Study on Driving Factors of Grain Yield Change in Hunan Province from 1995 to 2015

WuDan[1, 2, 3, 4, *]

[1]Shaanxi Provincial Land Engineering Construction Group Co. , Ltd. Xi'an 710075,China;

[2]Institute of Land Engineering and Technology, Shaanxi Provincial Land Engineering Construction Group Co. , Ltd. Xi'an 710075,China;

[3]Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resources,Xi'an 710075,China;

[4]Shaanxi Provincial Land Consolidation Engineering Technology Research Center,Xi'an 710075,China

Keywords: Grain yield,principal component analysis,regression analysis, correlation analysis.

Abstract: This paper selects the grain production data of Hunan Province from 1995 to 2015, and based on the theoretical basis of econometric geography, several mathematical analyses are performed on this data. A series of data surveys were used to explore various elements related to grain production in Hunan Province. The grain output between 1995 and 2015 in Hunan Province was used as the dependent variable. , Per capita GDP, effective irrigated area, and rural population are independent regression models. The results show that the main factors affecting Hunan's grain output are fertilizer application, total power of agricultural machinery, GDP per capita, effective irrigated area, and rural population. . The increase in the amount of chemical fertilizer application is one of the main factors leading to the increase in grain output in Hunan Province. At the same time, the effective irrigation area also has an impact on grain output. The total power of agricultural machinery has also greatly promoted the grain output. Per capita GDP and rural population The correlation between these two factors and grain yield is also strong, and the impact of crop planting area on grain yield is not significant.

1. Introduction

Human survival is inseparable from food. Food affects such major strategic issues as national economy, people's livelihood, economic security, and social stability. With the continuous growth of the world population and the rapid advancement of urbanization, and the continuous expansion of land desertification, food has become more and more important. People's demand for natural resources such as food has increased year by year, and the relationship between supply and demand for food is very serious [1].

Aiming at China's grain production, a large number of scholars have conducted in-depth explorations on this issue. Most of the studies have been conducted from the aspects of grain production pattern [2, 3], stage characteristics [4, 5], and influencing factors [6]. Song Xiaosong pointed out that the agricultural labor force and the sown area of crops that are not affected by disasters are the most important factors affecting grain yield; chemical fertilizers have increased crop yields to a certain extent, and the grasp of the amount of chemical fertilizers applied will affect crop yields and pollute the environment [7]. Xiao Haifeng and others found that the area of grain cultivation, the degree of fertilization, and the use of other materials played a direct role in the growth of grain, and the lack of planting area also greatly limited the output of grain output [8]. Hu Wenhai and others pointed out the disadvantages of the grain output problem. To understand the grain output problem, the relationship between the effective irrigated area of crops, the area planted and the area affected by the disaster must be studied, and it must be studied as a key factor [9].

Based on the previous research results, starting from the historical trajectory of grain production in Hunan Province (1995-2015), the principal component analysis was used to study the driving

factors of grain output change in Hunan Province, and different driving factors were obtained through regression analysis and correlation analysis. The degree of impact on grain output provides theoretical support and scientific basis for the stabilization of Hunan's grain production system and grain production decisions of related departments.

2. Data sources and research methods

2.1 Data Sources

This document was searched from 1995 to 2015 for a total of 21 years. The data obtained are from China Statistical Yearbook and Hunan Statistical Yearbook, the website of the National Bureau of Statistics of China and the website of the Bureau of Statistics of Hunan Province.

2.2 research method

The principal component analysis method was introduced by the founder Pearson in the early nineteenth century. After 30 years of Hotlin's improvement, the principal component analysis method was used. Its main feature is that it uses a reduced mathematical level, which enables us to Instead of those that are interrelated, you can replace the initial population variables with as few information variables as possible. In short, the principal components of the data compression and interpretation transformation of the principal component analysis exist independently, and the effect of the principal component analysis becomes more obvious with the correlation between the parameters. Therefore, the research factor chosen in the principal component analysis, that is, the independent variable, must have a strong correlation with the dependent variable of the study. Its main functions are integrated in spss software and combined with GIS spatial analysis.

3. Result analysis

3.1 Analysis of grain production fluctuation trend in Hunan Province in recent years

According to the grain data of Hunan Province from 1995 to 2015, on the whole, the grain output showed a fluctuating growth trend, and the change trend of per capita grain output and grain yield was in sync with the trend of total grain output. (As shown in Figure 1).

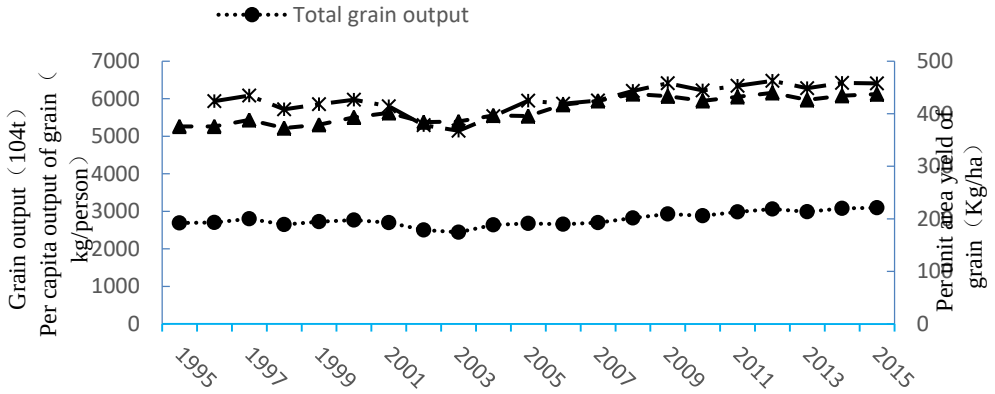

Figure 1. Fluctuation of grain production in Hunan Province from 1995 to 2015.

There were four stages of changes in Hunan's grain output from 1995 to 2015. The first stage: from 1995 to 1999, the main characteristics of this stage are: steady and slow development that lasts for 5 years, and the overall trend shows a relatively stable output. The second stage is from 1999 to 2003, and this stage is a period of continuous production reduction. This stage is characterized by the fact that after reaching a new high since the reform and opening up in 1999, the total grain output showed a significant downward trend, and reached the lowest level in this stage in 2003. The third stage was from 2003 to 2007, and it resumed a period of continuous increase in production. This stage changed the bleak scenes of the above two stages. After continuing the downward trend, it

finally ushered in a new dawn. This is largely due to the food production of Hunan in the government, and the promotion of the market has also started To promote the role. Compared with the above two stages, not only has it grown steadily and slowly, but grain production has made breakthrough progress, reaching new highs beyond the previous two stages. The fourth stage is from 2007 to 2015. This phase is characterized by a sharp decline in 2008 and remained stable for the next few years. There are four stages of change, mainly due to natural and human factors. Based on mathematical analysis, this paper analyzes the different reasons for changes in grain output.

3.2 Principal Component Analysis Results

Fertilizer use, sown area, total agricultural machinery power, effective irrigation area, agricultural electricity consumption, agricultural labor, disaster area, arable land reduction area, and per capita GDP are the main factors affecting the amount of grain. KMO and Bartlett tests were performed on the data to analyze associations between selected correlation factors.

Table 1. KMO and Bartlett tests

Kaiser-Meyer-Olkin (KOM)		.609
Bartlett sphericity test	Approximate chi-square	232.590
	df	15
	Sig.	.000

As can be seen from the table above, the KMO measurement value is 0.609. Using the index set by statistician Kaiser, when the value of KMO is greater than 0.6, it is suitable for factor analysis [10]. The sig of the Bartlett sphericity test is 0.000, which is less than the significant level of 0.05 [11], indicating that the setting of the research indicators in this paper meets the validity test and has significant differences. The Bartlett sphericity test results are significant, indicating that the six indicators are not independent. That is, there is a correlation, so the research index selected in this paper is suitable for factor analysis.

Table 2. Total variance explained

Ingredients	Initial eigenvalue			Extract square sum load		
	total	Variance contribution rate(%)	Cumulative contribution rate(%)	total	Variance contribution rate(%)	Cumulative contribution rate(%)
1	4.155	69.254	69.254	4.155	69.254	69.254
2	1.539	25.646	94.900	1.539	25.646	94.900
3	.261	4.348	99.248			
4	.031	.522	99.770			
5	.012	.194	99.964			
6	.002	.036	100.000			

Processing the data, we can see the characteristic value, contribution rate and cumulative contribution rate of grain production. The results are shown in Table 2. It can be seen from the table that the eigenvalues greater than 1 are the first two main factors, so the first two main factors are extracted. The variance interpretation rates are 69.254% and 25.646%, and the cumulative variance interpretation rate is 94.9%. 80%, so the first two factors were selected as the main influencing factors to analyze the grain output of Hunan Province.

Table 3. rotation component matrix

	Ingredients	
	1	2
Total power of agricultural machinery (10^4 kilowatts)	.992	
Fertilizer application (10^4 t)	.985	
GDP per capita (yuan)	.366	.904
Effective irrigation area (10^3 ha)	.808	.400
Rural population (10^4 people)	-.648	.754

The above research results show that the amount of material input is the most important factor affecting grain yield, and the production of crops cannot be separated from irrigation and fertilization. The population density of the second principal component indicates that human factors also have a great influence.

4. Conclusion

Ccording to the above analysis, the following conclusions can be drawn: grain production is closely related to the total power of agricultural machinery, the amount of fertilizer applied, the effective irrigation area, per capita GDP and the number of rural population. The increase in the amount of chemical fertilizer application is one of the main factors leading to the increase in grain output in Hunan Province, and the production of grain is inseparable from the application of chemical fertilizers. The factor of effective irrigation area is also within the scope of Hunan's grain yield analysis and research, and it is also closely related. The definition of effective irrigated area is that the land is relatively flat, with certain water resources and irrigation facilities, and the area of farmland that can be normally irrigated in the general year, is the sum of the area of irrigated paddy field and dry land. It can be said that the size of the effective irrigated area can be regarded as an indicator for measuring the degree of water conservancy and agricultural production stability in agricultural production units and regions. The total power of agricultural machinery has played a significant role in promoting the increase in grain output. The correlation between agricultural population and per capita GDP on food production is also strong, mainly because the larger the rural population, the more labor force invested in agriculture, and the higher the food production.

References

[1] Ma Weipeng, Cao Shuhua, Nie Lei, Chen Juan. Analysis of Grain Yield Changes and Driving Forces of Influencing Factors in Anhui Province [J]. World Agriculture, 2014, (09): 178-184.

[2] Chen Yangfen, Li Xiande. Temporal and spatial pattern and influence factors of grain yield changes in China [J]. Journal of Agricultural Engineering, 2013, 29 (20): 1-10.

[3] Liu Dong, Feng Zhiming, Yang Yanzhao, et al. The characteristics of China's grain production development and the spatial pattern of land resource carrying capacity [J]. Journal of Agricultural Engineering, 2011, 27 (7): 1-6.

[4] Cheng Yeqing, Zhang Pingyu. Regional Pattern Changes of China's Grain Production and Response of Commodity Grain Bases in Northeast China [J]. Geographical Sciences, 2005, 25 (5): 513-520.

[5] Yang Chun, Lu Wencong. Study on the regional pattern of grain production in counties based on spatial econometric model [J]. Agricultural Technology and Economy, 2010 (5): 24-29.

[6] Liu Muhua. Empirical Analysis of the Impact of Comprehensive Agricultural Natural Disasters on Food Production in Hunan Province [D]. Hunan University of Science and Technology, 2015.

[7] Song Xiaosong, Leng Kailuo. Comparative analysis of influencing factors of grain production in China's major grain producing provinces [J]. Journal of Yunnan University of Finance and Economics, 2008 (3): 108-110.

[8] Xiao Haifeng, Wang Yan. Analysis of influencing factors of China's comprehensive grain production capacity [J]. Agricultural Technology and Economy, 2004 (6): 45-48.

[9] Hu Wenhai. Characteristics of grain production in central China and its impact on food security in China [J]. Geographical Research, 2008, 28 (4): 85-895.

[10] Peng Xingyu, Ji Xionghui. Current Status and Prospects of Fertilizer Application in Hunan Province [J]. Hunan Agricultural Science, 2006 (6): 66-69.

[11] Yang Yue'e. Installing Powerful Engines for the Construction of New Countryside))) Current Situation and Countermeasures of Hunan Agricultural Mechanization Development [J]. Hunan Agricultural Machinery, 2006 (4): 4-5.