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Research on the Sustainable Development of Agriculture in China under the Policy of "Agriculture, Countryside and Farmers"

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Abstract

In order to explore the development level of agriculture in China and its influencing factors, this paper uses STATA software to make a statistical analysis of the related factors of agricultural development through descriptive statistical analysis, linear regression model, variance expansion factor test, White test and Ramsy test. It is found that the affected area of crops, effective irrigation area, agricultural labor force and financial agricultural expenditure have significant effects on agricultural development. This paper puts forward some substantive suggestions for promoting agricultural development from these aspects.

Keywords

Agriculture; Countryside and Farmers; Agricultural Development; STATA Software; Linear Regression Model.

1. Introduction

On February 13th, 2023, the No.1 document of the Central Committee "Opinions of the Central Committee of the Communist Party of China and the State Council on Doing a Good Job in Promoting Rural Revitalization in 2023" was released, and the development of China's agriculture under the policy of "agriculture, countryside and farmers" once again became a topic of discussion among the people. Agriculture is the root of human development and the primary condition of all production. China has thousands of years of farming civilization, and agriculture plays a very important role in China's social and economic development. Since the founding of New China, the development of agricultural science and technology and the national financial expenditure on agriculture have injected a strong impetus into China's agricultural development, and agriculture has developed rapidly. However, due to the particularity of China's agricultural production conditions and the subjectivity of small-scale farmers' management, it is often in a passive position in the face of natural disasters and market fluctuations. In addition, due to unreasonable agricultural production activities, problems such as soil erosion and soil fertility decline have gradually emerged. Therefore, how to improve the level of agricultural modernization and promote agricultural sustainable development has been valued and discussed by many experts and scholars. This paper selects the data of China's total agricultural output value, affected area of crops, effective irrigation area of irrigation area, agricultural labor force, total power of agricultural machinery and financial agricultural expenditure from 2008 to 2020, and uses STATA statistical software to analyze China's agricultural development level and its influencing factors and put forward suggestions for China's agricultural sustainable development.

2. Literature Review

At present, many domestic experts and scholars have studied the influencing factors of agricultural development, among which Yu Liang explored the influencing factors of green production mode in counties and cities of Hunan Province through binary Logistic regression

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analysis. Li Tianxiao used SPSS software to establish the relationship between the total agricultural output value and the total sown area in Jiangsu Province. Xiong Jiazhi, Zhang Wei and zhang xiaodan used Eviews6. 0 to quantitatively analyze the agricultural influencing factors in Xiangxi. Xiong Yanhan used LMDI model to decompose the factors affecting agricultural carbon emissions in Yunnan Province, and quantitatively analyzed the contribution degree of each influencing factor. Zhang Haiyang analyzed the influencing factors of agricultural GDP in Changzhi by combining qualitative analysis with quantitative analysis. Pu Qianqian used multiple regression method to analyze the factors affecting the development of low-carbon agriculture in Henan Province. Zhu Lijun combed and analyzed the influencing factors of the development of low-carbon agriculture in Anhui Province by establishing the broken-line trend charts of Anhui's total agricultural output value and carbon emissions, and carbon emissions and fiscal agricultural expenditures. Sharla Cheung, He Guosong and Zhu Juncheng selected Xianning City from 1990 to 2013 to conduct regression analysis on the influence of the data of fertilizer application, total power of agricultural machinery and crop planting area on the total agricultural output value. Tu Renzhong explored the impact on agricultural development from the meteorological perspectives of temperature, moisture and wind.

In this paper, the quantitative analysis method of scholars is used for reference, and the powerful STATA software is used to build a multiple linear regression model. In view of the lack of comprehensive influencing factors of other scholars, this paper extracts index data from multiple angles to comprehensively and accurately analyze the influencing factors of China's agricultural development.

3. Data Selection

In order to ensure the authoritative and practical significance of the data, this paper selects the data from 2008 to 2020 in China Agricultural Statistical Yearbook. The total agricultural output value is the microscopic embodiment of the agricultural development level, so this paper chooses the total agricultural output value as the representative of the agricultural development level, that is, the explained variable. In the selection of explanatory variables, this paper integrates multiple influences, makes it clear that farmers are the main body of agriculture and financial expenditure is the guarantee of agricultural development, and selects six second-level indicators from four first-level indicators: agricultural scale, agricultural conditions, farmers and government.0, as shown in Table 1.

Table 1. Data indicators

Level 1 index	Level 2 index
Agricultural scale	Affected area of crops Effective irrigation area of irrigation area
Agricultural conditions	Fertilizer application rate Total power of agricultural machinery
Farmer	Agricultural labor force
Government	Financial agricultural expenditure

Among them, the agricultural scale index includes the affected area of crops and the effective irrigation area, and the agricultural condition index includes the amount of chemical fertilizer applied and the total power of agricultural machinery; The index of farmers is the population of agricultural labor force; The government indicator is fiscal agricultural expenditure. To sum up, the data sequence is shown in Table 2.

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Table 2. Data of National Agricultural Indicators from 2008 to 2020

age	agriculture total output value (billion yuan)	crops Affected area (ten thousand hectares)	Effective irrigation area irrigated area (ten thousand hectares)	agriculture Labor force (ten thousand people)	chemical fertilizer Application amount (ten thousand tons)	agricultural machinery Total power (ten thousand kilowatts)	Fiscal agriculture expenses (billion yuan)
2008	25562.9	3999.0	2944.0	29923	5239.0	82190.4	2278.9
2009	28626.7	4721.4	2956.2	28890	5404.4	87496.1	3826.9
2010	31259.1	3742.6	2449.3	27931	5561.7	92780.5	3949.4
2011	37918.5	3247.1	2974.8	26472	5704.2	97734.7	4291.2
2012	42099.7	2496.2	2933.2	25535	5838.8	102559.0	5077.4
2013	46800.3	3135.0	3392.8	23838	5911.9	103906.8	5561.6
2014	51341.0	2489.1	3021.6	22372	5995.9	108056.6	5816.6
2015	54648.0	2177.0	2990.2	21418	6022.6	111728.1	6436.2
2016	56496.3	2622.1	3304.6	20908	5984.4	97245.6	6458.6
2017	58254.2	1847.8	3326.2	20295	5859.4	98783.4	6194.6
2018	60318.2	2081.4	3332.4	19515	5653.4	100371.7	6156.1
2019	64253.0	1925.7	3350.1	18652	5403.6	102758.3	6554.7
2020	68769.7	1995.8	3363.8	17715	5250.7	105622.2	7514.4

4. Descriptive Statistical Analysis

In order to facilitate data processing and set variable names for constructing linear regression model below, this paper named seven variables, namely, total agricultural output value, affected area of crops, effective irrigation area of irrigation area, agricultural labor force population, fertilizer application amount, total power of agricultural machinery and fiscal agricultural expenditure, respectively, Y, x1, x2, x3, x4, x5 and x6.

Enter: summarize y x1 x2 x3 x4 x5 x6 in the command box of STATA software, and the mean value, standard deviation, minimum value and maximum value of each variable will appear, as shown in Table 3. Through the descriptive analysis of the data, it is found that[2]There are no extreme and abnormal values in all the data of the selected observation variables, and the standard deviation is within a reasonable range, which shows that the data selected in this paper is rigorous.

Table 3. Descriptive statistical results of each variable

variable	observed value	average value	standard deviation	minimum value	maximum
y	13	48180.585	14072.562	25562.9	68769.703
x1	13	2806.169	902.425	1847.8	4721.4
x2	13	3103.015	273.087	2449.3	3392.8
x3	13	23343.385	4063.633	17715	29923
x4	13	5679.231	283.933	5239	6022.6
x5	13	99325.65	8152.512	82190.4	111728.1
x6	13	5393.585	1444.94	2278.9	7514.4

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5. Establish Multiple Linear Regression Model

Regression model is an important means to study the random causality between economic variables. The data selected in this paper are time series data, which has better fitting effect. In this paper, Y is taken as the explained variable, and x1, x2, x3, x4, x5 and x6 are taken as the explained variables to construct a multiple linear regression model.

Enter reg y x1 x2 x3 x4 x5 x6 in the command box of STATA, and the results of STATA model are shown in Table 5. And the linear equation expression is obtained:

$$y = -1.703x_1 + 2.732x_2 - 2.41x_3 - 2.313x_4 + 0.198x_5 + 1.681x_6 + 102826.75 \quad (1)$$

According to the display results, goodness of fit test, equation significance test, variable significance test and multicollinearity test are carried out in turn.

Table 4. Results of Multiple Linear Regression Model

variable	coefficient	Standard error	T value	P value	95% confidence interval/section	significance
x1	-1.703	0.473	-3.60	0.011	-2.86	-0.547
x2	2.732	0.775	3.53	0.012	0.836	4.628
x3	-2.410	0.226	-10.67	0	-2.962	-1.857
x4	-2.313	0.633	-3.65	0.011	-3.862	-0.764
x5	0.0198	0.0379	0.52	0.619	-0.0729	0.1126
x6	1.681	0.506	3.32	0.016	0.442	2.92
constant	102826.75	6378.418	16.12	0	87219.32	118434.17
obs			13			
R-squared			0.9995			
F-test			2068.80			
Prob>F			0.000			

5.1. Goodness of Fit Test

The goodness-of-fit test is used to test the fitting degree of the sample regression model to the observed values of the samples, and to explain the explanatory ability of the selected explanatory variables to the explained variables. The closer to 1, the stronger the goodness of fit. From the results of STATA regression, we can see that the determinable coefficient of the multivariate linear regression model constructed in this paper is 0.9995, which is very close to 1, which shows that the regression model fits the sample coefficient very well.$R^2R^2R^2$.

5.2. The Equation Significance Test

The equation significance test, that is, F test, is to test whether the parameter values of all explanatory variables are 0 at the same time at a certain significance level, which shows whether the selected explanatory variables are appropriate on the whole, and then infer whether the sample regression equation is fully representative of the overall regression equation. The greater the F statistic and the smaller its adjoint probability, it shows that the estimated sample regression equation is more significant. From the results of STATA regression, we can see that the multivariate linear regression model constructed in this paper has F=2068.8 and its adjoint probability p=0.000, which shows that the regression equation is significant overall if the original hypothesis that the explanatory variables are not significant to the explained variables is rejected at the level of significance, that is, the influence of the explanatory variables on the explained variables is significant.$\alpha = 0.05$.

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5.3. Significance Test of Variables

The significance test of equation, that is, T test, is to test that an explanatory variable has a significant influence on the explained variable at a certain significance level. The greater the absolute value of T statistic and the smaller its adjoint probability, it shows that the tested explanatory variables have more significant influence on the explained variables. According to the results of STATA regression, it is found that the adjoint probability of x5' s t statistic is greater than the significance level of 0.05, and the t test is not passed. It shows that the model may have multiple collinearity.

5.4. Multiple Collinearity Test

When there is a strong correlation between explanatory variables, the model will generally appear complete or incomplete multicollinearity. Variance expansion factor vif is one of the indicators to judge multicollinearity. To determine the existence of multicollinearity, generally speaking, vif must meet two criteria at the same time: one is that the maximum vif value is greater than 10, and the other is that the average vif value is greater than 1.[3].

Enter: vif in STATA's command box. The test results are shown in Table 6. According to the test results, the largest vif, i.e. x3, corresponds to a vif value of 52.808 greater than 10, and the average vif value of 18.103 greater than 1, which indicates that the regression model has serious multicollinearity.

Table 5. Test results of variance expansion factor

variable	VIF	1/VIF
x3	52.808	0.019
x6	33.579	0.03
x1	11.407	0.088
x5	5.991	0.167
x2	2.808	0.356
x4	2.026	0.494
MeanVIF	18.103	

6. Modified Multicollinearity

Table 6. Results of Modified Multiple Linear Regression Model

p=0.6195>=0.05 removing x5						
variable	coefficient	Standard error	T value	P value	95% confidence interval/section	significance
x1	-1.813	0.401	-4.530	0.003	-2.761	-0.866
x2	2.674	0.726	3.680	0.008	0.957	4.390
x3	-2.364	0.197	-11.980	0.000	-2.830	-1.898
x4	-2.239	0.584	-3.830	0.006	-3.620	-0.858
x6	1.839	0.386	4.770	0.002	0.926	2.751
constant	102954.2	6034.207	17.060	0.000	88685.600	1.17e+05
obs	13					
R-squared	0.9995					
F-test	2769.76					
Prob>F	0.000					

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From the test results, it can be seen that the model has serious multicollinearity, and the existence of multicollinearity may make it difficult to analyze the individual influence of each explanatory variable, the estimated values of model parameters lack stability, the variance increases, and its prediction interval also increases, thus reducing the prediction accuracy. Therefore, this paper modifies multicollinearity to get a stable regression model. In STATA, the stepwise regression method is often used to eliminate some variables that are not significant, so as to correct multicollinearity. Enter: swreg y x1x2 x3 x4 x6x6, pr (0.05) in STATA's command box. The results of the modified model are shown in Table 7. It can be seen that the STATA results exclude those that are not significant at 95% significance level.x_5.

The heteroscedasticity test and endogenous test were carried out on the modified multivariate linear regression model.

6.1. Heteroscedasticity Test

If some important variables are omitted or the model is set incorrectly, heteroscedasticity will occur. White test is often used to test heteroscedasticity in STATA. If the chi-square value is greater than the chi-square critical value given in advance at the significance level or its adjoint probability P is less than the significance level, the hypothesis of homovariance is rejected and heteroscedasticity is considered.α.

Enter: hettest in STATA's command box. White test results are shown in Figure 1. It can be clearly seen that ""in STATA results is far greater than the significance level of 0.05, which shows that the model does not have heteroscedasticity.$Prob > chi2 = 0.8049$.

```
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
         Ho: Constant variance
         Variables: fitted values of y

         chi2(1)      =     0.06
         Prob > chi2  =   0.8049
```

Figure 1. White test results

6.2. Endogenous Test

Different from the causes of multicollinearity, when the explanatory variables in the model are related to random disturbance terms, it is easy to produce endogeneity. The reasons leading to the endogeneity are the omission of important variables, the causality between explanatory variables and explained variables, and the poor sample selection. In STATA software, the ovtest command in Ramsy test is often used to test the endogeneity of missing variables, and the null hypothesis is that "there are no high-order missing variables in the model". If the F value given by the test exceeds the critical value, or its adjoint probability P is greater than the significance level, the original hypothesis is rejected, and it is considered that there are missing variables in the model, that is, the model has endogeneity.α.

Enter: ovtest in STATA's command box. The test results are shown in Figure 2. You can see the ""in the STATA result. It is far greater than the significance level of 0.05, which shows that the model does not exist endogeneity.$Prob > F = 0.3738$.

```
Ramsey RESET test using powers of the fitted values of y
       Ho:  model has no omitted variables
                 F(3, 4) =      1.36
                Prob > F =      0.3738
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Figure 2. Ramsy test results

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7. Analysis of Modified Regression Results

It can be clearly seen that after excluding x5, the determinable coefficient of the model is still 0.9995, and the fitting degree is still very good; F=2769.76, its adjoint probability p=0.000, and the F statistic is higher than that of the unmodified model, which indicates that the overall significance level of the modified regression equation is improved at the significance level of 0.05; The adjoint probability of t statistics of each variable is reduced, which is very close to 0, which shows that the explanatory variables of the revised model have greatly improved the significance of the explained variables. Moreover, heteroscedasticity test and endogenous test have passed, so this revision is very correct and necessary.$R^2\alpha =$.

The modified linear regression equation is:

$$y = -1.813x_1 + 2.674x_2 - 2.364x_3 - 2.239x_4 + 1.839x_6 + 102954.2 \tag{2}$$

The estimated value of x1 parameter is -1.8134, which shows that the total agricultural output value decreases by 181.34 million yuan for every 10,000 hectares of agricultural disaster area. The affected area of crops is a negative indicator of the total agricultural output value. Under a certain total planting area, the larger the affected area of crops means that the smaller the yield area is, the less the total agricultural output value is.

The estimated value of x2 parameter is 26737, indicating that the total agricultural output value increases by 267.37 million yuan for every 10,000 hectares of effective irrigation area. The soil moisture content of effectively irrigated farmland is more sufficient and the soil permeability is better, so the unit yield of effectively irrigated farmland is higher than that of non-effectively irrigated farmland, and the larger the effective irrigated area of cultivated land, the higher the output value of crops.

The estimated parameter value of x3 is -2.3640, which shows that the total agricultural output value will decrease by 236.40 million yuan for every 10,000 agricultural laborers. With the adjustment of China's industrial structure, the population of the primary industry flows to the secondary and tertiary industries in large numbers, and the agricultural labor force decreases, but the total agricultural output value in China is increasing. Cui Huiying[4]Studies have found that the reduction of agricultural labor input will hinder agricultural economic growth in the short term. However, in the long run, it will help promote the transformation of industries from labor-intensive to capital-intensive, thus affecting agricultural economic growth through industrial structure.

The estimated value of the parameter of x4 is-22386, which shows that the total agricultural output value decreases by 223.68 million yuan for every 10,000 tons of chemical fertilizer application. Yuan Xu[5]Studies have shown that excessive fertilization will have a serious impact on the physical and chemical properties of soil, destroy the structural stability of soil, make the soil compact and the soil fertility decline, and in the long run, it will lead to a decrease in yield and agricultural output value. Therefore, China is advocating the reduction of chemical fertilizers.

The estimated value of x6' s parameters is 1.8386, indicating that the total agricultural output value will increase by 183.86 million yuan for every 10,000 tons of fiscal agricultural expenditure. Financial expenditure on agriculture is an important guarantee for agricultural development. When faced with major meteorological disasters, geological disasters and agricultural products economic crisis, financial support plays an important role in stabilizing the market economy and ensuring farmers' income. Therefore, the more financial expenditure on agriculture, the higher the agricultural output value.

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8. Conclusions and Suggestions

According to the revised regression model, this paper increases the agricultural output value from five aspects: how to reduce the affected area, increase the effective irrigation area, improve the quality of agricultural labor force, rationally plan the amount of chemical fertilizer application and give play to the incentive role of financial agricultural expenditure.

8.1. Do a Good Job in Disaster Prevention and Build Farmland Water Conservancy Facilities.

For possible meteorological disasters, give full play to the meteorological disaster prevention and emergency work of governments at all levels and relevant departments, so that farmers can respond to meteorological disasters such as cold wave, flood and drought in time, reduce the affected area of cultivated land, and strive to minimize losses. At the same time, vigorously build reservoirs and other farmland water conservancy projects. Reservoirs discharge sand and store water in flood season and open floodgates and discharge water in dry season, which bear the important responsibility of allocating water resources.[6]It is a powerful measure to deal with natural disasters such as drought and flood. By allocating water resources, the area of soil erosion is reduced, the soil water content and fertility are improved, the living conditions of crops are improved, the unit yield of crops is improved, and the total agricultural output value will be greatly improved.

8.2. Empower Agriculture with Science and Technology and Improve the Level of Agricultural Mechanization.

Introduce and popularize advanced agricultural science and technology, including advanced irrigation technologies such as drip irrigation, sprinkler irrigation and infiltration irrigation; Advanced agricultural machinery technology, such as ammonia strip applicator, stretcher power duster, etc. Advanced planting techniques such as wall culture, soilless culture and greenhouse culture; Advanced biological control technologies such as antibiotic preparations and toxic protein crystal preparations. Improve the coverage of new agricultural mechanization technologies, and implement a technological development model that combines large, medium and small technologies with high school and low technology.[7]. At the same time, vigorously develop water-saving agriculture, ensure the steady decrease of agricultural water consumption, make crops absorb more water, improve irrigation efficiency, expand effective irrigation area and provide agricultural output value.

8.3. Increase Investment in Education and Improve the Cultural Quality of Rural Labor Force.

According to the statistics of China Agricultural Statistical Yearbook, the illiteracy rate of rural labor force in China decreased from 6.15% in 2008 to 3.4% in 2020. The popularization of nine-year compulsory education has improved the level of cultural quality in rural areas, and more and more well-educated rural laborers have transformed into secondary and tertiary industries, which will promote agricultural development through industrial restructuring in the long run. For the existing agricultural labor force, we can popularize agricultural knowledge and promote agricultural modernization through propaganda in the countryside.

8.4. Scientifically Plan the Application of Chemical Fertilizers and Advocate the Development of Green Agriculture.

The invention of chemical fertilizer is a great change in agricultural history. Rational application of chemical fertilizer can increase soil fertility, provide crop nutrients, and also improve stress resistance and prevent diseases and insects. However, due to the large proportion of small-scale farmers in China, there is no fixed standard for the application of chemical fertilizer, which

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leads to the abuse of chemical fertilizer, serious damage to soil pH, and on the contrary, the reduction of crop production. Therefore, it is imperative to plan the application of chemical fertilizer reasonably. Rational planning of chemical fertilizer application can be carried out from three aspects: first, clear the amount of chemical fertilizer application. According to the soil pH in different areas and the organic demand of different crop varieties, chemical fertilizers are applied in a planned way to avoid the abuse and misuse of chemical fertilizers. Second, organic fertilizers and chemical fertilizers are combined.[9]. Compared with chemical fertilizer, organic fertilizer has beneficial active bacteria and more kinds of organic matter. Combining organic fertilizer with chemical fertilizer can not only improve the low content of soil organic matter, but also make up for the weakness of single nutrient of chemical fertilizer. The third is to develop farmland rotation intercropping. There are rhizobia that can fix nitrogen in the roots of leguminous crops. The development of soybean-grain intercropping and melon-bean rotation can increase soil nitrogen content, soil nutrients and crop yield.

8.5. Guarantee the Financial Expenditure on Agriculture and Give Full Play to the Supporting Role of Finance.

Agriculture is a weak industry with high natural risk and market risk.[10]Therefore, we need national policy support to effectively avoid risks and promote the development of agriculture, rural areas and farmers. The state's support policies for agriculture are as follows: first, strengthen the construction of agricultural infrastructure and reduce the operating costs of farmers; The second is to increase direct subsidies to agriculture, including grain subsidies and agricultural machinery purchase subsidies; The third is to raise the government's minimum purchase price of grain and protect farmers' rights and interests to the maximum extent. Fourth, reasonably regulate import and export, set up necessary trade barriers and protect China's agricultural products. At the same time, agricultural production should also give full play to the incentive effect of fiscal expenditure, actively apply for agricultural subsidies, and rationally regulate agricultural production.

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