Research Article
Evaluation on the "One Village One Product" Economic Development Benefit of Chengdu Shuangliu County Based on Entropy Weight TOPSIS Method

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Abstract: The rapid economic development of Shuangliu County is closely related to its implementation of "one village one product" method. In this study, the evaluation index system that can reflect the agricultural production capacity, social service level, ecological guarantee level, farmer income level and rural economic contribution is constructed with the index decomposition method according to the winter strawberry production base in Yong'an Town, Xinxing Town and Gongxing Town, as well as three standardized production demonstration districts of fine pears, including Dalin Town, Jitian Town and Shengli Town. Economic benefit assessment is conducted for the above four professional villages with the entropy weight TOPSIS method. Eventually, it is concluded that in the four "one village one product" professional villages in Shuangliu County, the economic benefit of Yong'an Town, Xinxing Town and Gongxing Town is relatively high. It is proposed that the reinforcement of planning guidance, perfection of supporting facilities, innovation of investment financing method and increase of capital investment are the policy suggestions for the effective economic development of professional village.

Keywords: Economic benefit, empirical analysis, entropy weight TOPSIS method, "one-village-one-product", suggestions

INTRODUCTION

"One village one product" is an effective mode of agricultural and rural economic development in the market economic conditions (Wu, 2008). At present, "one village one product" has already become the significant support promoting the local modernized agriculture development and new rural construction (Du, 2007). As the top 100 country in China, Shuangliu County develops the local advantageous products and industry and promotes the economic development in Shuangliu County by taking advantages of the local resource advantages, regional advantages, natural and humanitarian advantages. In 2013, the entire county accomplishes 74.6 billion of gross regional production and the comprehensive strength of the country economy has been ranking the first in the whole province for 18 consecutive years and in 2012, it ranked the 9th among the top 100 counties in China (Kong and Li, 2008). In recent years, Shuangliu Country has been implementing the "one village one product" special agricultural industry development policy and exploring the new mode of park construction, such as "huge garden, small owner", "modern farm + family farm", "new collective economic organization + family farm", etc. Meanwhile, combining the regional advantages in the rural income and agricultural product competitiveness, remarkable achievements have been obtained. In 2013, it drove the added value of agriculture by 3.43 billion Yuan, increasing by 3.1% and the rural per capita net income was as high as 13949 Yuan, increasing by 12.3%. With the insistence on the "six-in-one" direction, including the industrial scale, organizational collectivization, input intensification, production standardization, service socialization and product branding, it has already formed the winter strawberry production base dominated by Yong'an Town, Xinxing Town and Gongxing Town, as well as the three standardized production demonstration bases of fine pears in Dalin Town, Jitian Town and Shengli Town, which not only integrates the local agricultural product resources and improves the market competitiveness, but also further deepens the industrialization process and improves the production efficiency. In this study, the evaluation index system and calculation model is constructed with index decomposition method and entropy weight TOPSIS method, for the evaluation and analysis of the development achievements of 6 professional villages "one village one product" in Shuangliu County from 2011 to 2014, so as to provide decision basis for local government of Shuangliu County and Sichuan Province to make related policies and promote the development of "one village one product".

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MATERIALS AND METHODS

"One village one product" economic benefit evaluation index system: As for the economic development benefit and effect of a region, it mainly considers if the implementation of "one village one product" will be favorable for the production mode transformation, rural economic growth, rural economic structure adjustment and rural income. The development effect of the "one village one product" economic benefit is studied from 5 categories of evaluation indexes, including the comprehensive productivity, social service level, ecological guarantee level, rural income level and rural economic contribution (Qin, 2009).

Comprehensive productivity capacity index: The development of "one village one product" leading industry may improve the professional knowledge quality and kills of farmers, increase the land area utilization efficiency and promote the improvement of overall agricultural productivity. Indexes measuring the comprehensive productivity capacity include:

- **Production efficiency of leading industry:** It is mainly measured by the labor productivity of the leading industry and comprehensive land yield rate. The labor productivity of leading industry may reflect the skills of labor of employees and the management level of the production process. The land comprehensive utilization rate may reflect the intensification and application performance of the agricultural means of production.
- **Agricultural products manufacturing base construction level:** This index is measured by ratio of the area of production base in the professional village and the total cultivated area.
- **Rural industrialized operation level:** It mainly reflects the agricultural operation level and organizational management level of farmers engaged in the leading industry and it is mainly measured by the ratio of leading enterprises connecting to the professional village, ratio of the construction of agricultural product wholesale market in professional village and ratio of establishing the professional agricultural cooperation and economic professional village.

Social service level index: As for the measuring index of the social service level, the brand agricultural development level is selected. It reflects the ability of featured and influential brand products of satisfying the rural and urban consumers' consumption demand and guarantee of the satisfaction of farmer income demand and it is mainly measured by the ratio of professional villages with registered trademark and ratio of professional villages wining the brand products above provincial level.

Ecological guarantee level index: The ecological guarantee level index is measured by the agricultural product safety production level. "One village one product" gradually becomes a trend in the modern agricultural development. The ratio of professional village with nuisance free agricultural product, green agricultural product and organic food authentication and production base will reflect the application of pesticides, chemical fertilizer, etc. The higher the safety production level of agricultural products is, the lower the destruction to the ecological environment will be. Therefore, the agricultural product safety production level index is indirectly measured by the ratio of professional village with nuisance free agricultural product authentication and ratio of professional village with green agricultural product authentication.

Rural income level index: Farmers are the economic subjects of the "one village one product" development and the core purpose is to improve the income level of farmers. The rural income will be measured with the following indexes:

- Farmer income level of leading industry, it reflects the income status of farmers engaged in the leading industry and it is measured by the per capita net income of farmers in the leading industry and multiple of the per capita net income of farmers in the leading industry (proportion of per capita net income of farmers in the leading industry and the per capita net income of farmers within the region).
- Farmer income level of the professional village, it will reflect the average income level of farmers in the professional village. The income of farmers in the professional village will be from the leading industry or correlative industry driven by the leading industry. It is mainly measured by the per capita net income of farmers in the professional village and multiple of per capita net income of farmers in the professional village (proportion of per capita net income of farmers in the leading industry and the per capita net income of farmers within the region).

Rural economic contribution index: Each region implements the "one village one product" mode, which attracts and drives some villages joining the queue of "one village one product", enhancing the professional degree and promoting the rural economic income growth. The indexes measuring rural economic contribution of "one village one product" are divided into the following two:

- Radiation range, it reflects the popularization of professional village, drive of professional village construction degree, as well as the adsorption of labors in the leading industry. The index is mainly measured by the proportion of professional villages in total villages and proportion of employees in the leading industry in the total rural employees.
- Income contribution level, reflecting the contribution to the growth of regional economy and

contribution to the adjustment of agricultural economic structure. It is mainly measured by the share of total income of the leading industry in the total rural economic income, as well as the shares of the economic income of professional villages in the total rural economic income.

Performance evaluation of "one village one product" based on the entropy weight TOPSIS method: Based on the evaluation index of the "one village one product" development effect, the entropy weight method is applied to calculate the weight of each evaluation index and the evaluation index system of "one village one product" development consisted by 5 broad categories of index, 9 sub-categories of indexes and 18 single indexes is constructed.

Principle of entropy weight method: Entropy weight method is an objective empowerment method, which mainly determines the weight according to the information reflected by the variation of evaluation index. In the information theory, the information entropy is systematic unordered program or uncertain measurement. Information is the measurement of systematic and ordered degree, the absolute value of the two is equal, but of opposite sign. The reduction of information entropy means the increase of information. That is to say, the higher the index variation degree is, the more information the index will contain. The smaller the information entropy is, the larger the role of this index in the comprehensive evaluation will be and the larger the weight will be. On the contrary, the smaller the index variation is, the less the information contained in the index will be and the larger the information entropy will be. Consequently, the smaller the role of index in the comprehensive evaluation is, the smaller the weight will be. Consequently, in the specific evaluation analysis process, the index weigh can be calculated with the information entropy according to the variation degree of the index and then the indexes shall be weighted, for obtaining relatively objective comprehensive evaluation result.

As for an evaluation problem, suppose there are m evaluated objects and n evaluation index, the specific steps of determining the index weight with entropy weight method is shown as follows.

Firstly, the dimensionless method I applied for the evaluation ids.

Suppose the j index value of the *i* evaluated object is x_{ij} (i = 1, 2,…, m; j = 1, 2,…, n), the original data will form a matric with m ranks and n lines $A = \{x_{ij}\}_{m \times n}$, which is generally called the decision matrix. The i rank of decision matric A is the index vector of the i evaluated target, noted as $x_i = (x_{i1}, x_{i2}, \cdots, x_{in}), (i = 1, 2, \cdots, m)$.

Considering that different indexes of the evaluated object usually have distinct dimension and dimension units. In order to eliminate the non-common measure of index, the effect coefficient conversion technique is applied to conduct the dimensionless treatment for the evaluation index. The specific practices are.

As for the positive index (the larger the index is, the better it will be), suppose:

$$y_{ij} = (1 - \alpha) + \alpha \times (x_{ij} - x_{\min(j)}) / (x_{\max(j)} - x_{\min(j)}) \quad (1)$$

As for the inverse index (the smaller the index is, the better it will be), suppose:

$$y_{ij} = (1 - \alpha) + \alpha \times (x_{\max(j)} - x_{ij}) / (x_{\max(j)} - x_{\min(j)}) \quad (2)$$

In the equation: $x_{\max(j)} = \max\{x_{ij}\}$, $x_{\min(j)} = \min\{x_{ij}\}$; 0<α<1, generally, α = 0.9.

After the above conversion, y_{ij} is the non-dimensionalization of original data x_{ij}, which is compressed within the interval (1-α, 1) and meanwhile, after the above treatment, the evaluation index also realizes the syntropy, namely, no matter x_{ij} is positive or inverse index, the larger y_{ij} is the better. All y_{ij} form a standardized decision matrix B = $(y_{ij})_{m \times n}$, in which, the i rank is the index vector of the i evaluated object, noted as: $y_i = (y_{i1}, y_{i2}, \cdots, y_{in}), (i = 1, 2, \cdots, m)$.

Secondly, proportion conversion is conducted for the index with dimensionless method:

$$p_{ij} = y_{ij} / \sum_{i=1}^{m} y_{ij} (i = 1, 2, \cdots, m; j = 1, 2, \cdots, n)$$

Thirdly, the entropy of index shall be calculated: $e_j = -K \sum_{i=1}^{m} p_{ij} \ln p_{ij}$ (in which k = 1/1 nm; j = 1, 2,… n).

Fourthly, the index diversity factor shall be calculated: $h_i = 1 - e_j (j = 1, 2, \cdots, n)$.

As for the given j, if the smaller the otherness of y_{ij} is, the larger e_j will be; the smaller h_i is, the role of the j index in the comprehensive evaluation will be; if y_{ij} are equal, $e_j = e_{max} = 1$, $h_i = 0$, meaning that the j index is meaningless in the comprehensive evaluation. If the greater the otherness of y_{ij} is, the smaller the e_j will be, the larger h_j is, the role of the j index in comprehensive evaluation will be.

Fifthly, normalization processing is conducted for h_j, as the weight of each index:

$$W_i = h_i / \sum_{1}^{n} h_i \ (j = 1, 2, \cdots, n) \quad (3)$$

Calculation result of entropy weight method: The results are shown in Table 1.

TOPSIS principle: TOPSIS method, also called Technique for Order Preference by Similarity to Ideal

Solution, sometimes is shortened as ideal solution. The application of TOPSIS method in the comprehensive evaluation of the evaluated object index, mainly sorts out the index evaluation vector of the evaluated object and ideal solution and negative ideal solution of the comprehensive evaluation problem (Lin and Zheng, 2008). The so-called ideal solution is an ideal optimal solution and each index will reach the optimal value in the comprehensive evaluation problem and it is also called optimal solution. The so-called negative ideal solution is the worst solution of another conception and the index reaches the worst value in the comprehensive evaluation problem and it is also called the worst solution. Although the set of index evaluation vector of the evaluated object has no such optimal and worst solution, if the index evaluation vector is compared to the optimal and worst solution for observing the distance from the optimal solution or worst solution. If the index evaluation value of the evaluated object is close to the optimal solution and most distant from the

worst solution, it will be the optimal, or it is the worst. With this method, it can rank the evaluated object. Consequently, TOPSIS method can also be called the optimal and worst solution distance method.

The specific steps of evaluating the index of target with TOPSIS method are shown as follows.

Firstly, the weighted standard decision matrix formed by the standard decision matrix $B = (y_{ij})_{m \times n}$ and weight vector $W = (w_1, w_2, \cdots, w_n)$:

$$R = (r_{ij})m \times n = (w_j y_{ij})m \times n$$

Secondly, determine the ideal solution and negative ideal solution, for forming the ideal solution vector S^+ and negative ideal solution S^- respectively:

$$S^+ = \{r_j^+\} \ (j = 1, 2, \cdots, n) \tag{4}$$

$$S^- = \{r_j^-\} \ (j = 1, 2, \cdots, n) \tag{5}$$

Table 1: Calculation result of entropy weight method

Broad category	Significant index	Single index		
		Index	Single arrangement weight	Total arrangement weight
Comprehensive productivity capacity (0.2562)	Production efficiency of leading industry (0.2933)	Labor industry in leading industry	0.6462	0.0877
		Land comprehensive yield rate	0.4538	0.0351
	Agricultural product manufacturing base construction level (0.3645)	Proportion of agricultural product base	1	0.1053
	Industrialization of agriculture (0.3422)	Ratio of leading enterprises connecting to the professional village	0.4023	0.0234
		Ratio of professional village with wholesale market	0.2013	0.0058
		Ratio of professional village establishing the professional cooperation organization	0.4964	0.0585
Social service level (0.1762)	Brand agricultural development level (1.0000)	Ratio of professional village with registered trademark	0.4723	0.0468
		Ratio of professional village with brand products above provincial level	0.5277	0.0702
Ecological guarantee level (0.1003)	Agricultural product safety production level (1.0000)	Ratio of professional village with pollution-free product authentication	0.5206	0.0643
		Ratio of professional village with green agricultural product authentication	0.4794	0.0526
Farmer income level (0.3202)	Income of farmers in the leading industry (0.5623)	Per capita net income of farmers	0.6543	0.0936
		Multiple of per capita net income of farmers	0.4457	0.0117
	Income level of farmers in professional villages (0.4377)	Per capita net income of farmers in professional village	0.7635	0.0994
		Multiple of per capita net income of farmers in professional village	0.2365	0.0292
Rural economic contribution (0.2530)	Driving range (0.5004)	Proportion of professional village in the total villages	0.6428	0.0819
		Proportion of employees in professional village in the total rural employees	0.3572	0.0175
	Income contribution level (0.4996)	Share of income of the leading industry in the total income of professional village	0.4662	0.0409
		Proportion of economic income of professional village in total rural economic income	0.5338	0.0760

Table 2: Comprehensive economic benefit assessment of "one village one product" in Shuangliu county from 2011 to 2014

Town	2011	2012	2013	2014
Yong'an town	51.13	53.22	55.25	56.65
Xinxing town	50.13	52.05	54.66	56.22
Gongxing town	52.25	54.65	56.33	56.86
Dalin town	48.03	51.56	53.46	54.95
Jitian town	49.62	52.12	53.98	54.89
Shengli town	49.03	53.33	54.78	56.73

In which:

$$r_j^+ = \max(r_{1j}, r_{2j}, \cdots, r_{mj}) \ (j = 1, 2, \cdots, n)$$

$$r_j^- = \min(r_{1j}, r_{2j}, \cdots, r_{mj}) \ (j = 1, 2, \cdots, n) \ (j = 1, 2, \ldots, n)$$

Thirdly, Euclidean distance equation is adopted to calculate the distance from the evaluated object to the ideal solution vector S^+ d_i^+ and negative ideal solution S^- d_i^- respectively:

$$d_i^+ = \sqrt{\sum_{j=1}^{n} (r_{ij} - r_j^+)^2} \ (i = 1, 2, \cdots, m) \qquad (6)$$

$$d_i^- = \sqrt{\sum_{j=1}^{n} (r_{ij} - r_j^-)^2} \ (i = 1, 2, \cdots, m) \qquad (7)$$

Fourthly, the distance from the evaluation index vector to the ideal solution shall be calculated:

$$C_i = 100 \times d_i^- / (d_i^+ + d_i^-) \ (i = 1, 2, \cdots, m) \qquad (8)$$

As the comprehensive evaluation value of the evaluated object.

Fifthly, the evaluated objects shall be ranked comprehensively.

Rank the evaluated object according to the comprehensive evaluation value *C*, the larger C_i is, the better the comprehensive evaluation of the evaluated object will be, or the poorer the comprehensive evaluation of evaluated target will be.

Result and analysis of TOPSIS method: The initial data obtained from the "one village one product" development of six professional villages in Shuangliu County is applied and the evaluation result of the "one village one product" development from 2011 to 2014 is shown in Table 2.

The following conclusion can be drawn through the economic benefit analysis table of the "one village one product" development in Shuangliu County from 2011 to 2014:

- Generally, the winter strawberry production base in Yong'an Town, Xinxing Town and Gongxing Town, is higher than the three standardized production demonstration districts of fine pears, including Dalin Town, Jitian Town and Shengli Town, suggesting that the abundant agricultural resources, developed economy and convenient traffic receives good effect and higher level of "one village one product" development.

- The "one village one product" development of Shuangliu County was improved greatly from 2013 to 2014, which was remarkable in the winter strawberry production base in Yong'an Town, Xinxing Town and Gongxing Town, which is characterized by the abundant regional resource and excellent traffic, etc.

- The "one village one product" development of Shuangliu County is in stable adjustment state and the difference of development effect is being reduced gradually.

RESULTS AND DISCUSSION

Economic benefit assessment:

Macro-perspective of the industry: The "one village one product" development directly drives the modernization transformation of local agriculture and local agriculture can rely on the advantages of the "one village one product" strategy policy. Combining the practical condition of the local environment, optimal decisions applicable for the local agricultural development shall be made, so as to adjust measures to local conditions, maximize the local resource utilization, improve the production efficiency of local agricultural products and promote the development of local featured agriculture. The "one village one product" mode will promote the development of regional agriculture with the most distinct features and enhance a series of industrial linkage, including the local tourist trade and recreational agriculture, so as to form different featured agricultural clusters among different villages in Shuangliu County and realize the organic integration of agricultural ecological benefit, economic benefit and social benefit.

Brand effect: The "one village one product" development guidelines allow the construction of agricultural infrastructure with a purpose, which greatly promote the modernized agricultural development and transformation of agricultural growth mode in Shuangliu County and enhance the brand marketing plan of local featured agricultural professionalism, standardization and marketization, so as to form the unique brand effect, improve the local celebrity, enhance the local core competitiveness, help gain advantageous position in the fierce market competition and develop the depth and breadth of local market.

Government perspective: In the above two sample villages, the farmer household + cooperation + government mode is adopted for development, which

effectively realizes the linkage of the organizational cooperation, improves the adhesion degree of local farmers and cooperation, expands the organizational scale and forms complete system integrating the production, technology and training. It will be favorable for realizing the benefit sharing and risk sharing development mode.

Microcosmic individual perspective: The "one village one product" development mode promotes the improvement of local farmer quality and agricultural skills, increases the net income of farmers and improves the living standard remarkably. With the promotion of local featured agriculture and development of related industries, there will be more and more employment opportunities and it will solve the laid-off employees and land-lost farmers effectively, expand the income increase channels and shorten the income gap of urban and rural residents.

DEVELOPMENT COUNTERMEASURES AND RECOMMENDATIONS

The promotion of "one village one product" development must focus on the new rural construction, give full play to the resources, regional advantages, natural and humanistic advantages, insist on enriching villages with industries and science, develop the village with talents and drive the agricultural and farmer development by combining the features of all regions in Sichuan, according to the requirements of "production and development, well-off live, rural civilization, clean and tidy village and management democracy":

- Promote the quality of "product", enrich the connotation of "product", develop the product with evident local features and excellent product quality, dig the product connotation, implement the standardized production, improve the quality and efficiency of "product", strengthen the product brand construction and improve the product celebrity and reputation.
- Perfect the supporting facilities and cultivate the professional farmers. Strengthen the information construction of agricultural products, agricultural scientific service training construction, rural financial service construction, etc. Meanwhile, cooperate with leading enterprises, scientific research institutions, etc., promote the construction of rural grass-roots cadres, agricultural technicians, backbone farmer team and enhance the modernized agricultural business training for farmers.
- Innovate the financing mode, increase the fund input. At first, the government shall carefully implement the direct food subsidy, subsidies for growing superior grain cultivators, subsidies for agricultural implements, etc., on the other hand, the "one village one product" special fund subsidy

policy shall be established according to the development status, give full play to the leverage effect. It can help farmers with financing through establishing the government guarantee institution, fund cooperation society, etc., secondly, guide and encourage the flow of social fund, to absorb the foreign fund and civil fund into the "one village one product" construction. Finally, the financial institutions, including Agricultural Development Bank, rural credit cooperative, small-loan company, etc., shall constantly perfect the rural financial products, so as to meet the demand of modernized agricultural development and provide fund guarantee for the "one village one product" development.

- Enhance the government guiding function and give play to the subjective role of rural economy. The government shall enhance the responsibility consciousness, establish sound working mechanism and exert the organizing, coordinating and service function. During the process of developing "one village one product" economy, please consider the rural environment and cultural construction task, cultivate good natural and humanistic features and realize the village construction and "product construction". Organize the productive cooperation with farmers actively, support sound rural cooperatives, promote the co-construction of village enterprise, realize the benign linkage of village enterprises, orderly cooperation among farmers, as well as the efficient production and high-quality products, for creating good and harmonious environment for the 'one village one product' development.

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