Research on Agricultural Sustainable Development Capability:Taking Pengxi County as an Example

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Abstract: The sustainable development of agriculture is not only the basis for the sustainable development of the entire society, but also a prerequisite for economic sustainability. Carrying out the evaluation of sustainable agricultural development in Pengxi County, and putting forward corresponding countermeasures and suggestions based on the analysis results, has practical guiding significance for promoting Pengxi County to take the road of sustainable agricultural development. In this study, the sustainable agricultural development of Pengxi County is qualitatively described and quantitatively analyzed by the principal component analysis method in the SPSSS software from the four subsystems of social sustainable system, environmental sustainable system, resource sustainable system, and economic sustainable system. From the four aspects of society, environment, resources, and economy, respectively, put forward suggestions and countermeasures that are beneficial to the sustainable development of agriculture in Pengxi County.

1. Introduction

China has grown from a backward agricultural country to the world's second largest economy. Agricultural technology has continued to advance and farmers' living standards have improved significantly. However, my country's agricultural development is still weak, agricultural resource problems are already very serious, agricultural ecological environment is severe, agricultural environmental pollution, etc. The problem is becoming more and more prominent. The extensive development of agriculture should be gradually eliminated. For the healthy development of agriculture, taking the road of sustainable agricultural development is the only way.

The sustainable development of agriculture will involve economic, social, resource, environmental and other issues. It is not only necessary to issue a series of agricultural support policies such as relevant policies, laws and regulations, implement farmland protection, and effectively protect the interests of farmers [1]. Closely integrated. Comprehensive consideration of all parties to realize the modernization, scale and technology of our country's agriculture, build a development path and management method belonging to our country, and finally realize the sustainable development of our country's agriculture [2].

2. Analysis of the status quo of sustainable agriculture in Pengxi County

Pengxi County belongs to Suining City, Sichuan Province, and is located in the east of the central Sichuan Basin and the middle reaches of the Fujiang River. Pengxi County covers an area of 1251 square kilometers, has a registered population of 712,600 (at the end of 2015), and governs 31 towns, 495 administrative villages, and 30 communities (including 9 urban areas). On January 14, 2019, Pengxi County received the title of Advanced County (City, District) in Sichuan Province's "Three Rural" Work in 2018. From Table 1 below, we can see the economic development of Pengxi County in recent years:

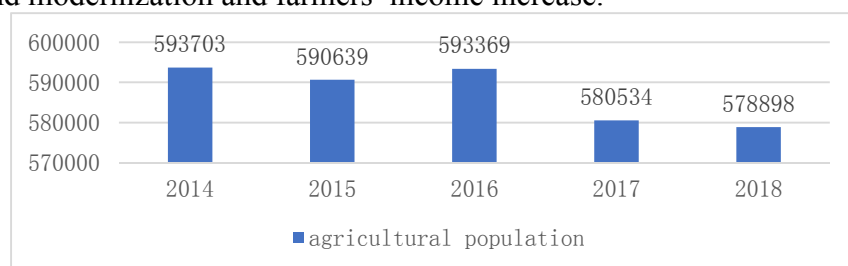**Table 1.** Agricultural population of Pengxi County (2014-2018)

Item	2014	2015	2016	2017	2018
Gross regional product (ten thousand yuan)	1065486	1197995	1325320	1475724	1607547
Total output value of forestry, animal husbandry and fishery	266759	292122	282680	291308	291308
Agricultural output value	517612	557829	526492	547917	571710
Gross agricultural production	305339	309716	263013	271717	282015

It can be seen from Table 1 that from 2014 to 2018, the regional GDP of Pengxi County has been on an upward trend, and its year-on-year growth rate fluctuated around 10-11%. Among them, the regional GDP in 2018 increased by 8.9% over 2017, and the regional GDP in 2017 increased by 11.3% over 2016. From the perspective of agricultural production value, from 2014 to 2015, this data has an upward trend, and then this data has declined in 2016, and it has started to rise again in 2016. From the perspective of the proportion of agricultural production value in the regional GDP, from 2014 to 2018, the proportions were 28.6%, 25.8%, 19.8%, 18.4%, and 17.5% respectively. This shows that agriculture occupies an important position in the economic development of Pengxi County, and this proportion has shown a declining trend from 2014 to 2018. From the perspective of the total output value of forestry, animal husbandry and fishery, it was relatively stable and slightly increased during the sample period. In contrast, the total agricultural output value has a greater upward trend, and its value in 2018 was 572,000 yuan, a year-on-year growth rate of 4.3%.

Table 2. Rural net income in Pengxi County (2014-2018)

Item	2014	2015	2016	2017	2018
Gross agricultural production	305339	309716	263013	271717	282015
Total grain output	339460	316988	318027	319392	320455
Total vegetable production	220067	219886	226372	229382	215100
Total meat production	54565	64661	66524	63616	60423
Total output of other cash crops	48506	46513	46507	47127	47716
Total sown area of crops (mu)	1369140	1401295	1382265	1394295	1277175

Judging from the crop situation in Pengxi County from 2014 to 2018, the overall crop development trend is good, and most crops are showing an upward trend. The total sown area of crops reached its highest peak in 2015 and then began to decline. In 2018, the total sown area was only 1,277,175 mu, a year-on-year decrease of 8.4%. This indicates that the development of urbanization may have led to farmers' cultivation of the land. Reduce, so that the planting area is reduced. Correspondingly, the decrease in the total sown area in 2018 also brought a decrease in the total grain output, a year-on-year decrease of 9.6%. Specifically, the total output of vegetables remained stable overall, at 215,100 in 2018, down 6.3% year-on-year, while the total output of meat fell 5.1% year-on-year. On the other hand, the total output of other cash crops is showing a clear upward trend, with a year-on-year growth rate of 1.2% in 2018. This shows that Pengxi County may have changed its focus on the selection of crop types. It is increasing the planting of economical crops on the basis of reducing traditional crops, which will affect its future agricultural transformation and modernization and farmers' income increase.

Figure 1. Agricultural population of Pengxi County (2014-2018)

As shown in Figure 1 above, the agricultural population of Pengxi County showed a trend of first decreasing, then increasing and then decreasing, and the decline was the largest from 2016 to 2017, with a year-on-year decrease of 2.2%. Since then, that is, in 2017 and 2018, the agricultural population of Pengxi County has stabilized at a relatively low level, and compared with 2017, the agricultural population of Pengxi County is still in a downward trend. There are only 578,898 people. This shows that with the development of the times, the number of people participating in agricultural production in Pengxi County is decreasing. This reflects the real needs of agricultural modernization and scale, and may also become a factual supporting evidence of agricultural aging and women'sization. In the future, the sharp decrease in the number of farmers will be an issue that local governments have to consider, and this will also serve as a driving force for the large-scale development of agriculture.
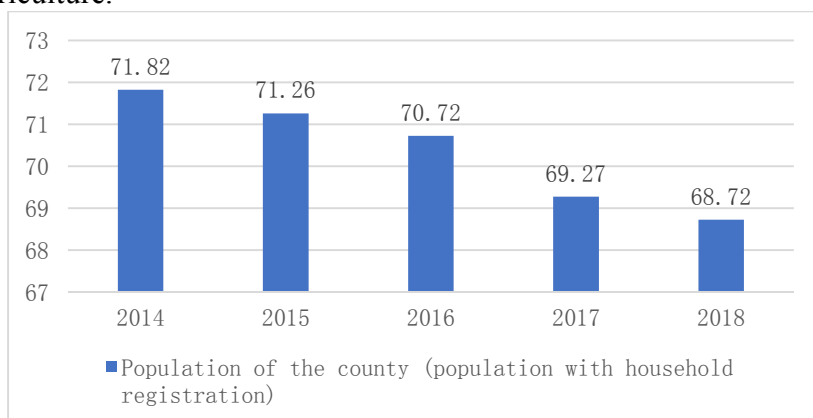

Figure 2. Rural net income in Pengxi County (2014-2018)

As can be seen from the above figure, rural net income in Pengxi County has a clear and relatively stable upward trend. In 2018, rural net income reached 12,298, a year-on-year increase of 13.5%. This shows that the income of farmers in Pengxi County has risen, that is, the benefits that the agricultural production sector can obtain are rising, which is also conducive to attracting more investment into agricultural and rural areas, thus contributing to the promotion of sustainable agricultural development in my country. power.

3. Construction of Evaluation Index System of Agricultural Sustainable Development in Pengxi County

3.1 Index System Design

Before the empirical analysis of the sustainable development of agriculture in Pengxi County in this article, it is necessary to construct a systematic and scientific indicator system, so as to lay the foundation for the principal component analysis in the following article. Therefore, in the process of constructing the indicator system, this article first analyzes the basic actual situation of agricultural development in Pengxi County in detail, and selects indicators that can completely and comprehensively reflect the sustainable development of agriculture in Pengxi County, and use this as an example. Based on the establishment of an indicator system. Specifically, the construction of the indicator system first needs to follow the principle of representativeness and comparability, because the availability of county-level data is lower than that of provincial-level data, and it needs to consider whether the indicators are quantifiable and whether the data can be linked to each other [3]. Second, we must follow the combination of dynamics and statics. Agricultural production is cyclical. As humans deepen the concept of sustainable development, we must select an indicator system that reflects dynamic development. In order to facilitate the comparison of data, it must be satisfied to a certain extent [4]. The relative stability of the index system. Finally, it is necessary to satisfy the comprehensiveness of indicators. This article selects corresponding representative indicators for all aspects of the sustainable development of agriculture in Pengxi County, and establishes connections through multi-level rich data to improve the availability and scientificity of

the indicator system. On the basis of the indicator system of agricultural sustainable development constructed by He Xiaohui, Ye Wenhu and Luan Shengji in the last part of the domestic literature review combined with the previous literature analysis, and then based on the principles to be followed in the construction of the indicator system, scientifically considering the actual situation of Pengxi County The indicators used in this article are determined under the premise, as shown in Table 3 below:

Table 3. Evaluation Index System of Agricultural Sustainable Development in Pengxi County

Classification	Index	Index Explanation
Economic category	Per capita disposable income	Residents can use for discretionary income
	Per capita gross output value of forestry, animal husbandry and fishery	Total output value of forestry, animal husbandry and fishery/agricultural population
	Per capita agricultural output value	Agricultural production value/agricultural population
	Per capita GDP (ten thousand yuan)	Per capita GDP/Agricultural population
	Per capita agricultural production	Agricultural production value/agricultural population
	Per capita food production	Total food production/agricultural population
	Per capita vegetable production	Total vegetable production/agricultural population
	Per capita meat production	Total meat production / agricultural population
	Per capita output of other cash crops	Total output of other cash crops/agricultural population
Resource	Per capita arable land area (mu/person)	Total arable land area/agricultural population
	Rural per capita electricity consumption (10,000 kWh/person)	Total electricity consumption/agricultural population
	Per Capita Agricultural Diesel Use	Agricultural Diesel Use/Agricultural Population
Environmental category	Fertilizer use intensity (ton/ha)	Fertilizer application/total sown area of crops
	Agricultural film usage level (tons)	Amount of agricultural film used/total sown area of crops
	Pesticide use intensity (ton/ha)	Amount of pesticide application/total sown area of crops
	Forest cover rate	Forest area/land area
Social category	Food expenditure of rural residents	
	Proportion of agricultural population	Agricultural population/total population of the county number
	Natural population growth rate	Natural population growth rate
	Fixed telephones owned by every 100 rural residents	Total number of telephones owned by rural residents per 100 households

Based on the above indicator system design, some indicators are explained and explained as follows:

(1)Economic category: 1) Agricultural production value: including the total output value of agriculture, forestry, animal husbandry and fishery and the total output value of agriculture, forestry, animal husbandry and fishery services, reflecting the scale and achievements of agricultural production in Pengxi County for a certain period of time. The larger this indicator is, The better the economic development. 2) The agricultural population refers to the total number of people who live in rural areas or whose household registration is rural, and maintain their living production through agricultural income derived from agricultural production.

(2)Resources: 1) The total area of cultivated land refers to the area of land that is often used for cultivation, including cultivated land, wasteland newly reclaimed that year, land abandoned for less than 3 years and fallow land, including planting crops, fruit trees, mulberry trees, and tea trees And so on. 2) The total amount of agricultural diesel used refers to the total amount of agricultural machinery diesel used in the whole process of agricultural production in Pengxi County, mainly including the diesel consumption of large, medium and small tractors and supporting agricultural machinery.

(3)Environmental category: 1) the total sown area of crops refers to the actual sown area or transplanted area of crops each year, including the area of crops cultivated on cultivated or non-cultivated land. The article refers to the total annual sown area of grain, vegetables and other cash crops in Pengxi County. 2) The amount of chemical fertilizers used refers to the actual amount of chemical fertilizers that can be used in agricultural production within a year, including nitrogen, phosphorus, potassium and compound fertilizers. The amount of agricultural film used refers to the total amount of agricultural plastic film used during the year. 3) Pesticide use: refers to the total use of pesticides throughout the year, including the total use of pesticides, fungicides and herbicides.

(4)Social category: 1) the natural population growth rate refers to the ratio of the natural population growth in a certain period to the average population in that period. It is usually calculated in years and expressed in thousandths. 2) The number of fixed telephones owned by every 100 rural residents reflects the closeness of agricultural population exchanges. The increase in the number of fixed telephones represents the improvement of agricultural technology management level to a certain extent, and thus represents the sustainable development of agriculture.

3.2 Evaluation Method-principal Component Analysis Method

The principal component analysis method is a good way to refine and streamline the analysis of multiple indicators. It can convert multiple indicators into a few indicators through dimensionality reduction, and this comprehensive indicator can contain the integrity of most of the original indicators. Information, from the use of this comprehensive indicator for analysis. After this processing, the overlapping information in the data can be eliminated, and the overall index analysis efficiency can be improved on the basis of reducing data loss. Specifically, this method performs comprehensive index conversion through dimensionality reduction and linear transformation, and then regards the selected comprehensive variables as principal components, arranges them in decreasing order of variance, and then weights the average with the principal component contribution rate. . At the same time, in the process of studying the evaluation system, the weights of the principal components can be used to express the proportion of the original information contained in each principal component [5, 6].

The principle of the model is as follows:

For specific research questions, establishing M indicators is the first step, and each evaluation observation object with m indicator values constitutes each sample value. N evaluation objects have n m-dimensional vectors, which form a data matrix X. Before positiveizing the sample data, first distinguish between positive and negative indicators. In this article, the negative indicators include: fertilizer use intensity, agricultural film use level, pesticide use intensity, and rural residents' food expenditure [7]. All indicators other than these are positive indicators. Then, based on the original sample matrix X, the standardized coefficient matrix is obtained according to the Z-Score method:

Then find the correlation coefficient matrix R, eigenvalues and eigenvectors, and select the number of principal components (the eigenvalue is greater than 1 or the cumulative contribution

rate is 85%), calculate the total score of each sample point, and finally perform Pengxi based on the score The final evaluation of the county's sustainable agricultural development.

4. Empirical Research on Agricultural Sustainable Development Evaluation in Pengxi County

4.1 Data Source and Processing

In this article, the sample period selected in this article is the annual data from 2014 to 2018. The specific data sources are as follows: First, the population data (the county's population, the agricultural population) comes from the public security annual report, and the agricultural data (such as The use of pesticides, fertilizers, agricultural film use levels, forest coverage, total arable land) are from the County Agriculture and Rural Bureau, and other data are from the Statistical Yearbook of the County Statistics Bureau.

Therefore, the specific indicators of this article are set as: per capita disposable income (X1), per capita gross output value of forestry, animal husbandry and fishery (X2), per capita gross agricultural output value (X3), per capita gross regional product (X4), per capita gross agricultural production value (X5), Per capita grain production (X6), per capita vegetable production (X7), per capita meat production (X8), per capita output of other cash crops (X9), per capita arable land area (X10), rural per capita electricity consumption (X11), per capita agricultural use Diesel consumption (X12), fertilizer use intensity (X13; negative index), agricultural film use level (X14; negative index), pesticide use intensity (X15; negative index), forest coverage (X16), food expenditure of rural residents (X17; negative indicators), the proportion of agricultural population (X18), the natural population growth rate (X19), and the fixed telephone number per 100 rural residents (X20).

Table 4. Principal component score and comprehensive score table

year	F1 score	rank	F2 score	rank	F3 score	rank	F4 score	rank	overall ratings	rank
2014	911.8	5	347.9166	5	980.42	5	-834.55	1	838.18	4
2015	987.41	4	451.5923	4	986.47	4	-942.37	2	858.72	3
2016	1096.8	3	497.1045	3	1099.74	3	-1045.2	3	1019.04	1
2017	1191.8	2	574.3073	2	1160.92	1	-1150.53	4	1019.04	1
2018	1297.5	1	786.9628	1	1102.54	2	-1340.35	5	1000.49	2

4.2 Analysis of Evaluation Results

The main component scores and comprehensive scores obtained according to the above calculation formula are shown in Table 11:From the comprehensive score table, the sustainable development of agriculture in Zhongpengxi County showed a clear upward trend from 2014 to 2018, and the comprehensive scores in 2016 and 2017 were tied for the first place, followed by 2018 and 2015. Third, fourth in 2014. Since the positive indicators in this article are the main type, the higher the comprehensive score, the better, and it also represents a better development trend. Therefore, the sustainable development of agriculture in Pengxi County is good under the current environment.

5. Countermeasures and Suggestions to Promote Sustainable Agricultural Development in Pengxi County

5.1 Agricultural Economy

In the development of the agricultural economy of Pengxi County, higher agricultural production value and higher crop yields are what we expect to see. Whether there is a substantial increase in the efficiency of agricultural production is to be reflected in economic indicators. Therefore, economic indicators will also become indicators to measure whether agricultural production has

progressed. In order to improve the performance of Pengxi County's agriculture in terms of economic indicators, the government can attach importance to the key aspects of sustainable agricultural development. The first is the early stage of sustainable agricultural development. The government can provide a large number of appropriate policies and institutional environments to raise funds for it. Corresponding funds, at the same time, the government can also actively guide the flow of funds to agricultural production and development departments. The government's call and policy orientation are an important driving force for the change of capital flows. The government can formulate agricultural-oriented fiscal and monetary policies, such as fiscal discounts for agricultural funds, tax cuts and fee reductions. Sufficient capital inflow is the prerequisite and guarantee for sustainable agricultural development. Only under this premise can agricultural production obtain a better development environment [8]. Secondly, all governments and agricultural departments should promptly adjust the agricultural industrial structure of Pengxi County and help Pengxi County's agricultural industrialization, scale and modern development. As the number of agricultural population in Pengxi County is decreasing year by year, this will be a necessary way for sustainable agricultural development, that is, more efficient use of a smaller population to obtain greater agricultural production efficiency, and mechanization is also an effective method. , Which will provide a solution to the reduction of agricultural population. The industrial structure of Pengxi County also needs key adjustment. From the data in recent years, it can be seen that the cultivation of cash crops in the crops of Pengxi County is increasing year by year. This can become a future development direction, that is, the development of cash crops Successfully planted to increase the income of farmers in Pengxi County, thereby promoting sustainable agricultural development in Pengxi County.

5.2 Agricultural Resources and Environment

From the resource situation of Pengxi County in recent years, it can be seen that although the fluctuation of resources is not large, the area of cultivated land has declined. As the basis of agricultural production, cultivated land maintains the normal operation of agricultural production. In terms of resources and environment, government departments, the Ministry of Agriculture and Rural Affairs, and agricultural production entities should all be aware of the positive effects of agricultural resources and the environment on their sustainable agricultural production. Therefore, we must actively use and protect resources, reduce environmental pollution and strengthen governance. For example, rational use of chemicals such as pesticides, fertilizers, and films that are harmful to the land and the environment can maintain the fertility of the soil and reduce the negative impact on the human living environment. Efforts should be made to improve the level of technology and promote farmers to achieve the same utility at a lower level of farming, thereby increasing the utilization rate. On the other hand, every part of the agricultural production process should strengthen the awareness of environmental protection and energy conservation [9]. The increased awareness will enable producers to curb waste of resources and environmental pollution from the source. Solving resource and environmental issues from the source will provide better conditions for the sustainable development of agriculture in Pengxi County in the future.

5.3 Social Aspects of Agriculture

With regard to the agricultural and social development of Pengxi County, the government should work hard to invest in the construction of agricultural infrastructure and ecological environment, so as to establish a better rural living environment, so as to attract more agricultural talents to take root in the agricultural and rural areas and contribute to Pengxi County's agriculture. Suggestions for sustainable development. On the other hand, the improvement of the rural environment will also weaken the motivation of agricultural population to migrate into cities and towns, give them the motivation to stay in the countryside, and ultimately provide more human capital and construction strength for the entire agricultural development of Pengxi County . Moreover, the government can continue to increase investment in science and technology to encourage agricultural innovation. Increased investment in science and technology can improve the efficiency of agricultural production and the utilization of resources, which can effectively alleviate farmers' complicated

operation pressure on agricultural production, and increase farmers' motivation and determination to carry out agricultural production [10]. Secondly, the improvement of the level of agricultural innovation can stimulate the vitality of agricultural production, promote the expansion of the entire agricultural scale, variety and scope of involvement, and lay the foundation for the entire agricultural development. Innovation can promote progress. The sustainable development of agriculture in Pengxi County must also be based on continuous innovation and progress in the entire agricultural field.

References

[1] D'Amato D, Droste N, Allen B, et al. Green, Circular, Bio economy: a comparative analysis ofsustainability concepts. Journal of Cleaner Production, 2017, 168.

[2] Donia E, Mineo A M, Mascali F, et al. Economic development and agriculture: Managing protected areas and safeguarding the environment. Ecological Engineering, 2017, 103:198-206.

[3] Finkbeiner, M., Schau, E. M., Lehmann, A., & Traverso, M. (2010). Towards life cyclesustainability assessment. Sustainability, 2(10), 3309-3322.

[4] Durand C, Fournier S, Coomes O T. Can Geographical Indications Modernize Indonesian andVietnamese Agriculture? Analyzing the Role of National and Local Governments and Producers' Strategies.World Development, 2017, 98:93-104.

[5] Mcgillivray M, White H. Measuring development? The LTNDP's human development index. Journal of International Development, 2010, 5(2):183-192.

[6] Mottese A F, Naccari C, Vadala R, et al. Traceability of Opuntiaficus-indica L. Miller by ICP-MS multi-element profile and chemometricapproach. Journal of the Science of Food&Agriculture, 2018, 98.

[7] Tasca A L, Nessi S, Rigamonti L. Environmental sustainability of agri-food supply chains: An LCA comparison between two alternative forms of production and distribution of endive innorthernItaly. Journal of Cleaner Production, 2016, 140:725-741.

[8] Rockström J, Williams J, Daily G, et al. Sustainable intensification of agriculture for human prosperity and global sustainability. Ambio, 2016, 46(1):1-14.

[9] Donia E, Mineo A M, Mascali F, et al. Economic development and agriculture: Managing protected areas and safeguarding the environment. Ecological Engineering, 2017, 103:198-206.

[10] Kaur G, Uisan K, Ong K L, et al. Recent Trends in Green and Sustainable Chemistry & Waste Valorisation: Rethinking Plastics in a circular economy. Current Opinion in Green & Sustainable Chemistry, 2018, 9:30-39.