

Level of Rural Industrial Integration and Regional Patterns in Henan Province

Xueru Wang

School of Business Administration, Henan Polytechnic University, Jiaozuo, Henan, China

Abstract: The integration of primary, secondary, and tertiary industries in rural areas acts as a pivotal driver of rural revitalization and agricultural modernization on a national scale. This study systematically clarifies the core evaluation principles governing rural industrial integration in China, with Henan Province selected as a representative case study. A multi-dimensional, comprehensive evaluation index system for rural industrial integration is constructed, and a combined method of the Analytic Hierarchy Process (AHP) and entropy weight method is employed to quantitatively measure the integration level across all prefecture-level administrative regions in Henan. Furthermore, this study dissects the spatiotemporal characteristics of rural industrial integration in the province and examines the underlying causes of regional disparities in integration development. Finally, targeted, region-specific development strategies are proposed to address the identified disparities, thereby providing actionable insights for elevating the overall level of rural industrial integration in Henan and beyond.

Keywords: Rural Industrial Integration; Integration Level Evaluation; Analytic Hierarchy Process (AHP).

1. Introduction

In the context of advancing Chinese-style modernization, addressing the “Three Rural Issues” (i.e., agriculture, rural areas, and farmers) remains the most formidable challenge. Rural industrial integration (RII) has evolved into a pivotal strategy for China to mitigate these challenges and enhance farmers’ income. Promoting the integrated development of primary, secondary, and tertiary industries in rural regions is a critical measure to accelerate the transformation of agricultural development paradigms and establish a modern agricultural industrial system. The essence of RII lies in anchoring agriculture as the core to achieve cross-sectoral integration of capital, technology, and resources. This framework dismantles institutional and operational barriers between production, processing, and distribution, facilitating organic synergy among agriculture, manufacturing, marketing, catering, leisure services, and other related sectors. Beyond extending agricultural value chains, expanding industrial functions, and fostering innovative industrial formats, RII creates additional employment opportunities and diversifies farmers’ income sources. Ultimately, it cultivates a resilient industrial ecosystem characterized by seamless inter-linkages across all stages and mutually beneficial coexistence among stakeholders [7]. By grounding development in agriculture, farmers can effectively share the dividends derived from the integration of the three industries, which in turn attracts modern production factors to upgrade traditional agriculture, expands agriculture’s multifunctional value, nurtures new rural growth engines, and advances agricultural modernization.

Henan Province, a major agricultural hub with a large rural population, plays an irreplaceable role in China’s grain security system and exerts a profound influence on the national agricultural landscape. However, in its transition from a large agricultural province to a high-quality agricultural powerhouse, Henan faces prominent bottlenecks: inadequate agricultural industrialization, incomplete industrial chain extension, constrained efficiency improvement, and a relatively low level of modernization [1].

With the accelerated implementation of China’s rural revitalization strategy, systematic research on RII development levels has garnered growing academic and policy attention. Against this backdrop, this study explores the current status of integrated development of rural primary, secondary, and tertiary industries in Henan. This research holds significant practical implications for Henan’s pursuit of agricultural modernization and comprehensive rural revitalization, while also providing valuable insights for other major agricultural regions globally confronting similar development dilemmas.

2. Establishing an Evaluation Indicator System for Rural Industrial Integration

2.1. Principles for Constructing the Evaluation Indicator System

1. Systemic principle [2]: RII is a complex systemic project involving multiple dimensions, including politics, economy, society, and ecology. Therefore, it is essential to comprehensively analyze the influences and interactions of various elements throughout the integration process. Relevant indicators should be selected scientifically and objectively to reflect the core priorities and development objectives of the integrated development of rural primary, secondary, and tertiary industries.

2. Dynamic principle: Industrial integration is not a static process but a dynamic evolutionary phenomenon. A dynamic perspective must be adopted to identify critical issues and bottlenecks emerging during the RII process. This principle emphasizes proactive exploration of targeted solutions to address the challenges encountered in industrial convergence, ensuring the indicator system can adapt to the evolving characteristics of RII.

3. Sustainability principle: The construction of the indicator system should not only focus on resolving current problems in industrial integration but also adhere to a long-term vision. It aims to continuously improve the level of rural industrial integration and promote the sustainable

development of the rural industrial ecosystem, aligning with the long-term goals of agricultural modernization and rural revitalization.

4. Operability principle: Significant regional disparities exist in agricultural infrastructure, industrial integration supporting facilities, resource inputs, and output efficiency across different rural areas. Thus, the selected indicators must be quantifiable, with data readily accessible from official statistics or field surveys. Full consideration should be given to the practical feasibility of the indicator system in real-world evaluation scenarios to ensure its applicability and reliability. [3]

2.2. Constituent Elements and Evaluation Indicator System for Rural Industrial Integration

Based on the fundamental concept of rural industrial integration and incorporating the above principles, an evaluation indicator system for rural industrial integration has been established, comprising 2 primary indicators, 5 secondary indicators, and 10 tertiary indicators.

Primary Indicators (Objective Level) cover two aspects: First, the integration and interaction between agriculture and related industries, primarily evaluating the consolidation and development of agriculture, agritourism, agricultural services,

and other related sectors; Second, socioeconomic impacts, focusing on comparative analysis of the direct and indirect effects of rural industrial integration on promoting rural economic growth and social development, increasing farmers' income, and narrowing the urban-rural income gap.

Secondary indicators (criterion level) encompass five dimensions: Agricultural industrial chain extension examines the role of agricultural industrial chain development in extending agricultural value chains, advancing agricultural processing, and enhancing the added value of agricultural products; Agricultural multifunctional evaluation studies the multifaceted roles of agricultural development in areas such as agricultural machinery, agricultural information, and ecological environment; Agricultural Service Integration Development measures the degree of integration between agriculture (as the primary sector) and the tertiary sector, particularly focusing on enhancing service capabilities to promote related industries like agriculture; Evaluating Urban-Rural Integration Development examines rural industrial development and urban-rural income disparities; Farmer Income Growth and Agricultural Efficiency focuses on the role of rural industrial integration in boosting farmer income and agricultural productivity. [4]

Tertiary indicators (indicator layer) comprise 10 specific evaluation metrics, as shown in the table below:

Table 1. Tertiary indicators (indicator layer) comprise 10 specific evaluation metrics

A. Target Layer		B Guideline Layer	C Indicator Layer	Unit	Indicator Value
Evaluation Indicator System for Rural Industrial Integration Level	Integration and Interaction of Agriculture and Related Industries	B1Extension of the Agricultural Industry Chain	C1Total Output Value of Agriculture, Forestry, Animal Husbandry, and Fisheries C2Proportion of the workforce engaged in agriculture	billion yuan %	+ +
		B2Evaluation of Agricultural Multifunctionality	C3Total Agricultural Machinery Power C4Number of Rural Biogas Projects	104kw Each	+ +
		B3Integrated Development of Agricultural Services	C5Total Output Value of Agriculture, Forestry, Animal Husbandry, and Fisheries Services C6Primary industry's share of regional GDP	billion yuan %	+ -
	Social Effects of Integrated Development	B4Integrated Urban-Rural Development	C7Public Finance Expenditures for Agriculture, Forestry, and Water Affairs C8Ratio of Per Capita Income Between Urban and Rural Residents	billion yuan %	+ -
		B5Increasing Farmers' Income and Enhancing Agricultural Efficiency	C9Rural per capita disposable income C10Total Grain Production	Yuan 10 million tons	+ +

3. Measurement of Rural Industrial Integration Level in Henan Province

3.1. Calculation Method and Steps

The entropy method is an objective analytical approach that eliminates subjective factors and neutralizes the impact of different measurement units through range standardization. This paper employs this method to measure the level of rural industrial integration subsystems and the overall integration level in Henan Province. The specific steps are as follows:

1. Data Standardization: Since collected data originate from various industries with differing units and positive/negative orientations, making calculations inconvenient, normalization methods are employed for

standardization.

Positive indicators: $X'_{ij} = \frac{X_{ij} - \min X_j}{\max X_j - \min X_j}$ Negative

indicators: $X'_{ij} = \frac{\max X_j - X_{ij}}{\max X_j - \min X_j}$ Where “j”

represents the five secondary indicators B1, B2, B3, B4, B5 under the criterion layer; is the raw data, and is the normalized data.

2. Determine the entropy values and weights of the indicators:

$$P_{ij} = \frac{X'_{ij}}{\sum_{i=1}^n X_{ij}}$$

$$e_j = -\frac{1}{\ln n} \sum_{i=1}^n P_{ij} \ln(P_{ij}), 0 \leq e_j \leq 1$$

$$g_j = 1 - e_j$$

$$W_j = \frac{g_j}{\sum_{i=1}^m g_j}, j = 1, 2, \dots, m$$

Here, “n” denotes the sample size, and “m” denotes the number of indicators.

3.2. Data Sources and Empirical Analysis

This study examines 18 municipal districts in Henan Province. Primary data were sourced from the 2023 China Statistical Yearbook, Henan Statistical Yearbook, and statistical yearbooks of Henan's municipal districts. Analysis was conducted using the indicator system constructed in Table 1. Results are presented in Table 2, with weightings for each level shown in Table 3.

Table 2. Normalized Results of Rural Industrial Integration Data for Municipal Administrative Districts in Henan Province

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Zhengzhou	0.18	0.00	0.26	0.02	1.00	1.00	0.66	0.93	1.00	0.12
Kaifeng	0.54	1.00	0.37	0.00	0.11	0.24	0.43	0.52	0.22	0.32
Luoyang	0.35	0.54	0.32	0.01	0.12	0.82	0.54	0.00	0.24	0.24
Pingdingshan	0.28	0.63	0.26	0.04	0.16	0.65	0.29	0.31	0.21	0.22
Anyang	0.32	0.50	0.31	1.00	0.12	0.53	0.31	0.51	0.33	0.39
Hebi	0.09	0.09	0.12	0.03	0.01	0.63	0.14	0.93	0.60	0.11
Xinxiang	0.42	0.57	0.52	0.01	0.08	0.51	0.51	0.66	0.39	0.50
Jiaozuo	0.18	0.28	0.13	0.00	0.03	0.70	0.15	1.00	0.65	0.20
Puyang	0.33	0.74	0.24	0.04	0.00	0.34	0.30	0.33	0.19	0.31
Xuchang	0.25	0.71	0.24	0.00	0.19	0.78	0.21	0.87	0.58	0.30
Luohe	0.19	0.64	0.14	0.06	0.01	0.55	0.15	0.70	0.46	0.18
Sanmenxia	0.19	0.89	0.04	0.05	0.02	0.53	0.21	0.63	0.31	0.05
Nanyang	1.00	0.97	0.99	0.12	0.08	0.15	0.97	0.47	0.27	0.76
Shangque	0.83	0.85	0.61	0.05	0.10	0.01	0.60	0.15	0.05	0.79
Xinyang	0.96	0.85	0.47	0.27	0.29	0.00	1.00	0.55	0.21	0.61
Zhoukou	0.95	0.81	0.69	0.07	0.07	0.07	0.88	0.37	0.00	1.00
Zhumadian	0.84	0.69	1.00	0.05	0.04	0.06	0.76	0.32	0.09	0.87
Jiyuan	0.00	0.08	0.00	0.10	0.00	0.89	0.00	0.92	0.75	0.00

Table 3. Weighting Levels for Evaluation Indicators of Rural Industrial Integration Development in Henan Province

Indicator	B2	B3	B4	B5
Weight	0.3454	0.2764	0.1075	0.1488
Indicator	C2	C3	C4	C5
Weight	0.0471	0.0804	0.2651	0.1988
Indicator	C7	C8	C9	C10
Weight	0.0653	0.0422	0.0698	0.0790

As shown in Table 4's comprehensive index scores for rural industrial integration, Zhengzhou City achieved an overall score of 0.4879 for agricultural industrial integration, ranking second. It secured first place in agricultural service integration, urban-rural integration, and farmer income growth alongside agricultural efficiency enhancement. However, its rankings were lower in agricultural industrial chain extension and multifunctional agriculture. This indicates that while Zhengzhou, as Henan's provincial capital, possesses a relatively high level of economic development, it must strengthen exploration in extending industrial chains and integrating multifunctional agriculture during the agricultural industrial integration process. In contrast, the

three prefecture-level cities of Hebi, Sanmenxia, and Puyang rank relatively low in the comprehensive index. This may be attributed to their smaller geographical scope and relatively large populations, which may be less conducive to agricultural development [5], leading to lower rankings across various indicators.

Regarding agricultural industrial chain extension integration, Nanyang, Xinyang, and Zhoukou ranked among the top three provincially, reflecting their substantial agricultural-related output value and large agricultural workforce. Jiyuan and Zhengzhou ranked lower, primarily due to regional constraints such as limited arable land and agricultural labor force [5], which hindered significant

development in this area.

Table 4. Comprehensive Index of Rural Industrial Integration Development Levels Across Municipal Administrative Districts in Henan Province

	B1		B2		B3		B4		B5		Comprehensive Score	Rank
	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Score	Rank		
Zhengzhou	0.0247	17	0.1029	12	0.5583	1	0.1731	1	0.1704	1	0.4879	2
Kaifeng	0.1901	5	0.1344	8	0.1022	12	0.1039	10	0.0833	14	0.2581	10
Luoyang	0.1110	12	0.1225	9	0.2659	3	0.0604	18	0.0747	16	0.2500	11
Pingdingshan	0.1141	11	0.1109	10	0.2287	5	0.0671	17	0.0681	17	0.2406	12
Anyang	0.1018	14	0.4606	1	0.1848	7	0.0910	14	0.1103	11	0.5082	1
Hebi	0.0254	16	0.0568	15	0.1810	8	0.1164	9	0.1084	12	0.1864	18
Xinxiang	0.1225	9	0.1902	7	0.1685	9	0.1275	5	0.1358	5	0.2964	8
Jiaozuo	0.0585	15	0.0519	16	0.2094	6	0.1260	6	0.1301	7	0.2222	13
Puyang	0.1333	8	0.1034	11	0.1003	13	0.0699	16	0.0763	15	0.1964	16
Xuchang	0.1189	10	0.0894	13	0.2727	2	0.1186	8	0.1335	6	0.2939	9
Luohe	0.1039	13	0.0775	14	0.1598	10	0.0937	12	0.0993	13	0.2139	14
Sanmenxia	0.1342	7	0.0373	18	0.1574	11	0.0926	13	0.0580	18	0.1946	17
Nanyang	0.2421	1	0.3914	2	0.0668	15	0.1561	3	0.1571	2	0.4308	4
Shangque	0.2076	4	0.2338	6	0.0351	17	0.0822	15	0.1279	8	0.3064	7
Xinyang	0.2232	2	0.2598	5	0.0853	14	0.1688	2	0.1253	9	0.4391	3
Zhoukou	0.2168	3	0.2665	4	0.0433	16	0.1367	4	0.1518	3	0.3626	5
Zhumadian	0.1881	6	0.3694	3	0.0333	18	0.1190	7	0.1453	4	0.3496	6
Jiyuan	0.0121	18	0.0414	17	0.2517	4	0.1008	11	0.1142	10	0.2003	15

In agricultural multifunctionality, Anyang, Nanyang, and Zhumadian ranked first, second, and third respectively. However, their rankings in integrated agricultural service development were relatively low, indicating significant imbalances in rural industrial integration. This highlights the need to coordinate resources, address shortcomings, and strive for balanced progress across all fronts.

Regarding integrated urban-rural development, farmer income growth, and agricultural efficiency, Zhengzhou, Nanyang, and Zhoukou all rank highly. This indicates these three prefecture-level cities have significantly narrowed the urban-rural gap, with higher disposable incomes for farmers and higher resident happiness indices. In contrast, Pingdingshan City and Luoyang City rank relatively low, indicating slower progress in advancing integrated urban-rural development, increasing farmers' income, and enhancing agricultural efficiency. These cities need to accelerate efforts to improve residents' living standards and narrow the urban-rural gap.

4. Recommendations

To address regional disparities in rural industrial integration across Henan Province and promote coordinated development while addressing shortcomings, the following recommendations are proposed:

4.1. Implement Categorized Guidance for Different Regions

Central Cities like Zhengzhou: Building on existing strengths in service sector integration, urban-rural integration, and farmer income growth, prioritize extending agricultural supply chains and developing multifunctional agricultural land. Encourage the development of deep processing of agricultural products, cold chain logistics, and brand marketing. Promote the integration of agriculture with tourism, culture, wellness, and other sectors to enhance industrial value-added. Agricultural hubs like Nanyang, Xinyang, and Zhoukou should leverage their industrial chain foundations to accelerate expansion into high-value segments,

cultivate leading enterprises, strengthen technological empowerment, and advance standardized and scaled development. Concurrently, focus on elevating agricultural service levels to facilitate integrated production and marketing. Regions with prominent multifunctional characteristics, such as Anyang, Nanyang, and Zhumadian, should leverage their ecological, cultural, and tourism advantages while addressing weaknesses in agricultural services. This includes improving the agricultural socialized service system and enhancing supporting capabilities in technology, finance, and information. Regions with lower overall rankings, such as Hebi, Sanmenxia, and Puyang, should develop specialty and premium agriculture based on their resource endowments, promoting small-scale, high-quality transformation. Strengthen regional collaboration to optimize population and resource allocation, thereby improving agricultural development conditions. Regions with lagging urban-rural integration, such as Pingdingshan and Luoyang, should prioritize enhancing urban-rural infrastructure connectivity and equalizing public services. Cultivate county-level economies to promote local employment and entrepreneurship among farmers, thereby expanding income channels.

4.2. Common Provincial Development Directions

1. Refine policy and evaluation mechanisms. Establish differentiated support policies. Governments should formulate rural industrial integration policies based on local conditions, providing tailored policy support for different types of industrial integration. Actively guide leading enterprises to develop, accelerate corporate and social capital participation, and establish rural credit and insurance products to provide farmers and agricultural enterprises with financial support and risk protection. Support the development of rural micro and small enterprises by offering entrepreneurial guidance and financing services, and actively leverage the role of entrepreneurship and innovation funds. [6]
2. Develop new agricultural models. Accelerate the

transformation and upgrading of traditional agriculture, optimize industrial structures, and actively explore new agricultural models. Promote modern agricultural technologies such as smart farming and precision agriculture to enhance crop yields and quality. Develop efficient water-saving irrigation and green pest control methods to promote sustainable agricultural development. Utilize e-commerce platforms to expand agricultural product sales channels, enabling simultaneous online and offline sales.

3. Improve institutional mechanisms for urban-rural integration. Facilitate two-way flow of resources between urban and rural areas by establishing platforms for capital, talent, and technology to flow into rural areas. Guide targeted urban resource allocation to rural industries through dedicated funds and talent return incentive policies. Activate idle homestead and farmhouse resources to develop homestays, warehousing, and other business models, ensuring asset appreciation benefits for farmers. Focusing on rural industrial integration needs, provide targeted skills training in cultivation techniques, agricultural processing, and rural e-commerce to comprehensively enhance farmers' endogenous motivation for employment and entrepreneurship, thereby narrowing the urban-rural development gap.

Acknowledgments

Supported by Henan Provincial University Humanities and Social Sciences Research General Project (2024-ZZJH-407).

References

- [1] Gao, M. F., & Zhang, J. N. (2023). Current situation and countermeasures of rural three-industry integration development in Henan Province under the background of rural revitalization. *Shanxi Agricultural Economy*, 352(16), 66–68. <https://doi.org/10.16675/j.cnki.cn14-1065/f.2023.16.021>.
- [2] Li, K. F. (2023). Measurement and promotion strategies of rural industrial integration level in Henan Province [Master's thesis]. Henan Agricultural University. <https://doi.org/10.27117/d.cnki.ghenu.2023.000203>.
- [3] Li, X. W. (2024). Research on regional differences and influencing factors of rural industrial integration level in Henan Province [Master's thesis]. Henan University of Technology. <https://doi.org/10.27791/d.cnki.ghegy.2024.000714>.
- [4] Wang, H. (2025). Evaluation of rural primary, secondary, and tertiary industry integration development based on AHP-fuzzy comprehensive method: A case study of Shaanxi Province. *Journal of Anhui Agricultural Sciences*, 53(16), 196–202.
- [5] Wang, Y., Wang, K., & Li, H. X. (2022). Measurement and countermeasure analysis of rural primary, secondary, and tertiary industry integration development level in Henan Province. *South China Agriculture*, 16(24), 127–129. <https://doi.org/10.19415/j.cnki.1673-890x.2022.24.041>.
- [6] Xue, X. T., & Meng, C. (2025). The impact of rural industrial integration on rural revitalization level. *Contemporary Rural Finance and Economics*, 347(8), 18–23.
- [7] Xu, Y. J. (2024). Research on rural industrial integration development level and its impact on farmers' income in Henan Province [Master's thesis]. Chongqing Technology and Business University.