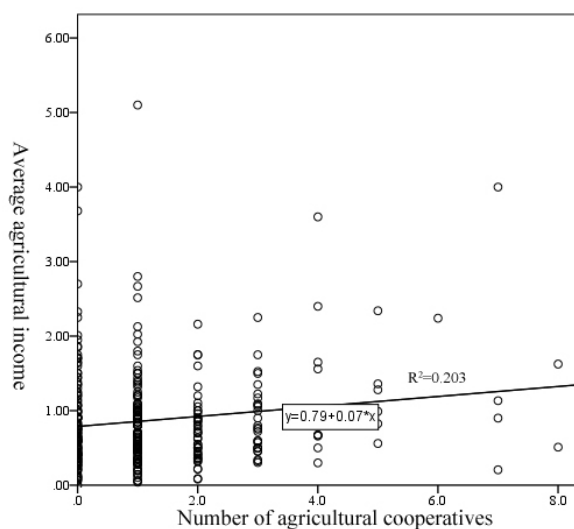


Figure 5. Scatter plot of average income of agricultural cooperatives and agricultural households

Class worth of farming income and agricultural farmers cooperative relationship, you can see from the scatter plot, points on the fitting line of distribution is dense, the agricultural class worth of income and agricultural farmers cooperatives correlation is very strong, from the point of the fitting line, with the increase of agricultural farmers cooperatives, agricultural class worth income increase, but growth is small. The results of linear regression analysis show that $\beta_0=0.0670, \beta_1=0.1511, t=2.8065, p=0.0052<0.01$, indicating a strong linear correlation and a significant positive correlation between the two regression equations.

Table 2. Coefficient of regression equation

VARIABLE	NORMALIZATION COEFFICIENT			T	P
	β_0	Standard Error	β_1		
AVERAGE AGRICULTURAL INCOME	0.0670	0.0239	0.1511	2.8065	0.0052
_CONS	0.7881	0.0456	—	17.2505	0.0000

6. Conclusion and Discussion

According to the data aiming 819 farmers' professional co-operatives, and on January 20, 2020 to Feb. 10 questionnaire interview based on the data obtained, using kernel density, average nearest neighbor analysis, spatial autocorrelation, and linear regression analysis, analysis of farmers' professional co-operatives point model space layout characteristics and economic effect. The results showed that:

(1) The distribution of professional farmer cooperatives in Ningling County presents uniform distribution on the whole, and small agglomeration phenomenon in each township center. On the whole, the number of farmers' cooperatives in the north of Ningling County is more than that in the south, and the number of cooperatives in the towns decreases gradually from the center to the outside. The number of specialized farmer cooperatives in the center of each township and town affects the agglomeration center. Therefore, for the study area, strengthening the exchange and cooperation among the cooperatives can promote the influence of the cooperatives.

(2) The rural cooperatives in Ningling County are dominated by planting industry, followed by breeding industry. The number of forestry cooperatives is the least, and agricultural cooperatives account for 78.99% of the total. The number of agricultural cooperatives in Ningling County has a significant impact on the study area, showing a positive linear correlation. Therefore, an appropriate increase in the number and type of cooperatives can promote the economic growth of the region.

In this paper, the economic effects of research need to be strengthened. The selection of independent variables in regression analysis is relatively limited, and the explanatory power of the conclusions is weak. The influence of cooperatives on the village area is also disturbed by many other factors, such as policy dynamics and unpredictable natural disasters. Whether the cooperative in this area serves the village economy completely is open to question.

Implementing the rural revitalization strategy is an important foundation for building a modern economic system and a key measure for building a beautiful China. In the report to the 19th National Congress of the CPC, we made solving problems related to agriculture, rural areas and farmers a top priority in the work of the whole Party. Under the market economy, the transformation of agricultural forms in poor areas must be sufficiently specialized, so the cooperative emerges as The Times require and becomes an important economic carrier for rural development. Cooperatives can connect agriculture as an industry with the market, and play an important role in providing employment opportunities for the vast number of rural workers, reducing the gap between urban and rural resource distribution, stabilizing the rural labor force population, improving the visibility of county characteristic agricultural products and improving the quality of products, thus promoting the development of rural economy. Relative to other similar studies, this study in aiming of Henan province as an example, this paper discusses the spatial distribution characteristics of the rural professional cooperatives, build the economic effect evaluation model, provide guidance on the economic development of village domain, for aiming related economic policy has the guiding role of the government, at the same time, enrich the theory of cooperative research content and system.

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