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# Study on Coordinated Development of Chemical Park Industrialization Advance and Agricultural Economy Industrialization

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Since the "13th Five-Year Plan", the construction of chemical parks in China has entered a new stage of improving quality and efficiency. The constant establishment and development of chemical parks have facilitated the process of industrialization in China. It is of great significance to speed up the research on the coordinated development of the industrialization advance of chemical parks and the industrialization of agricultural economy. This paper takes the chemical industrial parks in Jiangsu Province as an example to study the interrelationship between the industrialization and the development of agricultural industrialization through a multiple linear regression model. The results show that there are 63 chemical industrial parks in Jiangsu Province, the number is among the highest in the country, but these parks are mainly small and medium sized chemical parks, and most of them are still in the phase of project investment and construction. The development level of new-type industrialization in chemical industrial parks and the level of industrialization of agricultural economy are increasing year by year, but the foundation is not solid. Through multiple linear regression analysis, it was found that the marketization and informatization of industry strongly promoted the development of agricultural informatization and agricultural mechanization, and the industrial internationalization has a positive influence on the sustainable development of agriculture, but the effect is not significant.

## 1. Introduction

China's chemical industrial parks started from the 1990s and have shown a rapid development momentum since 2000. Since the “13th Five-Year Plan”, the construction of China's chemical industrial parks has come into another boom, and it has entered a new stage of improving quality and efficiency. With the constant establishment and development of chemical parks in large areas of China, it has promoted the progress of industrialization in China (Wolf and Wood, 2010). Although China's chemical industrial parks have made significant progress, they are still facing a series of serious problems. While realizing industrialization, how to achieve its coordinated development with the agricultural economy, so far there is no mature experience available for reference (Wanna, 1984). Therefore, how to speed up the coordinated development of industrialization advance within the chemical parks and the industrialization of agricultural economy has become a hot topic for current studies, and it is also a very important issue to promote the healthy and sustainable development of China's economy.

With regard to the research on the relationship between industrialization and agriculturalization, domestic and foreign scholars have formed a series of research results. Some scholars have studied the connotation of industrialization and related theories (Long et al., 2009; Clemons and Row, 1992); some scholars have studied the theory of agriculturalization (Trampusch and Eichenberger, 2012; Jo and Kathleen, 2007); and there are also scholars who have studied how industry is feeding back agriculture (Gereffi and Lee, 2016; Waltham and Sheaves, 2015). This paper takes Jiangsu Province chemical industrial parks as an example, focusing on the coordinated development of the industrialization advance of chemical parks and the industrialization of agricultural economy, and it has great guiding values and reference significance for the construction of other chemical parks in China.

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## 2. Introduction of multiple linear regression analysis

Regression analysis is a mathematical statistics method that deals with the statistical correlation of variables. Its basic idea is to find mathematical expressions that can represent the relationship between independent variables and dependent variables. In regression analysis, if there are two or more independent variables, it is called multiple regression (Chan et al., 1999). When there is a linear relationship between the independent variable and the dependent variable, it becomes a multiple linear regression analysis.

Set the linear regression model of random variable y and general variables $X_1$, $X_2$,...,$X_k$ as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots \beta_k X_k + \varepsilon \tag{1}$$

Where, Y is a dependent variable, $X_i$ is an independent variable, $\beta_i$ is a regression parameter, and ε represents a random error.

In the linear regression model, Y is divided into two parts: the deterministic part and the non-deterministic part (Grossman et al., 1996). In the actual analysis process, multiple observations are required to obtain n sets of sample data ($y_i$;$x_{i1}$,$x_{i2}$,...,$x_{ip}$). The multiple linear regression model can be expressed as:

$$\begin{cases} y_1 = \beta_0 + \beta_1 X_{11} + \beta_2 X_{12} + \cdots \beta_k X_{1p} + \varepsilon_1 \\ y_2 = \beta_0 + \beta_1 X_{21} + \beta_2 X_{22} + \cdots \beta_k X_{2p} + \varepsilon_2 \\ \cdots \\ y_n = \beta_0 + \beta_1 X_{n1} + \beta_2 X_{n2} + \cdots \beta_k X_{np} + \varepsilon_n \end{cases} \tag{2}$$

Formula (2) can be simplified as:

$$Y_i = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \cdots \beta_k X_{ip} + \varepsilon_i \tag{3}$$

In multiple linear regression analysis, the degree of fit of the model needs to be tested (Sousa, S.I.V., et al. 2007). Under normal circumstances, the multiple coefficient of determination is mainly used for the test. The formula is:

$$R^2 = \frac{\mathrm{SSR}}{\mathrm{SST}} = 1 - \frac{\mathrm{SSE}}{\mathrm{SST}} = 1 - \frac{\sum(y-\hat{y})^2}{\sum(y-\bar{y})^2} \tag{4}$$

Where, SSR and SSE represent regression sum of squares and residual sum of squares, respectively, and SST is sum of squares of total dispersion.

The range of $R^2$ is [0, 1]. The smaller the $R^2$ is, the lower the fitting degree of the regression equation is; the larger the $R^2$ is, the higher the degree of fitting is (Broadhurst et al., 1997). Because $R^2$ is relatively easy to be affected by the number of independent variables, it is usually necessary to adjust $R^2$. The specific method is to divide SSE and SST by their respective degrees of freedom, thereby effectively reducing the influence of the number of independent variables on the degree of fitting (Liu, 1988). The specific formula is:

$$\overline{R^2} = 1 - \frac{\frac{\mathrm{SSE}}{\mathrm{n-k-1}}}{\frac{SST}{n-1}} = 1 - (1 - R^2)\frac{n-1}{n-k-1} \tag{5}$$

At the same time, it is also necessary to test the significance of multiple regression equations. The commonly used method is the F test. The formula is:

$$\mathrm{F} = \frac{\mathrm{SSR/k}}{SSE/(n-k-1)} \tag{6}$$

Larger F value indicates that, the change of dependent variable caused by the change of independent variable is bigger than that caused by random variable (Çamdevýren et al., 2005). At the same time, the F statistic can also reflect the degree of fit of the regression equation. By making certain changes to formula (4) and formula (6), we can get:

$$\mathrm{F} = \frac{R^2/k}{(1-R^2)/(n-k-1)} \tag{7}$$

From equation (7), it can be seen that the higher the degree of fit, the more significant the F statistic; the more significant the F statistic, the higher the degree of fit.

## 3. Empirical analysis on the coordinated development of industrialization advance and agricultural economy industrialization

At present, China's key chemical parks or industrial parks with oil and chemical-led industries have reached 502, including 47 national level parks, 262 provincial level parks and 193 city level parks. The details are shown as Figure 1. Chemical industrial parks have gradually become the main battlefield for the development of the industry, and they are playing an increasingly important role in the industry's "structural adjustment and production transformation."

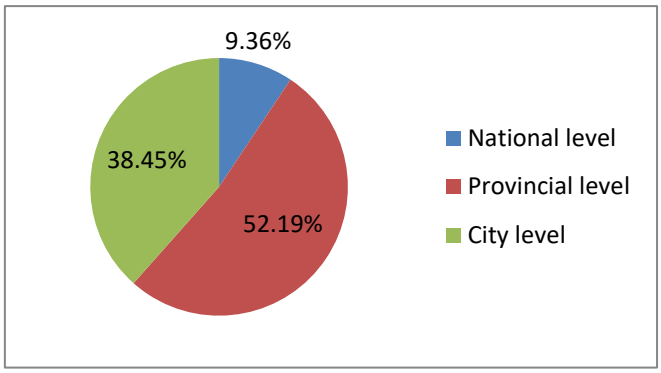


*Figure 1: Composition of key chemical industrial parks in China*

There are 63 chemical parks in Jiangsu Province, the number of which is among the highest in the country, but these are mainly small and medium-sized chemical parks, most of them are still in the phase of project investment and construction. Among them, the petrochemical, fine chemical, new chemical materials and other chemical industry's main revenue exceed 60% of the revenue of all industries.

This paper mainly takes the chemical industrial parks of Jiangsu Province as the research object, and analyzes the problem of the coordinated development of industrialization and agricultural industrialization in the parks. The industrialization level of the chemical parks is mainly represented by the new industrialization index. Table 1 shows the new industrialization index of Jiangsu chemical industrial parks from 2010 to 2016. It can be seen from the Table that during the process of industrialization, the level of industrialization, industrial informatization, and internationalization of industrial parks are constantly rising.

*Table 1: New industrialization index in 2010-2016*

| Year | Industrial marketization(%) | Industrial informatization (%) | Industrial internationalization(%) |
|---|---|---|---|
| 2010 | 67.3 | 32.5 | 68.5 |
| 2011 | 66.5 | 34.1 | 72.4 |
| 2012 | 65.4 | 36.6 | 83.9 |
| 2013 | 66.8 | 37.8 | 84.4 |
| 2014 | 65.3 | 39.5 | 90.6 |
| 2015 | 66.7 | 40.7 | 100.7 |
| 2016 | 68.2 | 41.9 | 125.3 |

The development of industrialization of agricultural economy in the chemical parks is mainly reflected in three aspects of agricultural informatization, agricultural mechanization, and agricultural sustainability. This paper establishes an index system for the development of industrialization of agricultural economy based on these three aspects, as shown in Table 2.

In terms of agricultural informatization, it is mainly reflected by the two indicators of the output value of the first agricultural information department and the output value of the second agricultural information department. The output values of the first and second agricultural information departments in the chemical parks are shown in Figure 2 and Figure 3, respectively. From the data shown in Figure 2 and Figure 3, we can see that the level of agricultural informatization in the chemical industrial parks has shown an increasing trend year by year, but overall, the base of the informatization level is low, which is mainly reflected in the lower proportion of increment value in the second agricultural information department.

*Table 2: Development index system of agricultural economy industrialization*

| | | |
|---|---|---|
| Industrialization and development of agricultural economy | Agricultural informatization | The output value of the first information department of Agriculture(X1)<br>The output value of the second information department of Agriculture(X2) |
| | Agricultural Mechanization | Total power of agricultural machinery(X3) |
| | Agricultural sustainability | Forest cover area(X4)<br>Disaster area accounts for the proportion of affected area(X5) |

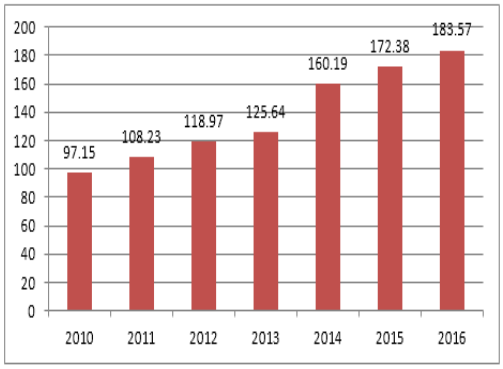


*Figure 2: Output value of the first information department of agriculture in Jiangsu during 2010-2016*

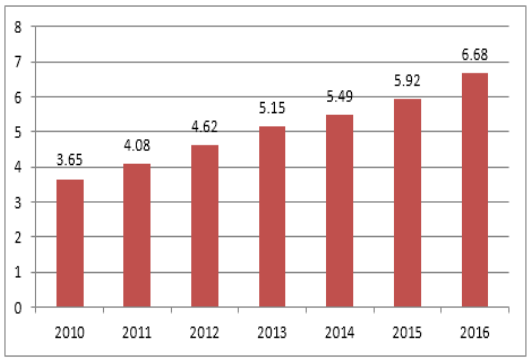


*Figure 3: Output value of the second information department of agriculture in Jiangsu during 2010-2016*

Under normal circumstances, the total power of agricultural machinery can reflect the level of agricultural mechanization. The data of the total agricultural machinery power in Jiangsu Province chemical industrial parks from 2010 to 2016 is shown in Figure 4. From the data shown in the figure, it can be seen that the level of agricultural mechanization in the chemical industrial parks is showing a rising trend, but overall, the basic strength is still relatively weak.

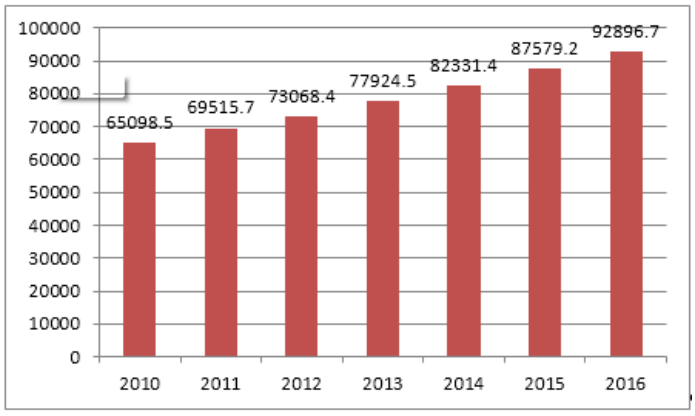


*Figure 4: New industrialization indexes during 2010-2016*

Table 3 shows the forest coverage and the proportion of affected area to the covered area, from which we can see that, the level of sustainable agricultural development in the chemical industrial parks also shows a rising trend.

*Table 3: Forest coverage and the proportion of affected area to the covered area in 2010-2016*

| Year | Forest coverage(%) | Disaster area accounts for the proportion of affected area(%) |
|---|---|---|
| 2010 | 16.75 | 62.38 |
| 2011 | 16.75 | 59.62 |
| 2012 | 19.32 | 57.84 |
| 2013 | 19.32 | 45.06 |
| 2014 | 19.32 | 51.74 |
| 2015 | 20.84 | 43.97 |
| 2016 | 21.38 | 49.62 |

In order to better illustrate the relationship between industrialization and agriculturalization, this paper conducts an empirical analysis of industrialization promoting development of agricultural industrialization, and establishes the following empirical model:

$$y_i = \sum \beta_i x_i + \varepsilon_i \quad (8)$$

Where, $y_i$ is the explained variable, including various indicators included in agricultural informatization, mechanization and sustainability. $x_i$ is explaining variable, mainly including the indicators included in the new type industrialization. $\beta_i$ and $\varepsilon_i$ represent variable coefficient and residual term, respectively.

Use Stata13.0 software to perform multiple linear regression on the relevant variable data. The specific results are shown in Table 4.

According to the data in Table 4, it is found that the marketization and informatization of the industry display in Model 1 have shown a significant positive impact on the development of agricultural informatization. Among them, the coefficient of influence of industrial marketization on the two indicators of agricultural informatization was 12.396 and 8.324, respectively, and the t value was 6.31 and 4.94, respectively. The coefficient of influence of industrial informatization on the two indicators of agricultural informatization was 0.728 and 0.814, respectively, and the t value was 5.04 and 6.17 respectively. The development of new-type industrialization has promoted the popularization of communication technology, and therefore, it has also strengthened the driving force of new agricultural informatization.

Model 2 shows that the marketization and informatization of industry has strongly promoted the development of agricultural mechanization. Among them, the influence coefficient of industrial informatization on agricultural mechanization was 6.185, and the t value was 3.76. The influence coefficient of industrial informatization on agricultural mechanization was 0.188, and the t value was 4.29. With the continuous advancement of new industries, mechanical technology has been greatly improved, which, to a certain extent, has also led to the development of agricultural mechanization.

*Table 4: Empirical analysis of new type industrialization promoting agricultural informatization, mechanization and sustainability*

| | Model 1 | | Model 2 | Model 3 | |
|---|---|---|---|---|---|
| | Agricultural informatization | | Agricultural Mechanization | Agricultural sustainability | |
| | X1 | X2 | X3 | X4 | X5 |
| Industrial marketization | 12.396*** (6.31) | 8.324** (4.94) | 6.185*** (3.76) | | |
| Industrial informatization | 0.728*** (5.04) | 0.814*** (6.17) | 0.188** (4.29) | | |
| Industrial internationalization | | | | 0.536*** (5.98) | 1.747*** (4.83) |
| C | 57.926*** (7.08) | 36.184** (4.75) | 34.592*** (5.71) | 3.785*** (19.32) | 3.064*** (5.75) |
| Adj-$R^2$ | 0.9836 | 0.9453 | 0.9109 | 0.5742 | 0.9778 |

Model 3 shows that industrial internationalization has a positive influence on the sustainable development of agriculture, but the effect is not significant. With the development of new type industrialization, the sustainable development of agricultural industrialization has been promoted. However, the sustainable development of agricultural industrialization cannot be fully realized in a short term and it requires a gradual process. Therefore, the effect of the influence is not significant. However, we cannot abandon the concept of sustainable

development. The country should formulate more policies and measures, and constantly encourage the internationalization of industry and the sustainable development of the industrialization of agricultural economy.

## 4. Conclusion

(1) There are 63 chemical industrial parks in Jiangsu Province, the number of which is among the highest in the country, but these are mainly small and medium-sized chemical parks, and most of them are still in the phase of project investment and construction. The development level of new-type industrialization and the level of industrialization of agricultural economy in the chemical industrial parks are increasing year by year, but the foundation is not solid.

(2) This paper performed multiple linear regressions on the related indicators of the new type industrialization and agricultural industrialization of the chemical parks. The results showed that the marketization and informatization of the industry have strongly promoted the development of agricultural informatization and agricultural mechanization, and industrial internationalization had a positive influence on the sustainable development of agricultural sustainable development, but the effect was not significant.

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