Research on the Coupling Coordination between the Development of Rural Logistics Industry and Farmers' Living Standards under the Background of Rural Revitalization-Taking Ganzi Prefecture as an Example

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***Abstract*—In order to promote the coordinated development direction of the rural logistics industry and farmers' living standards, and fully implement the rural revitalization strategy in my country, taking Ganzi Prefecture as an example, an index system of rural logistics industry and farmers' living standards is constructed, and the coupling coordination degree model is used to analyze the influence relationship and coordinated development status between the two aspects. The research results show that from 2011 to 2020, the orderly degree of rural logistics industry and farmers' living standards in Ganzi Prefecture is increasing, and the coupling degree and coupling coordination degree indicate that Ganzi Prefecture has transitioned from an unbalanced recession area to a coupling coordination area, but still in the primary coupling coordination.**

***Index Terms*—Rural revitalization, rural logistics, coupling coordination, Ganzi prefecture**

I. Introduction

In the context of rural revitalization, the issue of "agriculture, rural areas and farmers" has become one of the most serious and urgent issues in my country. On the basis of fully tapping the development potential of the primary and secondary industries, the rural logistics industry as the tertiary industry not only It has become an important way for rural economic development and an important bridge to increase farmers' income and promote farmers' consumption. At present, Ganzi Prefecture is in the critical stage of consolidating the achievements of poverty alleviation and effectively connecting rural revitalization, and the ultimate goal of rural revitalization is to solve the problem of unbalanced development between urban and rural areas, improve the quality of life of rural residents, and achieve common prosperity. Therefore, for an underdeveloped area such as Ganzi Prefecture, it is necessary and urgent to study the coupling and coordinated development level of rural logistics industry and farmers' living standards, which is conducive to promoting the coordinated development of rural logistics industry and farmers' living standards, and it can also provide theoretical reference for the living standards of farmers in Ganzi Prefecture and the development of rural logistics industry.

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Since the release of the rural revitalization strategy, the development of rural areas has attracted the attention of many scholars, and there have been relatively rich achievements in the research on the relationship between farmers' income and rural logistics and the coordinated development between logistics and economy. Ting *et al*. [1] taking Hunan Province as an example, used the statistical data of farmers' income and rural logistics-related indicators from 1996 to 2008, combined with econometrics and system dynamics models, to explore the causal relationship between farmers' income and rural logistics; Rui *et al.* [2] used cointegration analysis and VAR model to preliminarily analyzed the relationship between rural logistics and rural residents' income and consumption, used impulse response function and variance decomposition to deeply explore the influence relationship between variables, and put forward feasible suggestions; For the purpose of increasing farmers' income, Wen *et al*. [3] based on the comprehensive evaluation index of new urbanization and rural logistics obtained by principal component analysis, combined with VAR model, cointegration theory, causality test and other analysis methods, In-depth analysis of the relationship between new urbanization, rural logistics and farmers' income and put forward suggestions. Taking the logistics industry and regional economy of Shandong Province as the research object, Guang *et al*. [4] used the coupling coordination degree model to analyze the logistics industry and regional economic development, and combined with the spatial autocorrelation model to analyze the spatial distribution characteristics of 17 prefecture-level cities in Shandong Province; Based on the perspective of rural logistics, Ling *et al.* [5] obtained the main problems and solutions of the coordination between the two in the emerging stage through the research on the coordination of regional economy and rural logistics; From the perspective of rural revitalization, Ying *et al.* [6] conducted an empirical study on the relationship between rural logistics and the coordinated development of rural economy by using the Gompertz model; Rao *et al.* [7] made an in-depth analysis of the interactive development effect and mechanism of regional economy and rural logistics; Jun *et al*. [8] and others focused on the underdeveloped area - Gansu Province, measured the degree of coupling and coordinated

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development of logistics and economy in Gansu Province, and put forward specific suggestions based on the calculation results.

To sum up, domestic scholars have rarely carried out research on the coupling and coordinated development of farmers' living standards and rural logistics industry. Therefore, this paper takes Ganzi Prefecture as an example to conduct empirical analysis and build an index system for rural logistics industry and farmers' living standards. And select the relevant statistical data of Ganzi Prefecture from 2011 to 2020, use the coupling coordination degree model to analyze the coordinated development status of the two aspects, and provide decision-making reference for relevant departments and similar regions.

II. Construction of the Indicator System

For farmers in the underdeveloped Ganzi Prefecture, the primary industry is the main source of income. The rural logistics industry is subordinate to the tertiary industry, serving the primary industry and an important bridge connecting the primary industry and the market. The living standards of farmers can reflect the development of local industries and determine the scale and potential of the rural logistics industry. Therefore, the development of rural logistics industry is closely related to the living standards of local farmers [9]. Coupling does not change the autonomy of the elements of each system, but it can break through the barriers between different systems and form a unified and benign new system. After coupling, farmers' living standards can achieve a sustainable and benign development cycle with the rural logistics industry. With a common goal and a series of operations, the efficient operation of the rural logistics industry can effectively reduce costs and gain, and the improvement of farmers' living standards can provide a guarantee for the development environment of the rural logistics industry. On the basis of referring to previous researches and considering the reality of rural logistics industry and farmers' living standards in Ganzi Prefecture, the indicators of rural logistics industry are selected as shown in Table I below, and farmers' living standards are expressed by farmers' disposable income and consumption expenditure. The initial data of all variables come from the Sichuan Statistical Yearbook (2011-2020) and the Ganzi Prefecture Statistical Yearbook (2011-2020), which ensures the authenticity and authority of the data.

TABLE I: Initial Data

Subsystem	Dimension	Index		Regulation
Farmer's living standard	Farmers' Income Expenditure	Per capita gross income of rural residents	Y1	Positive
		Per capita total expenditure of rural residents	Y2	Positive
Rural logistics	Logistics capacity	Number of logistics companies	X1	Positive
		Logistics employment	X2	Positive
		cargo volume	X3	Positive
		Added value of logistics industry	X4	Positive
		Preferential support	X5	Positive
	Logistics potential	Logistics fixed asset investment	X6	Positive
		Rural education level	X7	Positive
		Rural education level	X8	Positive
	Logistics potential	Rural education level	X9	Positive
		Electrification rate	X10	Positive
		Post Office	X11	Positive
		Truck ownership	X12	Positive

The rural logistics industry is a complex system, and its existing logistics capabilities can fully reflect the development scale and development status of rural logistics, it is expressed by the number of logistics enterprises, the number of logistics employees, the volume of goods and the added value of the logistics industry; the logistics potential reflects the future development trend and development potential of the rural logistics industry, expressed in terms of policy preferential support, logistics fixed asset investment, and rural education level; the logistics infrastructure is a necessary condition for the development of the rural logistics industry, and it is related to the efficiency of logistics operation, which is expressed by the number of highway mileage, rural delivery lines, electricity rate, postal business outlets and the number of trucks [10].

III. Coupling and Coordinated Development Model

The coupling coordination degree includes two important dimensions: coupling degree and coordination degree. Among them, the coupling degree is used to evaluate the magnitude of the influence of two or more elements or systems on each other, and the coordination degree indicates the strength of the benign coupling in the mutual influence, reflecting the mutual coordination state. Therefore, under the background of the policy dividend of rural revitalization, a coupling coordination degree model of rural logistics and farmers' income in Ganzi Prefecture is constructed. The calculation steps of coupling coordination degree are as follows:

A. Dimensionless Processing

In order to eliminate the deviation of the initial data due to the inconsistency of the dimensions, it is necessary to perform dimensionless processing on the initial data.

1) The extreme difference formula is as follows

$$X_i = \frac{X_i - X_{\min}}{X_{\max} - X_{\min}}, X_i = \frac{X_{\max} - X_i}{X_{\max} - X_{\min}}$$

2) Calculate weights

$$P_{ij} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} (i = 1,2,\cdots,m; j = 1,2,\cdots,n)$$

3) Comprehensive evaluation index

$$f(x) = \sum_{i=1}^{m} a_i x_i'; g(y) = \sum_{i=1}^{m} b_i y_i'$$

Among them, $f(x)$ and $g(y)$ represent the comprehensive benefit of each subsystem, and ai and bi represent the weight of each indicator in each system.

4) Coupling: $C = \frac{2\times\sqrt{f(x)\times g(y)}}{f(x)+g(y)}$

5) Coupling coordination degree

$$D = \sqrt{C\times T}, T = \alpha f(x) + \beta g(y)$$

Among them, T represents the comprehensive evaluation index of the level of coupling and coordinated development, and α and β are the weights of the subsystems, respectively.

IV. Empirical Analysis

Taking Ganzi Prefecture as an example, this paper explores the coupling and coordination degree between farmers' living standards and rural logistics industry, and provides reference for the solution of the "three rural" problems and rural revitalization in the underdeveloped area - Ganzi Prefecture.

A. Find the Weight Value

According to the formula, the indicator weight values of farmers' income expenditure and rural logistics industry are obtained, as shown in Table II:

TABLE II: Farmers' Income Expenditure and Rural Logistics Industry Indicator Weight Value

Subsystem	Farmer's living standard (0.1004)					
Index	Y1	Y2				
Weights	0.0491	0.0513				
Subsystem	Rural logistics industry (0.8996)					
Index	X1	X2	X3	X4	X5	X6
Weights	0.1525	0.0496	0.1160	0.0517	0.0611	0.0286
Index	X7	X8	X9	X10	X11	X12
Weights	0.0397	0.0524	0.1753	0.0420	0.0729	0.0579

It is not difficult to conclude from Table II that when measuring the dimension of farmers' living standards, farmers' consumption expenditure (5.13%) is slightly higher than farmers' disposable income (4.91%), which is also in line with the reality. From the perspective of the index weight of the rural logistics industry, the order is rural delivery lines (17.53%), the number of logistics enterprises (15.25%), the number of logistics employees (11.6%), postal business outlets (7.29%), and preferential support (6.11%) , truck ownership (5.79%), highway mileage (5.24%), added value of logistics industry (5.17%), cargo volume (4.96%), electricity connection rate (4.2%), rural education level (3.97%), logistics planning and construction investment (2.86%), The rural logistics industry in Ganzi Prefecture is relatively backward, so it should continue to focus on the improvement of logistics infrastructure, and at the same time, continue to develop new logistics potential on the basis of ensuring existing logistics capabilities.

B. Coupling

The coupling degree can fully reflect the degree of interaction between farmers' income expenditure and the rural logistics industry, that is, the dynamic relationship between the two, which is related, interdependent, and mutually promoting. The coupling degree values are shown in Table III below:

TABLE III: The Coupling Degree between Farmers' Income Expenditure and Rural Logistics Industry

Years	2011	2012	2013	2014	2015
Orderly degree of farmers' income and expenditure	0.00001	0.0129	0.0239	0.0338	0.0455
Orderly degree of rural Logistics industry	0.0296	0.0960	0.1037	0.2060	0.3342
Coupling C	0.0368	0.6466	0.7807	0.6962	0.6493
Years	2016	2017	2018	2019	2020
Orderly degree of farmers' income and expenditure Orderly degree of rural	0.0559	0.0672	0.0777	0.0928	0.1004
Logistics industry	0.4207	0.4311	0.5079	0.5941	0.6433
Coupling C	0.6437	0.6831	0.6785	0.6838	0.6835

It can be seen from Table III that from 2011 to 2020, the order degree values of the rural logistics industry and farmers' living standards in Ganzi Prefecture showed an increasing trend, and the order degree values of the rural logistics industry were all lower than the order degree values of farmers' living standards. The side reflects that the rural logistics industry in Ganzi Prefecture is in its infancy. According to the existing research [11], the results of the coupling degree stage division are shown in Table IV. It is not difficult to see that Ganzi Prefecture was in the coupling separation stage in 2011, that is, there was no coupling trend, and it was in the coupling running-in stage from 2012 to 2020, that is, the rural logistics industry and farmers' income expenditures have formed a preliminary coupling trend, and is in the process of continuous adaptation and adjustment.

TABLE IV: Coupling Stage Division

Interval value	0.000-0.299	0.300-0.499	0.500-0.799	0.800-1.000
Years	2011		2012-2020	
Type	Separation stage	Counterbalance stage	Gradual cooperation stage	Coupling stage

C. Coupling Coordination Degree

The coupling coordination degree can reflect the coordinated development of farmers' income expenditure and rural logistics industry, and promote the healthy development of farmers' income expenditure and rural logistics industry, and has high-efficiency development quality. The calculated coordination index T and coupling coordination degree D are shown in Table V below:

TABLE V: Coordination Index T and Coupling Coordination Degree D

Years	2011	2012	2013	2014	2015
Coordination index T	0.0266	0.0877	0.0957	0.1887	0.3052
Coupling coordination degree D	0.0313	0.2381	0.2734	0.3625	0.4451
Years	2016	2017	2018	2019	2020
Coordination index T	0.3841	0.3945	0.4647	0.5438	0.5888
Coupling coordination degree D	0.4972	0.5191	0.5615	0.6098	0.6344

The coordinated development status of farmers' income expenditure and rural logistics industry in Ganzi Prefecture

can be obtained according to the classification and division of order value, coupling degree, coordination index and predecessor coupling coordination type [12]. The classification and division of coupling coordination types are shown in Table VI. From Table VI, it is not difficult to conclude that the coordinated development level of farmers' income expenditure and rural logistics industry in Ganzi Prefecture was unacceptable from 2011 to 2014, and entered the transition zone after 2015, by 2019, it will reach the coupling coordination area, but it is still in the primary coupling coordination.

TABLE VI: CLASSIFICATION OF COUPLING COORDINATION DEGREE TYPES

Grade	Interval value	Type	Years
Dissonance Decline (Unacceptable)	0.000-0.099	Extreme dissonance recession	2011
	0.100-0.199	Severe dissonance recession	—
	0.200-0.299	moderate Dissonance decline	2012-2013
	0.300-0.399	Mild dysregulation decline	2014
Transition period (reluctantly accepted)	0.400-0.499	On the verge of a dysfunctional recession	2015-2016
	0.500-0.599	Barely coupled coordination	2017-2018
Coupling coordination area (acceptable)	0.600-0.699	Primary Coupling Coordination	2019-2020
	0.700-0.799	Intermediate Coupling Coordination	—
	0.800-0.899	Good coupling coordination	—
	0.900-1.000	Quality coordination	—

V. CONCLUSION

Based on the construction of the index system of rural logistics and farmers' living standards, this study established a coupled and coordinated development model of rural logistics and farmers' living standards in Ganzi Prefecture. From the calculation results, in the ten years from 2011 to 2020, the degree of coupling and coordination between the rural logistics industry and the living standards of farmers in Ganzi Prefecture has been continuously improved, and the coordinated development status has also tended to be good, but the gradients have large differences and are in the primary coordination stage. For the development of rural logistics, the government should increase the construction of logistics infrastructure, especially the widely trusted postal logistics, and introduce preferential policies to attract more logistics enterprises to cooperate, gradually cultivate a team of logistics talents, and improve local rural logistics. In the era of e-commerce, it can promote the realization of local characteristic industries, not only increase farmers' income, but also promote farmers' consumption expenditures, and finally realize the sustainable and coordinated development of rural logistics industry and farmers' living standards.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHOR CONTRIBUTIONS

Mr. Wang Cheng completed literature review, model building, data collection, data analysis and other work. Ms. Wu Shanshan completed the establishment of the index system, data analysis, conclusions and suggestions. Both approved the final version; all authors had approved the final version.

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