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Spatial–Temporal Evolution Characteristics of Agricultural Economic Resilience: Evidence from Jiangxi Province, China

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Abstract: To promote the resilient and coordinated development of regional economies, in this study, to construct an index system, we used the entropy weight method to measure the agricultural economic resilience of 11 prefecture-level cities in Jiangxi province, China during 2011–2020, and we analyzed the characteristics of their spatial-temporal pattern evolution. We used the Theil index method to analyze the main sources of their spatial differences. The results showed that: First, the mean value of agricultural economic resilience of prefecture-level cities in Jiangxi trended upward during 2011–2020. Among the prefecture-level cities, Ganzhou had the highest mean agricultural economic resilience value, while Yingtan had the lowest. From the perspective of regional division, the agricultural economy in southern Jiangxi was the most resilient, whereas that in northeast Jiangxi was the least. Second, since 2011, the overall difference in agricultural economic resilience in the four regions of Jiangxi has trended downward, with the inter-regional difference being the main source of the overall difference. Based on this, we provide the following policy implications: first, to continuously enhance the intrinsic dynamics of the agricultural economic resilience and strengthen policy support in Jiangxi; second, to coordinate the development of regional agricultural economic resilience and achieve overall improvement.

Keywords: agricultural economic resilience; spatial–temporal evolution; Theil index method

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1. Introduction

The agricultural economy is an important part of the development of any national economy, and the health of its development is directly related to the development of the economy and society and the long-term stability of society. Maintaining the stable and sustainable development of the agricultural economy is a practical step in promoting agricultural modernization in China. At present, China is facing supply shocks such as tightening resource and environmental constraints, weak appreciation of agricultural economic benefits, and declining demographic dividend, so agricultural resilience must be created to ensure food security and sustainable social development [1]. In response to various risks and challenges, we must focus on a national strategy, ensure the stability of the basic agricultural framework, speed up the strategic adjustment of the agricultural structure, and work positively and collaboratively with agriculture, rural areas, and farmers. The UN's 2021 data reported in World Economic Situation and Prospects show that among the world's top three economies in 2020, the U.S. and Japanese economies contracted by 3.5% and 5.3%, respectively, due to the COVID-19 pandemic, whereas China achieved a GDP growth of 2.3%, indicating the resilience of the Chinese economy. In addition, China's economy has shifted from a stage of high-speed growth to one of high-quality development. Improving the resilience of the agricultural economy is an important element in guaranteeing the healthy development of the agricultural economy and promoting the modernization of agriculture. The increase in the resilience of the agricultural economy will not only help to enhance the endogenous forces driving agricultural growth to facilitate the shift from a large agricultural country to a strong agricultural country, but also contribute to the continuous and stable growth of China's economy so as to promote the development of China's agricultural economy to a new level.

The No. 1 Document of the CPC Central Committee in 2021 emphasizes the importance of addressing issues related to agriculture, rural areas, and farmers. Of the difficult challenges produced by COVID-19, food security has increasingly become one of the most important issues. Enhancing the ability of the agricultural economy to cope with risks is crucial to the realization of the overall national security, agricultural modernization, and rural revitalization strategies. Increasing the resilience of the agricultural economy means improving the ability to respond to and recover from agricultural crises. Therefore, we must scientifically understand the types of rural regional systems and their differences [2] and systematically explore the characteristics of the spatial–temporal evolution of agricultural economic resilience to determine the regional agricultural development status, provide guidance for agricultural transformation and upgrading, and promote sustainable and balanced agricultural development.

As one of the major agricultural centers in China, Jiangxi province has an important development strategy to achieve the high-quality and sustainable development of agriculture. To accurately and systematically analyze the resilience of agricultural economy in Jiangxi, increase the resistance and recovery ability of agricultural economy in the face of uncertainties and challenges, and promote the coordinated development of agricultural economy in various regions, we need to pay close attention to the following issues: (1) the state and trend of agricultural economic resilience in Jiangxi in recent years and which regions have strong and weak agricultural economic resilience; (2) whether spatial differences exist in agricultural economic resilience in Jiangxi and the main sources of such differences. Based on the above considerations, in this study, we systematically measured the resilience of agricultural economy in Jiangxi over a ten-year time span, comprehensively analyzed its differences in time and space, and determined the development status of the agricultural economy in different regions in Jiangxi. Our findings provide theoretical guidance and have practical value for the sustainable and high-quality development of China's rural economy under the impact of internal and external risks.

The remainder of this paper is structured as follows: In Section 2, we review the literature. Then, we describe the research methods, data sources, and the construction of the index system in Section 3. Section 4 provides our empirical results, a summary of the study, and our related policy implications.

2. Literature Review

The concept of resilience originates from physics. Later, the concept was introduced into the ecosystem field by Holling in 1973 to analyze the ability of an ecosystem to maintain its state or return to its original state after natural and anthropogenic shocks. Given ongoing economic globalization, the concept of resilience has been gradually introduced into the scope of economics to consider the impact of sudden public health events and economic cycle fluctuations on the economy [3,4]. Scholars from around the world have gradually formed an analytical framework and systems for studying economic resilience, mainly to define and develop the concept of economic resilience, to measure and determine spatial differences in economic resilience, to determine the importance of and to evaluate economic resilience, and to determine the factors influencing economic resilience. Martin [5] considered economic resilience as the ability of economies to recover and mediate the effects of shocks, that is, the ability to recover quickly and withstand a shock. Wink. [6] with the help of relevant regional economic theories, stated that resilience is a kind of coping and adaptation ability in the face of risks. Most scholars have discussed economic resilience from the perspectives of equilibrium and evolution. First, from the perspective of equilibrium, Hassink and Edward. [7,8] stated that regional economic resilience is a kind of ability to restore the economy to the equilibrium state after a crisis. From the perspective of evolution, Tan et al. [9] reported that economic resilience refers to the ability of a region to rebuild its economic structure after a crisis. Its essence is to constantly adapt to the impact of complex external changes and quickly restore its own sustainable economic development structure. Cellini et al. [10] divided regional economic resilience into two parts: an exogenous region, representing resilience and maintenance; and an endogenous region, considering evolution and application analysis. In conclusion, with the in-depth study of economic resilience, its concept and connotation have become clearer and more explicit, which has also laid a theoretical foundation for subsequent research.

The literature on economic resilience measurement methods mainly falls into two categories: The first is the index system method, in which all relevant indicators are selected to construct an index system, to enable the assessment of economic resilience [11]. According to Zhang et al. [12]. economic resilience refers to the ability of the economic system to cope with external risks, adapt to the postrisk environment, and improve the economic growth mode within a certain region. Therefore, they divided economic resilience into resistance and reconstruction capacity to construct economic resilience indicators. Sun and Yuan. [13] measured the level of economic resilience through three dimensions of the pressure, state, and response (PSR) model. The second is the core variable method, in which the economic indicators that are vulnerable to the impact of the risk, and thus widely fluctuate, are selected [14,15]. According to the key variables that are subject to the largest fluctuation as a result of economic shocks, the indicators of changes in GDP and employment rate are selected to measure economic resilience. Martin. [16] constructed a regional evaluation model to empirically measure the responses of economic agents facing shocks based on several dimensions. Li and Sun et al. [17,18] linked the regional economy and ecosystem, and from the perspective of nature, society, and ecosystem, and found that agricultural economic resilience should be measured from multiple dimensions, such as the natural environment, agricultural economy, and agricultural production.

Studies have also been conducted on the factors influencing economic resilience. First, regional economic resilience has been the main object of analysis. Crespo et al., Huggins et al., PROKKOLA and Liu et al. [19–22] argued that internal production characteristics play a key role in regional economic resilience, such as social capital, innovation capacity, industrial structure, and total factor productivity. Zhao et al., Cui et al., Li et al and SIMMIE. [23–26] emphasized that external production environment factors such as policy support, economic agglomeration, financial support, and urban–rural integration strongly promote regional economic resilience. Second, the analyses have mainly been based on industrial resilience. Lu et al. and Hu et al. [27,28] found that the industrial structure is the key variable in the creation of industry resilience. Li et al. [29] emphasized that improving business innovation ability is an effective method for the service industry to withstand shocks and improve its self-recovery ability. Yu et al. [30] analyzed the spatial–temporal pattern of and factors influencing China's agricultural development resilience at the provincial scale based on a spatial econometric model. With the deepening of the research on economic resilience, the resilience of the agricultural economy has gradually attracted the attention of scholars. Jiang [31] analyzed the resilience of China's agricultural economy and the correlation between the national spatial structure by using social network analysis. Hao et al. [1] found that industrial integration in rural areas can promote agricultural resilience by promoting rural economic growth and accelerating human capital accumulation.

Through this literature review, we found that the current research on economic resilience in China is still relatively simple, and studies on agricultural resilience have mostly emphasized the production or ecological level. A macro perspective and grasp of the overall agricultural economic resilience are lacking. The system of evaluating the corresponding indicators needs to be optimized in terms of rationality and operability. Agriculture is an important industrial sector in the national economy, and Jiangxi province is a major agricultural region in China. The resilience of its agricultural economy is crucial to the high-quality and sustainable development of agriculture in the future. Based on this understanding, we performed an exploratory analysis of the characteristics of the temporal and spatial evolution of agricultural economic resilience in Jiangxi. The contributions of our study are three-fold: (1) We quantitatively measured agricultural economic resilience in Jiangxi. We scientifically constructed a comprehensive index system for evaluating the agricultural economic resilience of Jiangxi from two perspectives: the ability (resistance) of the agricultural economic system to maintain its current level when a disturbance occurs, and the ability of the economic system to fully use and optimize its own resources to achieve a new stage of economic growth after the disturbance (reconstruction power). (2) We introduced the Theil index to measure the differences in agricultural economic resilience in the provincial regions, proving that this method is also applicable to a more microregional scope. (3) We focused on the intercity differences in agricultural economic resilience in Jiangxi, and clarified the mechanism of this spatial evolution according to the similarity and difference in the index level distribution, thereby providing a reference for the coordinated development of regional agricultural economic resilience.

3. Study Content

3.1. Overview of Study Area

Located on the southern bank of the middle and lower reaches of the Yangtze River, Jiangxi province produces a large proportion of the total agricultural products in China, having a large proportion of the population engaged in agriculture and a large rural area. The terrain and landform of Jiangxi can be summarized as sixty percent mountains, ten percent water, twenty percent fields, and ten percent roads and housing. However, the north is relatively flat; southern and northeastern Jiangxi are surrounded by mountains, and the middle of Jiangxi is hilly. Known as the land of plenty since ancient times, Jiangxi has rich agricultural resources and serves as an important agricultural product supply base in the Yangtze River and Pearl River Deltas, with the scale of the production of grain and other agricultural products being large every year. The climate of Jiangxi is also pleasant, with four distinct seasons, sufficient sunshine, abundant rainfall, and a long frost-free period. This subtropical warm climate is suitable for the development of various forms of agriculture. In this study, we divided Jiangxi into central, northeastern, northern, and southern parts, with Pingxiang, Ji'an, Yichun, Fuzhou, and Xinyu in central Jiangxi; Jingdezhen, Shangrao, and Yingtan in northeastern Jiangxi; Jiujiang; and Nanchang in northern Jiangxi; and Ganzhou in southern Jiangxi.

3.2. Methods and Data Sources

3.2.1. Entropy Evaluation Method

To avoid the randomness of subjective weights and ensure the double availability of the indicators, we used the entropy method to determine the index weights. The concept of entropy originated from physics. Entropy is used to judge the dispersion degree of indicators and determine the corresponding weight by its entropy value, enabling the measurement of the uncertainty degree of events. In this method, the lower the information entropy, the larger the weight of the index, the higher the importance, and the larger the proportion in the whole index system. The specific steps are as follows: First, to eliminate the influence of dimension and the positive and negative directions of variables on the results, the data need to be dimensionless. In this study, we applied deviation standardization to convert the original data index system into a dimensionless index. Supposing there are m prefecture-level cities and n evaluation indexes, then X_{ij} is the value of the jth index of the ith prefecture-level city (i = 1,2..., m; j = 1,2..., n). The treatment method of the positive index is shown in Equation (1), and the treatment method of the negative index is shown in Equation (2):

$$Z_{ij} = \frac{X_{ij} - X_{ijmin}}{X_{ijmax} - X_{ijmin}} \quad (1)$$

$$Z_{ij} = \frac{X_{ijmax} - X_{ij}}{X_{ijmax} - X_{ijmin}} \quad (2)$$

where X_{ij} is the original value of the jth index of the ith prefecture-level city; X_{ijmax} and X_{ijmin} are the maximum and minimum values of indicators, respectively; Z_{ij} is the dimensionless value of the index.

Second, we used Equation (3) to calculate the proportion P_{ij} of each index in each city. On this basis, we calculated the information entropy of each index, as shown in Equation (4), and the calculation formula of coefficient K is shown in Equation (5):

$$P_{ij} = Z_{ij} / \sum_{i=1}^{n} Z_{ij} \quad (3)$$

$$E_j = -k \sum_{i=1}^{n} P_{ij} \ln P_{ij} \quad (4)$$

$$k = 1/\ln m \quad (5)$$

where Z_{ij} is the dimensionless value of the jth index of the ith prefecture-level city; P_{ij} is the proportion of the Z_{ij} index; m represents the number of research objects; E_j is the information entropy value of index j; and k is the dimensionless coefficient.

Finally, we used Equation (6) to calculate the entropy redundancy $D_{j,}$ and then obtain the weight W_j. Through the product of the dimensionless processing result value of each index and the weight, we calculated the comprehensive score, and we obtained the economic resilience level R_k, as follows:

$$D_j = 1 - E_j \quad (6)$$

$$W_j = D_j / \sum_{j=1}^{h} D_j \quad (7)$$

$$R_k = \sum Z_{ij} W_j \quad (8)$$

where E_j is the information entropy value of index j; D_j is the entropy redundancy of index j; W_j is the weight of index j; Z_{ij} is the dimensionless value of the jth index of the ith prefecture-level city; and R_k is the resilience level of agricultural economy of each index.

3.2.2. Theil Index

The Theil index was used by Dutch economist Theil to study income inequality according to the concept of entropy in information theory. As an index measuring income inequality, it is decomposable and can calculate the intra- and intergroup gaps according to different sample groups to quantify the contribution degree of the intra- and intergroup gaps to the overall gap. With the help of the Theil index, we analyzed the differences in agricultural economic resilience among and within Jiangxi province as a whole and four major regions of Jiangxi province (southern, northern, middle, and northeastern Jiangxi). The Theil index of agricultural economic resilience is expressed as

$$T_t = \sum_{i=1}^{n} \frac{p_i}{p_t} \frac{x_i}{\bar{x}_t} \ln \frac{x_i}{\bar{x}_t} \quad (9)$$

$$T_{wt} = \sum_{j=1}^{m} \frac{t}{p_t} \left(\sum_{i \in z} \frac{p_i}{p_{jt}} \frac{x_i}{\bar{x}_{jt}} \ln \frac{x_i}{\bar{x}_{jt}} \right) \quad (10)$$

$$T_t = T_{wt} + T_{bt} \quad (11)$$

where i represents the prefecture-level city, j represents the region, t represents the year, P represents the total rural population, x represents agricultural economic resilience, and

$\overline{x}$ represents average agricultural economic resilience. T_t, T_{wt}, and T_{bt} represent the regional, intraregional, and inter-regional Theil index in year t, respectively.

3.2.3. Data Sources

We selected 11 prefecture-level cities in Jiangxi province as the study objects. We comprehensively measured the resilience level of the agricultural economy, and we analyzed the internal spatial differences and influencing factors. We obtained the data we used mainly from the Jiangxi Statistical Yearbook and statistical yearbooks and statistical bulletins of various cities in Jiangxi province.

3.3. Construction of Index System

By combing the relevant literature as a reference [32–36], we considered agricultural economic resilience as the ability of the agricultural economic system to self-defend, adjust, recover, and improve its adaptive capacity when external disturbances occur, which is mainly manifested as the resistance to and the reconstruction force after risk shock. Resistance refers to the ability of an agricultural economy to maintain its current level in the face of disturbances; reconstruction capacity means that the economic system is still able to achieve a new stage of economic growth by integrating its own resources and fully using optimization. The more reasonable the reconstruction capacity structure after the disturbance's impact, the more conducive it is to its sustainable development.

In this study, we investigated resistance from three perspectives: economic base, social factors, and production conditions. (1) We considered the economic basis mainly from three aspects: the development level of the regional agricultural economy, production cost, and quality and benefits. Therefore, we selected the total output value of agriculture, forestry, animal husbandry, and fishery; the intermediate consumption of agriculture, forestry, animal husbandry, and fisheries; and rural per capita disposable income as the economic base measurement indices. (2) We mainly considered the production factors in terms of labor, land, and capital. Therefore, we selected the number of people employed in primary industry, fixed asset investment in the primary industry, and the sown area of crops as three indicators. (3) Production conditions can create a conducive agricultural production situation in the region and a strong ability to resist the impact of disturbances. Therefore, we selected four indicators for measurement: agricultural fertilizer application amount, pesticide consumption amount, total power of agricultural machinery, and agricultural electricity consumption.

From the concept of reconfiguration force, we focused more on the endogenous dynamics and technological reserves of the economic system to achieve sustainable development, so we examined reconfiguration force from two perspectives: economic growth and technological progress. Investment and consumption play an important role in agricultural economic growth, so we selected the two indicators of per capita consumption of rural residents and fiscal expenditure on agriculture, forestry, and water. Agricultural technology progress mainly depends on the support of the government and enterprises in the agricultural field. Because most agricultural science and technology research depends on special government finance, we selected the expenditure on science and technology for measurement. The specific indicators are shown in Table 1.

Table 1. Index system of rating agricultural economic resilience.

Level 1 Indicator	Level 2 Indicator	Level 3 Indicator	Indicator Properties	Indicator Weights
Resistance	Economic Foundation	Gross output value of agriculture, forestry, animal husbandry, and fishery (million RMB)	Positive	0.1281
		Intermediate consumption of agriculture, forestry, animal husbandry, and fishery (million RMB)	negative	0.0267
		Rural per capita disposable income (RMB)	Positive	0.035
	Production factors	Number of employed people in primary industry (million people)	Positive	0.0822
		Investment in fixed assets of primary industry (million RMB)	Positive	0.0538
		Crop sown area (ha)	Positive	0.0878
	Production condition	Fertilizer application rate (ton)	Positive	0.0881
		Pesticide use (ton)	Positive	0.1099
		Rural electricity consumption (kWh)	Positive	0.0608
		Total power of agricultural machinery (kW)	Positive	0.0875
Reconstruction capacity	Economic Growth	Rural per capita living expenditure (FM)	Positive	0.0566
		Expenditure on agriculture, forestry and water resources (ten thousand RM)	Positive	0.0709
	Technological advances	Expenditure on science and technology (million RMB)	Positive	0.1127

4. Analysis of Spatial Difference in Agricultural Economic Resilience in Jiangxi

4.1. Overall Analysis

In this study, we constructed an agricultural economic resilience index system, and we used the entropy method to comprehensively calculate the agricultural economic resilience of 11 prefecture-level cities in Jiangxi Province from 2011 to 2020. The results are shown in Table 2.

Table 2. Comprehensive calculation results of agricultural economic resilience in Jiangxi province from 2011 to 2020.

Prefecture-Level City	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Average
Fuzhou	0.368	0.366	0.365	0.347	0.359	0.384	0.380	0.390	0.397	0.405	0.376
Ganzhou	0.455	0.476	0.446	0.471	0.500	0.512	0.655	0.512	0.508	0.546	0.508
Ji’an	0.395	0.416	0.402	0.422	0.441	0.444	0.455	0.433	0.416	0.447	0.427
Jingdezhen	0.075	0.085	0.076	0.095	0.116	0.114	0.138	0.138	0.155	0.160	0.115
Jiujiang	0.304	0.324	0.308	0.327	0.338	0.345	0.362	0.371	0.357	0.360	0.340
Nanchang	0.303	0.311	0.325	0.294	0.307	0.314	0.356	0.389	0.418	0.462	0.348
Pingxiang	0.096	0.103	0.102	0.125	0.145	0.144	0.147	0.153	0.164	0.181	0.136
Shangrao	0.439	0.453	0.415	0.434	0.461	0.471	0.488	0.501	0.510	0.493	0.466
Xinyu	0.091	0.114	0.119	0.122	0.143	0.132	0.147	0.166	0.171	0.197	0.140
Yichun	0.431	0.448	0.417	0.437	0.471	0.480	0.505	0.526	0.511	0.526	0.475
Yingtan	0.059	0.075	0.076	0.099	0.109	0.115	0.129	0.143	0.167	0.171	0.114
Average value	0.274	0.288	0.277	0.288	0.308	0.314	0.342	0.338	0.343	0.359	0.283

According to the comprehensive calculation results of agricultural economic resilience of Jiangxi (Table 2) and the mean change trend in the agricultural economic resilience in the province from 2011 to 2020 (Figure 1), we found that the average value of the resilience of agricultural economy of all prefecture-level cities in Jiangxi province has trended notably upward, which indicated that the resilience of the agricultural economy in Jiangxi has continuously strengthened. Jiangxi, as a major agricultural province, has stabilized its agricultural foundation, accelerated agricultural supply side structural reform, and fully implemented the rural revitalization strategy. Additionally, outstanding agricultural human resources have been developed. By vigorously supported the development of agricultural science and technology, the process of agricultural modernization has been accelerated, and the high-quality development of agriculture has been promoted. These measures, which benefit farmers, have substantially improved the resilience of the agricultural economy, promoted the development of agriculture in Jiangxi, and strengthened the ability of the agricultural system to resist external disturbances and natural disasters.

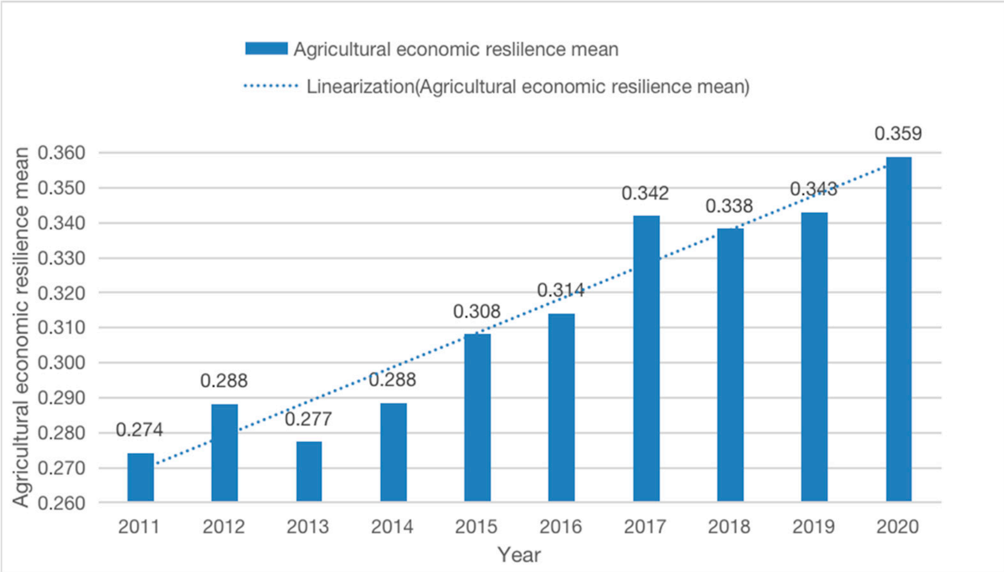

Figure 1. Trend in mean value of agricultural economic resilience in Jiangxi from 2011 to 2020.

Specifically, from the average value of agricultural economic resilience of prefecture-level cities from 2011 to 2020, we found that the agricultural economic resilience of Ganzhou, Yichun, and Shangrao was relatively high, at 0.508, 0.475, and 0.466, respectively. Ganzhou, Yichun, and Shangrao are all major agricultural cities in the province, where the advantages of focusing on agricultural science and technology innovation and actively exploring new agricultural management systems have gradually emerged in the process of agricultural development. Their agricultural modernization was notably ahead of that of other prefecture-level cities. Recent years have witnesses efforts to shift from cities with traditional agriculture to a areas demonstrating modern agriculture by optimizing the agricultural supply structure, creating a characteristic brand, forming their own agricultural industry systems, and deeply implementing food crop production strategies based on farmland management and the application of technology. Ganzhou is typically hilly and mountainous, with a large rural population and a large proportion of agriculture in the economy. The total population engaged in agriculture accounts for 67.4% of the total population. With rich agricultural industry resources, Ganzhou is a famous navel orange producing area in China and known as the World Orange Township. Yichun relies on enlarging and strengthening its grain industry, highlighting new advantages in grain production, steadily promoting agricultural development, and increasing grain production and farmer income. As an agricultural area, Shangrao has unique ecological agricultural resources and continuously optimizes its agricultural structure. It integrates high-quality agriculture, leisure tourism, and popular science education, and has built a modern science and technology agricultural demonstration park with thorough integration of primary, secondary, and tertiary industries. Compared with other cities, Ganzhou, Yichun, and Shangrao have a relatively perfect land transfer mechanism and transfer markets. Farmers can increase their diversified income through land transfer; enterprises conduct intensive operation and scientific management, which improves the use of land resources and production efficiency, which is conducive to agricultural modernization and industrialization, and promotes the increase in economic resilience in this region to a certain extent.

The resilience of the agricultural economy in Jingdezhen and Yingtan was relatively low, at only 0.115 and 0.114, respectively. Jingdezhen and Yingtan are small, having limited space for agricultural development, so their agricultural production scale is small due to limited areas suitable for cultivation. Additionally, the level of economic development is relatively lagging and the level of agricultural technology is low in these regions. The resilience of Xinyu's agricultural economy was only 0.140, because it has mainly developed industry rather than agriculture.

To more directly reflect the spatial differences in agricultural economic resilience in Jiangxi, we divided the agricultural economic resilience of prefecture-level cities in 2010 and 2020 into high, moderate, and low resilience according to the measure of agricultural economic resilience.

Table 3 shows that in 2011, the prefecture-level cities with highly resilient agricultural economies only included Ganzhou, Yichun, and Shangrao, which all have a strong agricultural foundation, unique geographical conditions, and advantages in terms of agricultural specialties; thus, their agricultural economies were relatively resilient. In 2020, the number of prefecture-level cities with highly resilient agricultural economies in Jiangxi substantially increased from the original three to six, including Fuzhou, Ganzhou, Ji'an, Nanchang, Shangrao, and Yichun. The result showed the effects of the work on and by agriculture, rural areas, and farmers over the ten-year period, which has improved the agricultural economy and enhanced its ability to deal with disturbances.

Table 3. Types of resilience level of agricultural economy.

Agricultural Economic Resilience Level	2011	2020
High (resistance value > 0.400)	Ganzhou, Yichun, Shangrao	Fuzhou, Ganzhou, Ji'an, Nanchang, Shangrao, Yichun
Moderate (0.200 < resistance value ≤ 0.400)	Fuzhou, Ji'an, Jiujiang, Nanchang	Jiujiang
Low (resistance value ≤ 0.200)	Jingdezhen, Pingxiang, Yingtan, Xinyu	Jingdezhen, Pingxiang, Yingtan, Xinyu

In 2011, the areas with moderate economic resilience were mainly distributed in central and northern Jiangxi. These prefecture-level cities, though having strong abilities to cope with disturbances, still faces some shortcomings in agriculture, such as outdated infrastructures such as agricultural water conservancy, weak agricultural production technology, and low investment in science and technology, which also affected the resilience of the agricultural economy. In 2020, only Jiujiang had a moderate level of resilience, while Fuzhou, Ji'an, and Nanchang all showed substantial increases in their resilience. The possible reason for this is that from 2011 to 2020, China comprehensively promoted rural revitalization, constantly deepened rural reform, vigorously promoted the innovation and development of agricultural science and technology, and improved the risk-resistance capacity.

Prefecture-level cities with low resilience were mainly distributed in northeastern Jiangxi, with problems mainly including the small agricultural scale and the low self-sufficiency rate of agricultural products, which restricted the resilience of the agricultural economy to a certain extent. The number of prefecture-level cities with low resilience in 2020 was the same as that in 2011. Although still at a low resilience level after ten years, they experienced notable increase in resilience compared with previously.

4.2. Regional Analysis of Spatial Difference in Agricultural Economic Resilience in Jiangxi

In this study, we divided Jiangxi province into central, northeastern, northern, and southern regions to further analyze the spatial differences in the agricultural economic resilience in the province. According to the mean value of agricultural economic resilience of each region in different years in Table 2, we drew a graph of the trend of the change in agricultural economic resilience of Jiangxi province and the four major regions (Figure 2).

According to Figure 2, the resilience of the agricultural economy in southern Jiangxi was far ahead that of other regions in the same period, and far above the average level of agriculture in Jiangxi. The mountainous area in southern Jiangxi is dominated by red soil, and the climate is a typical subtropical moist monsoon climate with a mild temperature, abundant rainfall, a large temperature gap between day and night, and a long frost-free period, which provides superior climate and soil conditions for the growth of southern Jiangxi navel orange. Southern Jiangxi is the largest navel-orange-producing area in China, with the annual output reaching one million tons. Based on its of climate and ecological resources advantages, and coupled with a location adjacent to the Guangdong–Hong Kong–Macao Greater Bay Area, southern Jiangxi is set to become into a strong agricultural region. With the continuous increase in agricultural industrialization, the agricultural infrastructure is also constantly improving, and the agricultural production structure is being optimized, all of which positively impact the strengthening of agricultural economic resilience. In addition, with the steady progress of the construction of digital countrysides, the primary goal southern Jiangxi region is the digital transformation of traditional industries in its national digital countryside pilot, adopting the government-led, market-based operation mode to build the an Internet service center for the fruit and vegetable industry, and achieve the interconnection of the agricultural Internet of Things, production management, quality control, monitoring and warning, traceability and tracking, and other regulatory data. The building of smart orchards and smart gardens by combining digital economy with industrial development will provide new internal impetus for increasing the resilience of the agricultural economy.

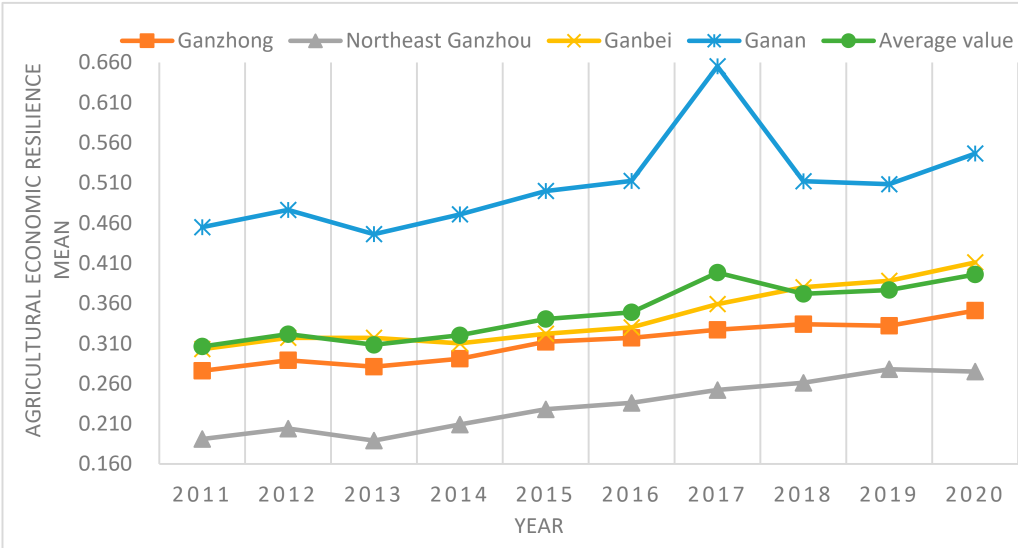

Figure 2. Trend of changes in mean value of agricultural economic resilience in four regions of Jiangxi province from 2011 to 2020.

The resilience of the agricultural economy in northern Jiangxi basically coincides with the average level of agriculture in the province. In general, the economic situation in northern Jiangxi is still the strongest, but agriculture shows room for improvement. In recent years, the resilience of the agricultural economy in northern Jiangxi has substantially strengthened, exceeding the average level of agriculture in Jiangxi. Among these northern regions, Nanchang applies a strategy of focusing on quality to improve agriculture, constantly deepening the reform of the agricultural supply side; vigorously promoting the high-quality development of fruits and vegetables, flowers, and seedlings, and traditional Chinese medicinal herbs; accelerating the development of modern agriculture; expanding the influence of agricultural products; and achieving the high-quality development of agriculture. Jiujiang actively moved with these trends by continuing to deepen agricultural and rural reform and accelerating the agricultural modernization from aspects including farmland infrastructure, agricultural structure adjustment, agricultural science and technology promotion and application, and the cultivation of high-quality agricultural products brands, thus achieving steady agricultural production growth. The resilience of the agricultural economy in northeastern Jiangxi was remarkably lower than that in other regions, mainly because the overall economic development in northeastern Jiangxi is relatively low, and the development of agricultural science and technology is insufficient. In addition, the mountainous area in northeastern Jiangxi is not conducive to large-scale farming, and the per capita arable land area is small. All of these restrict the development of the agricultural economy to a certain extent, and they hinder the improvement in agricultural economic resilience.

4.3. Spatial Difference Decomposition of Agricultural Economic Resilience in Jiangxi Province

To further understand the spatial differences in agricultural economic resilience among the different regions in Jiangxi, determine whether the differences were caused by inter- or intraregional disparities, and measure the contribution of the two, we calculated the Theil index of the four regions in the province, and analyzed the overall, intergroup, and intragroup differences, as well as their respective contribution rates (Table 4). Because Ganzhou is the only city in southern Jiangxi, its Theil index was zero, so the city is not listed in the table.

Table 4. Theil index of agricultural economic resilience and its decomposition.

Year	Northern Ganzhou		Northeastern Ganzhou		Central Ganzhou		Within Region		Inter-Regional		Territorial Thiel Index
	Thiel Index	Contribution Rate	Thiel Index	Contribution Rate	Thiel Index	Contribution Rate	Thiel Index	Contribution Rate	Thiel Index	Contribution Rate	
2011	0.0001	0.001%	0.2839	16.11%	0.1776	16.80%	0.1582	32.91%	0.3225	67.09%	0.4807
2012	0.0009	0.013%	0.2616	15.50%	0.1684	16.63%	0.1481	32.17%	0.3121	67.83%	0.4602
2013	0.0011	0.016%	0.2569	16.22%	0.1588	16.71%	0.1425	32.98%	0.2895	67.02%	0.4320
2014	0.0024	0.037%	0.2241	14.42%	0.1535	16.47%	0.1313	30.99%	0.2925	69.01%	0.4238
2015	0.0021	0.034%	0.2089	14.02%	0.1442	16.14%	0.1229	30.26%	0.2833	69.74%	0.4062
2016	0.0020	0.031%	0.2094	13.83%	0.1493	16.44%	0.1253	30.35%	0.2876	69.65%	0.4129
2017	0.0003	0.004%	0.1887	11.34%	0.1482	14.84%	0.1189	26.19%	0.3351	73.81%	0.4540
2018	0.0008	0.014%	0.1846	13.97%	0.1403	17.69%	0.1143	31.70%	0.2462	68.30%	0.3605
2019	0.0024	0.046%	0.1633	13.53%	0.1294	17.87%	0.1038	31.53%	0.2254	68.47%	0.3292
2020	0.0015	0.031%	0.1571	13.52%	0.1079	15.47%	0.0922	29.08%	0.2247	70.92%	0.3169

Table 4 shows that the Theil index of agricultural economic resilience in Jiangxi, as well as that within and between regions, trended downward from 2011 to 2020, which indicated that although regional differences in agricultural economic resilience were notable in Jiangxi, the differences among them also showed a trend of the decreasing year by year. Additionally, the contribution rate of inter-regional differences to the total regional differences was 67.09% in 2011, and first increasing in the following decade, although the overall trend of the contribution rate declined. Therefore, the regional differences were the main reason for the overall differences in agricultural economic resilience in Jiangxi.

Comparing the Theil indices of Jiangxi province, we found that the main source of the differences in the agricultural economic resilience in the province was regional differences, whose contribution rate reached about 70% from 2011 to 2020. This finding highlighted an agricultural economic resilience gap among the different regions. The other finding was that the contribution rate of intra-regional difference to the overall difference was approximately 30%. Among these regions, judging from the regional economic resilience value over the study period, the difference in the agricultural resilience of northern Jiangxi was small, indicating the region had achieved the unity of agricultural economic resilience growth and collaborative development. The Theil index in central and northeastern Jiangxi trended downward. From the Theil index value, we found that the gap in agricultural economic resilience in northeastern Jiangxi was still large, but the index decreased more in northeast Jiangxi than in central Jiangxi, which showed that cooperative agricultural development in northeastern Jiangxi in the last decade of the study period had achieved certain results. Although the Theil index in central Jiangxi was smaller than that in northeastern Jiangxi, the decline was smaller than that in northeastern Jiangxi, and its contribution rate to the overall difference was maintained at approximately 16.5%, which indicated that the gap in internal agricultural development in central Jiangxi cannot be ignored, and coordinated development needs to be further strengthened. Coordinated development provides important support for integrated regional development and is the key to solving the problem of unbalanced and inadequate development. To promote the coordinated development of the agricultural economy in central Jiangxi, agricultural construction must be strengthened; infrastructure such as irrigation and water conservancy must be constructed, and the agricultural development structure must be optimized according to local conditions.

5. Conclusions and Discussion

5.1. Conclusions

In this study, we selected the data of 11 prefecture-level cities in Jiangxi province from 2011 to 2020 as our object, established an index system of evaluating agricultural economic resilience, and used the entropy method to measure the agricultural economic resilience of each region in the period. We then systematically analyzed the spatial differences. We decomposed the main sources of these spatial differences using the Theil index method. We reached the following conclusions: (1) From 2011 to 2020, the average agricultural economic resilience of prefecture-level cities in Jiangxi province trended upward. The average value of agricultural economic resilience of Ganzhou was the highest, at 0.508; the average economic resilience of Yingtan and Jingdezhen was lower, at only 0.114 and 0.115, respectively. Of the regions, the agricultural economic resilience of southern Jiangxi province was the highest, being much higher than the average agricultural economic resilience of the province, thereby raising the overall agricultural economic level of the province. The resilience of the agricultural economy in northeast Jiangxi was low and the level of agricultural economy was notably lower than that in other areas. (2) Since 2011, the overall difference in the agricultural economic resilience in the four regions of Jiangxi province has trended downward year by year, both in terms of the overall agricultural economic resilience difference and the inter- and intraregional differences in this resilience. From the results of Theil index, we found that the inter-regional differences were the main sources of the differences among the four regions in Jiangxi province.

5.2. Policy Implications

To further improve the resilience of the agricultural economy of Jiangxi, narrow the spatial differences among the various regions, form a synergistic development situation in which each region promotes each other and they progress together, and promote the stable and healthy sustainable development of the agricultural economy of Jiangxi, according to our conclusions, we propose the following policy recommendations: (1) Continuously enhance the internal forces driving Jiangxi's agricultural economy resilience and strengthen policy support. First, according to the high-quality development requirements of Jiangxi, the construction of agricultural economic resilience systems should be strengthened from the policy level, and the standardization design of agricultural resistance and reconfiguration should be highlighted. Second, the government should focus on increasing the scale of financial investment in agricultural infrastructure and the proportion of investment in agricultural research funds to improve its comprehensive agricultural production capacity. Third, we should attach more importance to the transfer of agricultural land, increase financial subsidies, encourage farmers to participate in the transfer of agricultural land through incentives and subsidies, and further actively establish and improve the market-oriented platforms of the transfer of agricultural land, to provide convenience, transparency, and standardization of information acquisition for farmers who are interested in the transfer of agricultural land. We should try to introduce third-party evaluation institutions to standardize the price of agricultural land. Finally, given the differences in regional bases, local advantages should be considered, one domain and one strategy should be adopted to narrow the gap in the levels among various dimensions, agricultural digital empowerment should be strengthened, and the agricultural industrial chain should be extended to promote agricultural transformation and upgrading and high-quality development. (2) The resilience and development of regional agricultural economy should be coordinated to achieve overall improvement. From the perspective of coordinated interregional development, regions with high levels of economic resilience should strengthen the coordination of urban and rural development, and they should increase the feedback and support by industry of agriculture and by cities of rural areas. Regions with low levels of economic resilience should actively promote agricultural industrialization and large-scale construction according to local conditions, and they should strengthen the cultivation of leading agricultural enterprises guided by those with high output, high quality, and high added value; From the perspective of coordinated development within the region, we must pay attention to the integrated correlation effect within the region. The concept of regional development should be transformed from planning for one region to planning for the overall situation, fully benefitting from advantages of Ganzhou, Yichun, and Shangrao in economy, production, scientific research and other aspects. The cooperation and exchanges among prefecture-level cities should be strengthened, and efforts to support the infrastructure construction in areas with a weak agricultural foundation should be increased to speed up the flow of resources between different regions, enable the mutually exchange of resources, complement each other's advantages, enhance the correlation degree of agricultural economy between regions, and realize common development.

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