County-level Agricultural Ecological Civilization Evaluation Index System and Empirical Study: A Case Study of Shijiazhuang City (Postprint)

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Abstract

Agricultural ecological civilization constitutes an important component of China' s ecological civilization construction. Establishing an evaluation index system for county-level agricultural ecological civilization can assess the status of county-level agricultural ecological civilization, enable tailored policies for different counties, and is of great significance for constructing a scientific and rational agricultural development pattern. From the perspective of agricultural ecological civilization construction, this paper employs interval analytic hierarchy process and cluster analysis as foundational methods, selects 22 indicators across four domains—ecology, economy, society, and coordinated development—to construct a county-level agricultural ecological civilization evaluation index system. Taking 17 counties in Shijiazhuang City, Hebei Province as a case study and utilizing 2012 statistical data, this study conducts single-domain analysis and comprehensive evaluation of county-level agricultural ecological civilization, and proposes corresponding countermeasures and recommendations to provide a more robust theoretical foundation for agricultural ecological civilization construction. The results indicate that Xinle City, Pingshan County, Gaocheng City, Luancheng County, Lingshou County, Luquan City, and Jinzhou City in Shijiazhuang demonstrate significant overall advantages in the ecological domain; Gaocheng City, Xinji City, Luquan City, and Zhengding County receive favorable overall evaluations in the economic domain; Pingshan County and Luancheng County show the most prominent advantages in the social domain, while Zanhuang County, Gaocheng City, Jinzhou City, and Wuji County perform poorest overall in the social domain. In the coordinated development domain, Gaocheng City, Luquan City, and Luancheng County exhibit relatively strong performance. Comprehensive analysis of county-level agricultural ecological civilization reveals that indicator levels are jointly determined by the four domains, with the economic domain exerting a relatively large influence—most counties and districts with stronger economic performance demonstrate higher

comprehensive levels. This demonstrates that economic construction, social development, and coordination factors effectively support agricultural ecological civilization construction and development. Therefore, during the process of agricultural ecological civilization construction in Shijiazhuang City, it is essential to fully recognize the ecological, social, and economic development levels across different counties and districts, adhere to the principle of adapting measures to local conditions and implementing region-specific policies, enhance agricultural development levels in all counties, and optimize the development pattern of ecological agriculture.

Full Text

Evaluation Index System and Empirical Analysis of Agro-ecological Civilization at the County Scale—A Case Study of Shijiazhuang City

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Abstract: Agro-ecological civilization constitutes a crucial component of China' s ecological civilization construction. Establishing a county-level evaluation index system for agro-ecological civilization enables assessment of regional agro-ecological civilization levels and facilitates tailored policy implementation for different counties, which is essential for constructing a scientific and rational agricultural development pattern. This paper develops a county-scale evaluation index system for agro-ecological civilization comprising 22 indicators across four domains—ecology, economy, society, and coordinated development —based on interval analytic hierarchy process and cluster analysis methods. Using 2012 statistical data from 17 counties in Shijiazhuang, Hebei Province, the study conducts single-domain analyses and comprehensive evaluations of county-level agro-ecological civilization, proposing corresponding countermeasures and recommendations to provide a more robust theoretical foundation for agro-ecological civilization construction. The results indicate that Xinle City, Pingshan County, Gaocheng City, Luancheng County, Lingshou County, Luquan City, and Jinzhou City demonstrate significant overall advantages in the ecological domain. Gaocheng City, Xinji City, Luquan City, and Zhengding County show better performance in the economic domain. Pingshan County and Luancheng County exhibit the most prominent advantages in the social domain, while Zanhuang County, Gaocheng City, Jinzhou City, and Wuji County rank lowest in this domain. In terms of coordinated development, Gaocheng City, Luquan City, and Luancheng County perform relatively well. Comprehensive analysis reveals that overall index levels are determined jointly

by the four domains, with the economic domain exerting the greatest influence —counties with stronger economic performance generally achieve higher comprehensive levels. These findings demonstrate that economic development, social progress, and coordination factors strongly support agro-ecological civilization construction and development. Therefore, during the agro-ecological civilization construction process in Shijiazhuang, it is essential to fully understand the ecological, social, and economic development levels across counties, adhere to the principle of adapting measures to local conditions and implementing region-specific policies, enhance agricultural development levels in each county, and optimize the eco-agricultural development pattern.

Keywords: Agro-ecological civilization; Ecological vitality; Economic vitality; Social vitality; Coordination degree; County scale; Shijiazhuang City

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Agro-ecological civilization represents a form of ecological civilization carried by agriculture, wherein benign natural ecological environments promote agricultural development during production processes, creating harmonious, virtuous, and sustainable momentum. The degree of agro-ecological civilization development constitutes a critical component and key manifestation of China' s ecological civilization construction. The report of the 18th National Congress of the Communist Party of China explicitly called for vigorously promoting ecological civilization construction and placed agricultural, rural, and farmer issues in a prominent position within this agenda, highlighting the pivotal role of agricultural development in ecological civilization. Agro-ecological civilization encompasses not only stable agricultural economic development and efficient utilization of agricultural resources but also continuous improvement of the agricultural ecological environment, prosperous development of rural social undertakings, and effective support from science, technology, and education.

Currently, agro-ecological civilization construction faces several challenges, including weak agricultural foundations, severe agricultural environmental pollution, irrational agricultural industrial structures, backward rural culture, and imperfect agricultural laws and policies. Consequently, determining how to evaluate county-level agro-ecological civilization status and implement tailored policies to construct a scientific and rational agricultural development pattern warrants in-depth research. Studying county-level agro-ecological civilization evaluation index systems holds significant practical importance for China' s socialist modernization and harmonious society construction.

Existing literature primarily focuses on ecological civilization evaluation and agricultural sustainable development assessment. Regarding ecological civilization evaluation, scholars such as Jiang Xiaoping, Liu Yanjun, Wang Xiaohuan, and Zeng Jian have constructed provincial- and municipal-level ecological civilization evaluation index systems from perspectives including ecology, economy, society, environment, and culture. Concerning agricultural sustainable development evaluation, researchers including Zhou Yinghua, Xu Xuegong, Luo

Zhenli, and Luo Qiyou have respectively established national-, provincial-, and municipal-level agricultural sustainable development evaluation index systems covering production, economy, resources, environment, society, science, and education. Although these evaluations reflect ecological civilization elements and their relationship with agriculture from various angles and levels, they lack research on agricultural development evaluation from an ecological civilization perspective. Therefore, this paper constructs an agro-ecological civilization index evaluation index system based on ecological civilization theory, determines indicator weights, and evaluates and analyzes county-level agro-ecological civilization in Shijiazhuang City in 2012. Based on this analysis, the paper examines ecological, social, and economic development levels across Shijiazhuang' s counties, adheres to the principle of adapting measures to local conditions and implementing region-specific policies, proposes strategies for optimizing county-level eco-agricultural development patterns, and provides valuable references for advancing China' s agricultural modernization under ecological civilization construction.

1.1 Basic Concepts of Agro-ecological Civilization

As a future-oriented and holistic civilization form, ecological civilization carries people' s critical inheritance of existing civilization and constructive thinking about future civilization. It involves comprehensive transformation of production modes, lifestyles, thinking patterns, subject relationship models, and value concepts, touching upon economic, political, and cultural domains, and representing a systematic integration covering all social fields. Scholars have defined agro-ecological civilization differently. Some view it as a harmonious coexistence and virtuous cycle between natural ecosystems and human economic-social ecosystems in agricultural production, achieving comprehensive, coordinated, and sustainable agricultural development across ecological, economic, and social dimensions. Others consider it as following ecological-economic laws, integrating environmental and ecological objectives into modern agriculture, and developing resource- and energy-saving, eco-friendly agriculture. Despite definitional differences, all emphasize the ecological transformation and sustainable development of agriculture, essentially sharing common ground. Within the overall framework of civilizational ecologization, agro-ecological civilization represents an ecological civilization form carried by agriculture, comprising various concrete manifestations of ecological civilization in the agricultural sector. Its specific objective is to enhance agricultural economic, social, and ecological benefits while minimizing agricultural ecological environmental damage and resource consumption. Substantive advancement of agro-ecological civilization construction constitutes both the fundamental content of China' s ecological civilization construction and a crucial factor for its fundamental improvement.

1.2 Content of Agro-ecological Civilization Construction

The basic content of agro-ecological civilization construction involves ecological transformation of existing agricultural systems, including three aspects: First, ecologicalization of agricultural production objectives, which requires pursuing not only economic targets but also fully considering ecological goals and achieving coordinated unification of their values. Second, ecologicalization of agricultural economic structure, which advocates product and industrial diversification, achieves "softening" of structure through dynamic regulation, strengthens deep development and multi-level comprehensive utilization of agricultural resources, and shapes a circular and regenerative agricultural structure. Third, ecologicalization of agricultural production methods, which places various agricultural production technologies under the overall constraint of ecological objectives, fully protects and applies ecological resources during production processes, and compensates for and repairs ecological segmentation between industry and agriculture and urban-rural areas, as well as damage to water, forests, biological species, and other agricultural resources caused by industrialized agriculture.

2.1 Evaluation Principles

1) **Scientific Principle:** Human development requires balancing various relationships and living harmoniously with nature, with science serving as the criterion for coordinating contradictions. The scientific nature of the index system is paramount for reflecting current construction status across domains, necessitating adherence to scientific principles.

2) **Representative Principle:** Agro-ecological civilization evaluation should employ the most comprehensive indicators to reflect the most complete current status and existing problems.

3) **Integrity Principle:** Agro-ecological civilization involves not only natural ecosystems but also close relationships with economic development and mutual influences from political, cultural, and social aspects. Therefore, the integrity principle must be upheld, emphasizing both tangible natural ecological environments and economic material construction, as well as intangible spiritual and cultural domain improvement.

4) **Coordination Principle:** Comprehensive consideration of phased characteristics across economic and social development dimensions is necessary to enable continuous evaluation over time and comprehensive assessment of agro-ecological civilization construction levels across different periods.

2.2 Evaluation Methods

Considering the multi-objective nature of agro-ecological civilization and the universality and stability of evaluation index systems, it is necessary to emphasize evaluator subjectivity while maximizing the elimination of subjective weighting defects to ensure indicator weight objectivity. Therefore, this paper

employs interval analytic hierarchy process combined with cluster analysis to determine indicator weights and uses weighted summation to calculate county-level agro-ecological civilization evaluation indices (D).

2.3.1 Indicator Selection

Agro-ecological civilization represents a comprehensive manifestation of multiple subsystems working together, with each subsystem being both a component and influencing factor. To facilitate county-level evaluation, the agro-ecological civilization index represents agro-ecological civilization levels. This index is defined as the target layer (first-level indicator). Given the multifaceted nature of agro-ecological civilization evaluation, following scientific, representative, integrity, and coordination principles and synthesizing relevant research findings while consulting experts in ecology, resource-environment, economics, sociology, urban planning, physical geography, statistics, and soil-water conservation, the system is preliminarily divided into four domains—ecology, economy, society, and coordinated development—to construct second-level indicators, forming a hierarchical structure of "total indicator—investigation domain—specific indicator."

The selection of third-level indicators corresponding to ecology, economy, society, and coordinated development underwent three stages: initial screening, secondary screening, and expert selection. Raw indicators best reflect current construction status across domains.

1) Initial Screening: This paper reviewed recent domestic literature on agro-ecological civilization, approaching index system construction from two perspectives: theory-oriented indicator systems and practice-oriented indicator systems. Based on cluster analysis, comprehensive information from major research classifications and indicator selections across regions was synthesized, as shown in .

All final-level indicators identified in literature regarding agro-ecological civilization evaluation were first subjected to effectiveness evaluation using the formula:

$$V = X \times Y \times Z$$

where V represents indicator value (greater value indicates greater significance), X represents relative frequency, Y represents relative density, and Z represents relative abundance.

Relative frequency (X) is calculated as:

$$X = \frac{n_i}{N}$$

where n_i represents the occurrence count of indicator i across all cases, N represents total case studies, and i represents indicator count (i = 1, 2, ···, k).

Relative density (Y) is calculated as:

$$Y = \frac{\sum_{i=1}^{k} M_{ij}}{k}$$

where j represents indicator count (j = 1, 2, ···, m), i represents case study count (i = 1, 2, ···, k), and M_ij represents density of evaluation indicator j in case i.

Relative abundance (Z) is calculated as:

$$Z = \frac{\sum_{i=1}^{k} w_{ij}}{k}$$

where w_ij represents the weight of evaluation indicator j in case i (other variables same as above).

Applying these formulas to calculate importance values for all indicators and ranking them by importance value, 98 agro-ecological civilization-related indicators were extracted, covering 13 aspects including ecological protection, environmental improvement, ecological landscape, economic development, production modes, lifestyles, consumption patterns, social progress, infrastructure, livelihood improvement, ecological culture, ecological institutions, and characteristic indicators.

2) Secondary Screening: Scholars, experts, and leading officials from development reform, finance, statistics, environmental protection, forestry, agriculture, water affairs, and social sciences were invited to discuss, screen, and supplement indicators, and to consolidate indicator categories. This process identified 47 indicators across six categories. Subsequently, 20 experts in agricultural ecology, resource-environment, economics, sociology, agricultural economic management, physical geography, statistics, and agricultural meteorology were invited to evaluate the indicators. Based on the National Forestry Administration' s "Green Well-off County Creation Standards," the Ministry of Environmental Protection' s "Ecological County, City, and Province Construction Indicators (Revised Draft)"and "National-level Ecological County Construction Indicators,"the 18th National Congress Report, and referencing classification standards from Shandong, Henan, and Jiangsu provinces, experts recommended selecting 28 basic indicators across four categories to fully represent agro-ecological civilization construction across ecological, economic, social, and coordinated development domains.

3) Expert Selection: Based on the hierarchical structure of the evaluation index system, comparative judgment matrices were established between target and restriction layers, and between restriction and variable layers. Experts applied scaling methods to score judgment matrices. Each expert' s judgment matrix was calculated and consistency-tested. Validated judgment matrix eigenvectors

were normalized to obtain weight vector sets for system layers, state layers, and variables.

Judgment matrices compare elements pairwise at each hierarchical level to determine superiority, establishing judgment matrices B_k (k = 1, 2, ···, n). A 1-9 scale quantifies pairwise comparisons to obtain judgment matrices. The comparison matrix represents relative importance results from pairwise indicator comparisons, as shown in .

Fifty relevant experts and practitioners were selected to assign scores according to indicator importance at each level. Based on obtained indicator values, 22 indicators across four categories were finally selected, as detailed in .

2.3.2 Indicator Weight Calculation Method

Relative weights were determined using interval analytic hierarchy process, which quantifies subjective measurement standards to achieve subjective-objective integration. After evaluation factors were identified, single-factor weight intervals for interval-number judgment matrices were obtained through judgment matrix construction based on interval eigenvalue methods. Hierarchical judgment matrices were then solved to obtain local weight intervals for each indicator. Combined with expert importance evaluation scores, indicator weights were calculated. After testing and correction, final evaluation weight values were determined, as shown in .

2.3.3 Data Standardization

Due to inconsistent indicator attributes, data cannot be directly used and requires standardization. Normalization standardization processing was employed to calculate evaluation coefficients for corresponding indicators in agro-ecological civilization assessment.

For indicators positively correlated with agro-ecological civilization:

$$Q_i = \frac{C_i}{\max(S_i)}$$

For indicators negatively correlated with agro-ecological civilization:

$$Q_i = \frac{\max(S_i) - C_i}{\max(S_i)}$$

where Q_i represents the standardized value of indicator i, S_i represents the target value of indicator i, C_i represents the current value of evaluation indicator i, and max(S_i) represents the maximum target value of evaluation indicators multiplied by 1.05.

2.4 Calculation Method for County Agro-ecological Civilization Evaluation Index

Based on normalized statistical results for Shijiazhuang' s agro-ecological civilization indicators and corresponding weights, weighted summation was used to calculate domain development indices (D_j) and comprehensive agro-ecological civilization evaluation indices (D) for each county:

$$D_j = \sum_{i=1}^{n} W_i \times Q_{ij}$$

$$D = \sum_{j=1}^{4} W_j \times D_j$$

where D_j represents development indicators for ecological (j = 1), economic (j = 2), social (j = 3), and coordinated development (j = 4) domains of the agro-ecological civilization evaluation system; W_i represents the weight value corresponding to evaluation indicator i; Q_ij represents the standardized value of indicator i in domain j; and W_j represents the weight value of domain j.

3.1 Study Area Overview

Shijiazhuang City is located at the intersection of the North China Plain and the Taihang Mountain foothills, with abundant agricultural landscape resources including mountains, lakes, and plains. The city's agriculture leads domestically in scientific research, information, and infrastructure, demonstrating natural resource and research advantages for agricultural development. After years of development, Shijiazhuang' s agriculture has achieved certain scale, but remains in its initial stage compared with developed countries. Development faces numerous challenges including small scale, simple forms, inadequate tourism facilities, low cultural refinement, weak local characteristics, disorderly development, lack of planning, and obvious seasonal limitations.

3.2 Data Sources

Original data were primarily obtained from the *Hebei Statistical Yearbook*, *Shijiazhuang Statistical Yearbook*, and *Hebei Economic Yearbook*. Some data were derived through simple basic calculations, while other data were sourced from Shijiazhuang's municipal and district/county water affairs, forestry, landscaping, and environmental protection systems. Among 22 indicators, forest coverage rate, built-up area greening rate, water network density index, air quality, soil erosion rate, pesticide application intensity, renewable energy utilization rate, and per capita income were direct 2012 indicators. Water source protection, ecological sensitivity, proportion of technology investment in fiscal expenditure, industrial wastewater standard discharge rate, comprehensive utilization rate

of industrial solid waste, urban population density, urbanization rate, rural water improvement rate, rural toilet improvement rate, harmless treatment rate of municipal solid waste, proportion of environmental pollution governance investment in GDP, energy consumption per unit GDP, water consumption per unit GDP, and SO emissions per unit GDP were indirect indicator values obtained through simple calculations from 2012 data. Sampling substitution was used for individual difficult-to-obtain indicators. Ecological and economic-social data from survey regions were collected, classified, and analyzed using statistical methods.

4.1 Development Status of Agro-ecological Civilization in the Ecological Domain

As shown in , seven counties (cities) in Shijiazhuang exhibit level 1 ecological domain development, indicating good ecological quality. Nine counties rank at levels 2 and 3, also demonstrating relatively high ecological quality. Only Wuji County ranks at level 4, indicating relatively low overall ecological quality assessment. Xinle City, Pingshan County, and five other counties show high standardized values for forest coverage, water network density index, water source protection, and built-up area greening rate, while Wuji County shows low standardized values for these indicators, demonstrating their primary role in ecological domain development.

4.2 Development Status of Agro-ecological Civilization in the Economic Domain

As shown in , four central districts/counties—Gaocheng, Xinji, Luquan, and Zhengding—rank at level 1 in the economic domain, primarily due to convenient transportation. Luancheng, Zhao County, Jinzhou City, and Gaoyi City in the southeast, Xinle City in the north, and Pingshan County in the northwest rank at level 2, with these counties also having relatively convenient transportation. Mountainous Lingshou County in the west, Shenze County in the east, and Zanhuang County in the southwest have less convenient transportation and rank lowest in the economic domain. These results indicate that inconvenient transportation in western mountainous areas leads to low economic productivity, while northern plain areas, despite convenient transportation and high agricultural output, suffer from singular industrial structures and low total economic output, resulting in relatively backward economic status. Most counties in the southern, western, and southeastern regions exhibit medium economic development levels. The primary reason is that convenient transportation promotes local informatization and industrialization, introduces new ideas and technologies, improves agricultural industrial structures, increases local fiscal revenue, and stimulates economic development.

4.3 Development Status of Agro-ecological Civilization in the Social Domain

As shown in , Pingshan County and Luancheng County rank at level 1 in the social domain. Jingxing County, Zhengding County, Luquan City, and Xinle City in the central-northern region rank at level 2. Seven counties including Yuanshi, Zhaoxian, Gaoyi, Shenze, Xinji, Wuji, and Jinzhou rank at level 3, while Zanhuang, Lingshou, and Xingtang counties rank at level 4. The primary reason is that higher urbanization rates in Pingshan and Luancheng counties, along with higher agricultural production technology levels, facilitate transfer of surplus labor, appropriate-scale agricultural operations, and agricultural structure optimization and adjustment, resulting in higher social domain levels for these counties.

4.4 Single-Factor Analysis and Evaluation of the Coordinated Development Domain

shows that in the coordinated development domain, Gaocheng City in the east, Luquan City in the west, and Luancheng County in the south have high evaluation indices, ranking at level 1. Jingxing and Pingshan counties in the central-west, Xinle City in the north, Xinji City in the east, and Yuanshi County in the south rank at level 2. Wuji, Jinzhou, Lingshou, and Zhengding counties in the east-northwest, and Zanhuang and Gaoyi counties in the southwest rank at level 3. Zhaoxian, Xingtang, and Shenze counties rank at level 4. The primary reason is that Gaocheng, Luquan, and Luancheng have higher proportions of environmental pollution governance investment and relatively better ecological environments. This analysis reflects that central-western counties show higher coordinated development domain indicators and better ecological environments, while central and south-central counties with lower rankings should increase environmental governance investment, vigorously improve agricultural ecological environments, and pay attention to natural resource protection and rational utilization.

4.5 Analysis and Evaluation of the Agro-ecological Civilization Index

As shown in , Gaocheng City in eastern Shijiazhuang and Luquan City in western Shijiazhuang rank at level 1 in overall county agro-ecological civilization evaluation, with comprehensive scores significantly higher than other levels, indicating these two districts/counties hold advantageous positions in agro-ecological civilization construction. Pingshan, Zhengding, and Xinle counties in the north, Xinji City in the east, and Luancheng County in the south rank at level 2, occupying upper-middle positions and representing the mainstream group in Shijiazhuang' s agro-ecological civilization construction. Jingxing County in the west, Jinzhou City in the east, and Zhaoxian, Gaoyi, and Yuanshi counties in the south rank at level 3, showing insufficient overall agro-ecological civilization levels as subsequent development targets. Lingshou and Xingtang counties in the north, Zanhuang County in the southwest, and Wuji and Shenze counties

in the east rank at level 4, with relatively low overall agro-ecological civilization levels requiring improvement across all domains and possessing substantial upgrading potential. Higher indicator scores across the four domains result in higher overall agro-ecological civilization evaluation. Among the four domains, the economic domain plays a leading role—counties scoring higher in the economic domain achieve better overall comprehensive evaluation. The primary reason is that vigorous economic development promotes local informatization and industrialization, introduces new ideas and technologies, drives urbanization and agricultural modernization, effectively improves agricultural industrial structures, rationally allocates natural resources, and better promotes development in other domains.

5 Conclusions and Recommendations

Building upon previous agro-ecological civilization evaluation systems, this study improves the framework and evaluates Shijiazhuang' s county-level agro-ecological civilization. Innovatively introducing the coordinated development domain provides a new dimension to second-level indicators, enhancing evaluation result accuracy, feasibility, and objectivity to better guide practical implementation. This paper establishes a county-level agro-ecological civilization evaluation paradigm from the micro level to implement agro-ecological civilization construction concretely. The assessment of Shijiazhuang' s counties across ecological, economic, social, and coordinated development domains reveals that higher domain indicator scores yield higher overall agro-ecological civilization evaluation, with the economic domain playing the most significant role. The main conclusions are:

1) From the ecological domain perspective, seven counties including Xinle and Pingshan rank at high levels, while Wuji ranks lowest. Forest coverage, water network density index, water source protection, and built-up area greening rate play important roles in county agro-ecological civilization' s ecological domain. From the economic domain perspective, inconvenient transportation in western mountainous areas leads to low productivity, while northern plain areas with convenient transportation have high agricultural output but singular industrial structures and low total output, resulting in backward economic status. Convenient transportation better promotes local economic development. From the social domain perspective, central counties lead, with urbanization rate playing the primary role; several counties in the east-central region including Wuji rank lower than others, indicating counties with higher urbanization rates have higher social development levels. From the coordinated development domain perspective, large regional differences exist: the central region performs well, the eastern region shows unbalanced coordinated development, and the western region exhibits stepwise distribution with large dispersion. Counties with better coordinated development have higher environmental governance investment proportions and relatively better

ecological environments, which favor eco-agriculture and sustainable agriculture development, resulting in higher coordinated development domain levels.

2) From the overall agro-ecological civilization evaluation perspective, the central region performs well with obvious advantages, while the southwestern region lags with substantial development potential. Comparing the four domains, the economic domain plays a leading role, with counties scoring higher in this domain achieving better overall comprehensive evaluation.

Based on these analytical results, the following recommendations are proposed for Shijiazhuang' s county-level agro-ecological civilization construction:

1) Counties with low ecological domain development levels should strengthen forest and water source protection, increase built-up area greening rates, reduce regional ecological sensitivity, and enhance plant community stability. They should also improve water and soil resource protection and reduce pesticide application intensity. According to actual county conditions, economically lagging counties should strengthen transportation infrastructure construction, increase agricultural industrial informatization and industrialization, improve agricultural industrial structures, and optimize resource allocation. Counties with low social domain levels should appropriately increase non-agricultural population proportions while maintaining balanced development, comprehensively strengthen rural living service facilities, improve rural living environments, and raise urbanization levels. In the coordinated development domain, counties should appropriately increase environmental governance investment proportions according to actual conditions to improve agricultural production environments. Lower-ranked counties in central and south-central regions should increase environmental governance investment, vigorously improve agricultural ecological environments, and emphasize natural resource protection and rational utilization.

2) Counties with high overall agro-ecological civilization development levels need to address deficiencies in specific domains, focusing on resolving limiting factors and bottlenecks while continuing to develop previous comprehensive advantages to gradually promote comprehensive ecological, economic, and social development. Counties with low scores across all domains, particularly Shenze County, have weak foundations and unbalanced development. These counties should vigorously develop their economies while considering balanced development among ecology, economy, and society to accelerate construction progress.

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Note: Figure translations are in progress. See original paper for figures.