Pacific International Journal, Vol. 8(3); 2025
ISSN (Print) 2663-8991, ISSN (Online) 2616-4825[1]
DOI:10.55014/pij.v8i3.819
https://rclss.com/index.php/pij

Research on the Configurational Effects of Agricultural Economic Resilience Formation from the Perspective of New-Quality Productivity — A Comparative Analysis Based on Multiple Cases in Inner Mongoliaitle

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Abstract: Agricultural economic resilience faces challenges under the impacts of multiple dimensions such as resource constraints and international trade barriers. As a key driving force for agricultural modernization, the role of new quality productive forces in enhancing resilience urgently needs to be explored. This paper constructs a two-dimensional system of new quality productive forces featuring "substantial elements - penetrative elements", and uses the fsQCA to conduct a configurational analysis of the data of cities in Inner Mongolia from 2010 to 2022. The research findings are as follows: (1) A single new quality productive element does not constitute a necessary condition for generating high agricultural economic resilience; (2) Achieving high agricultural economic resilience requires the linkage and matching of multi-dimensional elements, and the "synergistic type of substantial elements" and the "science and technology leading type" constitute the conditional configurations for empowering high agricultural economic resilience; (3) The lack of new infrastructure and intelligence is a common cause of non-high agricultural economic resilience. The research reveals the collaborative empowerment mechanism of new quality productive forces, providing a theoretical basis and practical path for optimizing the agricultural industrial structure and strengthening regional resilience.
Keywords: Agricultural Economic Resilience , New Quality Productive Forces , fsQCA

Introduction

Agriculture, as a fundamental and strategic industry of a country, is the cornerstone of building a strong nation and a key area in international competition. Under the reshaping of the global economic pattern and the driving force of domestic consumption upgrading, high-quality agricultural development has become the core path to break through the constraints of resources and the environment. The improvement of total factor productivity[1], green finance[2], and digital economy significantly drive the high-quality development of agriculture. Ecological high-value agriculture provides insights for the upgrading of agricultural systems[3], while the misallocation of factors forms a key constraint[4-5].

Although China's agriculture has shown resilience in growth, it is facing systemic challenges. The allocation of germplasm resources is caught in a dilemma between “the ecological risks caused by large-scale homogenization” and “ the diseconomies of scale resulting from fragmented diversification. ” The specificity of production inputs has exacerbated the structural contradictions between specialized agricultural machinery and multi-variety cultivation. The decision-making on the application of chemical fertilizers and pesticides is subject to dual externalities of quality threshold control and irreversible environmental impacts. Moreover, the asymmetry of market price information has led to multiple constraints that form a “resonance of risks,” thereby weakening the risk resistance capacity of agriculture.

The new productive forces provide a new path for the optimization of factor allocation and can promote high-quality agricultural development through the diffusion of technological innovation, recombination of factors, and organizational change. However, existing research has limitations: it focuses on a single dimension and ignores the synergy of factors; it lacks an analysis of the configurational effects of “technology–institution–organization” innovation; and it fails to identify the core conditions and pathways for enhancing resilience, which affects the construction of systematic solutions.

This study is based on the theory of new productive forces and focuses on the main line of “technology innovation-driven — factor allocation reconstruction — system resilience enhancement,” addressing the three key issues of new laborers, new production tools, and new infrastructure. By revealing the dynamic reconstruction of factor allocation under the synergy of digital technology and institutional innovation, this study constructs a theoretical framework for the adaptive evolution of agricultural production systems and clarifies the core mechanism of new productive forces empowering economic resilience, thus providing a systematic solution for the upgrading of the agricultural industry structure.

Literature Review

The new productive forces are advanced productive forces generated by technological breakthroughs, innovation of production factors, and industrial transformation[6]. New quality productive forces signify revolutionary technological breakthroughs, innovative optimization of production factors, green transformation of development modes, in-depth

[Received 05 April 2025; Accepted 06 June 2025; Published (online) 20, June, 2025]

industrial upgrading, and a significant increase in total factor productivity[7]. Existing research has focused on the relationship between new-quality productive forces and high-quality agricultural development[8], agricultural modernization[9], food security[10], and agricultural economic resilience[11]. However, there are relatively few studies on the impact of new quality productive forces on agricultural economic resilience. Zhao (2025) found that new quality productive forces enhance agricultural economic resilience by promoting diversified agricultural planting[12]. Wu(2025) discovered that new quality productive forces improve agricultural economic resilience by facilitating agricultural industrial structure upgrading and accelerating land transfer[13]. This paper draws on the research of Han(2024) and analyzes the impact mechanism of new-quality productive forces on agricultural economic resilience from the two dimensions of substantive factors and permeating factors[14].

The enhancement of agricultural economic resilience driven by new factors exhibits multidimensional characteristics of co-evolution among technology, talent, and institutions. In terms of cultivating new laborers, talent structural contradictions can be resolved through the transformation of digital skills and innovation in organizational models, thereby increasing the retention rate of agricultural technicians at the county level[15]. The application of new production tools involves replacing human labor with intelligent agricultural machinery[16], enhancing value chain trust through blockchain traceability technology[17], and optimizing resource allocation efficiency via social platforms[18], thus establishing a technical support system characterized by "efficiency leap, value added, and risk dispersion". Regarding new infrastructure, digital infrastructure enhances information transparency and risk resistance[19], while financial infrastructure, through digital restructuring, optimizes capital allocation efficiency[20] and reduces losses from natural disasters[21]. New laborers provide human capital support for the application of technology, new production tools amplify the effectiveness of infrastructure through scenario-based innovation, and new infrastructure offers systematic support for talent cultivation and tool promotion. The coupling of these three dimensions promotes the enhancement of agricultural economic resilience.

In the dimension of intelligence, intelligent technologies can reduce the impact of natural risks[22], enhance the risk resistance of the industrial chain[23], and compensate for the labor gap of the elderly population[24]. In the dimension of data-driven technologies, dynamic optimization of resource allocation[25], digital inclusive finance to lower credit barriers[26], and block chain-based credit rating to strengthen risk prevention along the industrial chain have established a triple resilience system of "governance - finance - industry"[27]. The green transformation relies on the promotion of circular technologies[28], the enhancement of ecological compensation mechanisms , and the dispersion of natural risk losses through the integration of agriculture and tourism to shape the resilience of the agricultural economy.

Through a review of the literature, it has been found that most existing studies have used the entropy method to construct evaluation indicators for new quality productive forces and agricultural economic resilience, focusing on the marginal net effect of new quality productive forces on agricultural economic resilience. However, these studies have largely overlooked the interactive relationships among the various elements within new quality productive forces. Moreover, the use of the entropy method for both the dependent and independent variables results in regression outcomes that only reflect the association between two composite indicators, without clarifying the underlying mechanisms of action between the variables.

Therefore, drawing on Li(2025), this paper decomposes new-quality productive forces into two criteria levels and six indicators: New workers (Nlf), New production tools (Npt), New infrastructure (Ni), Intelligent (Int), Digital (Df), and Greenization (Grz)[29]. The aim is to explore the complex driving mechanisms of these factors on agricultural economic resilience and to construct the following analytical framework:

$$Res = F (Nif, Npt, Ni, Int, Df, Grz)$$

Research method and data construction

Fuzzy-Set Qualitative Comparative Analysis

Traditional econometrics assumes that the independent variables in a multiple regression model are mutually independent, and it is on this basis that the "net effect" of variables is analyzed. However, the enhancement of agricultural economic resilience driven by the development of new-quality productive forces is certainly the result of the interaction and coupling of multiple factors. This paper employs fuzzy-set qualitative comparative analysis (fsQCA) to open the "black box" of how the interaction and matching of various elements of new-quality productive forces enhance agricultural economic resilience, reveal the complex causal relationships of new-quality production factors, and enrich and expand the existing research on the factors affecting agricultural economic resilience.

Variable measurement

This study focuses on the league cities of Inner Mongolia Autonomous Region, with raw data sourced from Statistical Yearbooks (2010–2022). Building on the preceding analysis, the outcome variable is defined as agricultural economic resilience, and the antecedent conditions are selected from two dimensions: substantive factors and penetrative factors. Specifically: substantive factors include: New workers, New production tools, New infrastructure; penetrative factors comprise: Intelligent, Digital, Green.

The agricultural economic resilience (Res) defined by the entropy method draws on the research of Zhao (2023), and an evaluation system is constructed from three dimensions: risk resistance, adaptation and regulation, and innovation and transformation. Among them, the risk resistance ability includes the premium income of agricultural insurance, the payout of agricultural insurance, the total power of agricultural machinery per capita, and the comprehensive grain production capacity; the adaptation and regulation ability includes the number of newly entered green agricultural enterprises, the stock of green agricultural enterprises, the comprehensive utilization rate of livestock and poultry manure, and the greening rate of rural areas; the innovation and transformation ability includes the total number of agricultural patent applications, the number of authorized agricultural inventions, the average years of education of rural residents, and agricultural labor productivity.

Regarding the measurement methods of the characteristics of the new productive forces of various enterprises, this article draws on the research of Han (2024)[14], which is specifically shown as follows:

- New workers (Nlf): Number of regular colleges and universities.
- New production tools (Npt): The ratio of the number of robots installed to the number of employed people.
- New infrastructure (Ni): Number of Internet broadband users (1000 households).
- Intelligent (Int): Number of AI enterprises.
- Digital (Df): The mean value of logarithmic frequency of data assets in the annual report of listed companies.
- Green (Grz): Carbon trading, energy use right trading and emission right trading.

Variable calibration

This study refers to the research of Du Yunzhou et al. (2020) and uses the direct calibration method, employing the logit function (logarithmic probability) as the mathematical transformation tool to calibrate the remaining variables into fuzzy sets between 0.0 and 1.0. The full membership threshold, crossover point, and full non-membership threshold for the outcome variable and the antecedent conditions are set at the upper quartile (75%), median, and lower quartile (25%) of the sample descriptive statistics, respectively.

Categories	Variables	Full Membership Point	Crossover Point	Full Non-Membership Point
Outcome	Res	0.30	0.20	0.14
Conditions	Nlf	4	3	2
	Npt	4.33	2.47	1.22
	Ni	620	380	221
	Int	189	66	21
	Df	1.41	1.30	1.10
	Grz	0.68	0.49	0.31

Table 1: Calibration of variables

Data analysis and empirical results

Necessity analysis

This paper uses fsQCA software to examine the necessity of new-quality productive forces elements in enhancing agricultural economic resilience. In the fsQCA framework, single-variable necessity analysis calculates the consistency score of each antecedent condition to determine if it is necessary. Following Ragin’s (2006) standards, the consistency threshold is set at 0.9. If a condition’s consistency score exceeds 0.9, it is considered necessary for enhancing agricultural economic resilience. The results in Table 2 show that none of the six antecedent conditions representing new-quality productive forces, nor their negations, are necessary for high agricultural economic resilience.

Variables	High Res	Low Res
High Nlf	0.81	0.45
Low Nlf	0.29	0.65
High Npt	0.64	0.42
Low Npt	0.44	0.66
High Ni	0.80	0.28
Low Ni	0.31	0.84
High Int	0.79	0.31
Low Int	0.34	0.81
High Df	0.62	0.50
Low Df	0.45	0.58
High Grz	0.56	0.51
Low Grz	0.53	0.57

Table 2: Analysis of necessary conditions

Condition configuration analysis

Following Fiss (2011), we adopt the intermediate solution as the core object of analysis and interpret the results based on the following criteria: the existence of a core condition is indicated by an element that appears in both the intermediate solution and the parsimonious solution ("⬤"), while its absence is indicated by ("ⓧ"); the existence of a peripheral condition is indicated by an element that appears only in the intermediate solution ("•"), while its absence is indicated by ("⊗").In terms of parameter settings, we set the PRI threshold for configurational sufficiency at 0.80 and the case frequency threshold at 1. When conducting counterfactual analysis, we assume that the presence or absence of a single antecedent condition of new-quality productive forces may contribute to high agricultural economic resilience. The configurational results are shown in Table 3.

Configuration	High Res		Low Res	
	S1	S2	NS1	NS2
Nlf	⬤	•		⊗

NPT		•	⊗	
Ni	•	●	⊗	⊗
Int	●	●	⊗	⊗
Df	⊗		⊗	●
Grz		⊗		●
Consistency	0.89	0.89	0.92	0.94
Raw Coverage	0.27	0.15	0.45	0.19
Unique Coverage	0.15	0.15	0.38	0.12
Solution Consistency	0.88		0.92	
Solution Coverage	0.42		0.57	

Table 3: Analysis of sufficient conditions

First, the resilience-driven empowerment of agriculture through the factor synergy. Configuration S1 indicates that a combination of New-quality Productive Forces, with high-skilled labor, high intelligentization, and non-datafication as core conditions, and high new infrastructure as a peripheral condition, can generate high agricultural economic resilience. This means that with the support of high new infrastructure, an adequate number of high-skilled laborers, equipped with their professional knowledge and skills, combined with the efficient production and management models brought by high intelligentization, can significantly enhance the stability and risk resistance of the agricultural production system, even when the degree of datafication is relatively low. A synergistic relationship is formed between high-skilled labor and high intelligentization, with factor resources complementing each other to fully exploit the potential of agricultural production, creating favorable conditions for the enhancement of agricultural economic resilience. This, in turn, achieves high agricultural economic resilience and ensures the stable development of the agricultural economy in a complex and changing environment.

Second, the resilience-driven stability of agriculture through technology leadership. Configuration S2 indicates that a combination of new-quality productive forces, with high new infrastructure, high intelligentization, and non-greenization as core conditions, and high-skilled labor and high new production tools as peripheral conditions, is sufficient to generate high agricultural economic resilience. This means that with the solid foundation built by high new infrastructure and the efficient and precise characteristics endowed to agricultural production by high intelligentization, even if the level of greenization is relatively low, the agricultural production system can effectively withstand various shocks and risks with the professional quality of high-skilled laborers and the advanced efficiency of high new production tools. High new infrastructure and high intelligentization reinforce each other, driving peripheral elements to function and achieving efficient synergy among elements. This fully taps the potential of agricultural development, creates favorable opportunities for enhancing agricultural economic resilience, and thus achieves high agricultural economic resilience, ensuring the stable development of the agricultural economy in a complex environment.

Third, this paper analyzes the combinations of new-quality productive forces that lead to low agricultural economic resilience and identifies two configurations that can produce low agricultural economic resilience. Comparison of these two configurations reveals that both lack new infrastructure and intelligentization, indicating that this is the common cause of non-high agricultural economic resilience.

Robustness test

This paper conducted a robustness test on the configurations that produce high agricultural economic resilience: by increasing the case frequency threshold from 1 to 2, the three resulting configurations were consistent with two of the existing solutions, indicating that the results of this paper are relatively robust.

Conclusion

Research conclusion

This study employs fuzzy-set Qualitative Comparative Analysis (fsQCA) to dissect the formation mechanism of agricultural economic resilience in Inner Mongolia, revealing three core regularities. First, resilience enhancement relies on the synergistic effect of factors, with two typical pathways: the Factor Synergy Empowerment type (S1), which relies on the synergy of high-tech talent, intelligentization, and new infrastructure to enhance system stability; and the Technology-led Stability type (S2), which builds a technological foundation with new infrastructure and intelligentization and combines tool innovation to improve risk resistance capabilities. Second, new infrastructure and intelligentization are basic conditions, and their absence generally leads to low resilience levels. Finally, the existence of multiple equivalent pathways indicates that regions with different resources can achieve resilience leapfrogging through differentiated factor combinations. The conclusion reveals the nonlinear characteristics of “factor coupling—path differentiation—system resilience emergence,” providing a decision-making framework based on configurational thinking for the optimization of regional agricultural systems.

Theoretical implications

This study advances theoretical innovation in two aspects: First, it employs configurational methods to break through the limitations of traditional regression models, elucidating the nonlinear characteristics of factor interactions and innovating the methodology for studying agricultural complexity. Second, it verifies the structural role of the “digital base—intelligent core,” and by confirming the complementary relationship between new and traditional factors, it improves the theory of agricultural innovation systems and technology adaptation.

Practical implications

This study proposes a four-dimensional practical path: First, build a “new infrastructure + intelligentization” base by promoting digital infrastructure such as 5G base stations and agricultural Internet of Things, deepening AI and block chain traceability technologies, and supporting education for new professional farmers. Second, implement regional differentiated strategies, with resource-rich areas promoting smart agriculture (S2) and labor-advantaged areas developing technology transfer driven by university alliances (S1). Third, establish a resilience early warning system, using intelligentization to overcome the precise support of funds for technologically weak areas. Fourth, avoid data-related risks by dynamically adjusting data input intensity according to production scenarios and eliminating the formalistic construction of digital platforms. These measures form a solution that is compatible with agricultural ecological zones and provide a replicable practical paradigm for agricultural modernization.

***Acknowledgments*:** This research work was supported by the Hohhot Municipal Social Sciences Fund (Grant No. 2025BX02-5) and College-level Key Research Project of Inner Mongolia Honder College of Arts and Sciences (Grant No.HD2025002).

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