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Towards Sustainable Rural Revitalization: A Multidimensional Evaluation of Rural Vitality in China's Traditional Villages

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Abstract: Traditional villages constitute a significant component of China's rural heritage. In the context of national efforts to achieve sustainable rural revitalization, there is a lack of comprehensive assessments of rural vitality that can evaluate the balance between the competing demands of heritage conservation and rural development. This study addresses this gap by introducing an innovative evaluation index system, the rural vitality assessment (RVA). The RVA comprehensively evaluates both protective and developmental aspects while integrating natural and cultural ecological factors. This study leverages data from 206 traditional villages in Hebei Province and employs a hybrid model that combines subjective evaluations collected through interviews and questionnaires with spatial data analysis. This study shows that over 90% of traditional villages in Hebei Province exhibit an imbalance between protection and development, which could lead to gradual deactivation. Additionally, the spatial distribution of RVA outcomes shows polarization, with higher levels observed in the north and lower levels in the south. This study concludes that the RVA framework is an effective tool for analyzing the vitality level, spatial distribution, and disadvantage indicators of villages at different zoning levels. The results can provide a reference for the formulation of targeted heritage protection and development planning strategies and further aid in the rational allocation of resources, helping to narrow the development gap between urban and rural areas.

Keywords: traditional villages; rural vitality assessment; rural heritage conservation; rural revitalization; GIS

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1. Introduction

The conservation of rural heritage faces numerous challenges due to the transition from an agrarian to an urban industrial economy and the rapid development of the urban–rural dichotomy. Facing the global challenge of rural decline, the UNESCO World Heritage Centre (2021) stipulates the need for a comprehensive and coherent conservation strategy. This includes clarifying the content of conservation, promoting participatory planning and stakeholder coordination, and ensuring transparency of operational mechanisms to establish an effective management system [1]. In China, conservation and management of rural heritage is primarily accomplished through the selection of traditional villages at the national and provincial levels. In 2008, the Chinese government issued regulations on the protection of famous historical and cultural cities, towns, and villages, along with other relevant policies and regulations. This has led to the establishment of a relatively comprehensive system for the preservation of traditional villages [2]. In 2017, the Chinese government further emphasized the need to halt rural decline through scientific classification and methods, and subsequently released the "Rural Revitalization Strategic Plan (2018–2022)" [3]. This plan recommends categorizing villages into four types for sustainable revitalization as follows: upgraded villages, distinctive protection villages, relocated villages, and suburban integrated villages.

In China, villages are characterized and classified by their long-standing history, distinctive architectural and cultural elements, and tight-knit community bonds [4]. These settlements boast meticulously preserved traditional structures, ranging from ancient edifices to revered temples and shrines, alongside vibrant cultural practices like folklore, festivities, and indigenous craftsmanship [5]. These villages have evolved through centuries of architectural development and serve as repositories of local heritage. They encapsulate the shared memories and identities of their inhabitants [6,7]. Traditional villages play a crucial role in showcasing the local culture, customs, rural morphology, and architecture style of different regions [8]. They also serve as a reflection of the dynamic cultural and social development, and possess high aesthetic and environmental values [9]. However, rapid urbanization and industrialization have significantly impacted rural development, resulting in traditional villages facing various challenges, such as population exodus [10]. The collapse of numerous ancient buildings [11], the interruption of non-heritage cultural inheritance [12], and the rigid integration of old and new buildings [13] have led to the decline of rural settlements [14]. Despite the plethora of research on traditional Chinese villages, the majority remain fixated solely on heritage preservation, overlooking the broader spectrum of rural development initiatives.

Rural revitalization in China is considered a significant measure to address the loss of historical and cultural values and the lack of vitality in the development of China's traditional villages [15]. The aim of the action is to rediscover and highlight the vitality of rural "traditional genes", tap into regional culture, preserve the cultural heritage of the countryside, and promote cultural revitalization [16]. The new published policy in this context creates additional employment opportunities and facilitates the revitalization of the local economy [10]. Rural revitalization action also constructs and nurtures good talent and local relationships by dealing with agricultural industry, rural planning, and farmers [8,17]. As a consequence, rural tourism and the rural industrial chain have experienced significant growth since 2010, contributing to the rapid and diversified growth of the rural economy [18]. For an extended period, rural settlement construction has suffered from a dearth of systematic planning guidance, leading to haphazard layouts, diminutive scales, and dispersed distributions [19]. Therefore, the rational allocation of rural development factors and the optimization of rural living environments have become key to sustainable rural development, which will help promote comprehensive rural revitalization [20,21]. In the process of the holistic heritage management of traditional villages, it is imperative to establish a complete and systematic assessment framework. This framework necessitates the quantitative depiction of the practical challenges encountered by the rural regional system during urban–rural transformation, alongside the assessment of heritage value and development potential in traditional villages.

The balance between the preservation and development of rural heritage has consistently been a focal point for scholars. "Vitality" was introduced to urban studies by Kevin Lynch in the 1980s. Lynch identifies vitality as one of the five interconnected dimensions of performance that determines the quality of human settlements, alongside sense, fit, access, and control [22]. This concept can be applied to spaces of varying scales, including rural areas. Scholars have extensively investigated the conservation of traditional villages as part of efforts to optimize and revitalize rural settlements. Existing studies primarily focus on two dimensions: the dynamic spatial characteristics and the factors influencing or driving them [23–25]. Some scholars focus more on the morphological transformation of rural settlements, including the analysis of historic building characteristics and street layout using qualitative methods [23,26]. Many of the quantitative studies use ArcGIS 10.8 as the primary means of interpreting and evaluating the geospatial detection of spatial relationships and geospatial clusters through the construction of an analytical hierarchy of drivers [24,27,28]. Quantitative studies of traditional villages have tended to focus on a specific aspect, such as spatial restructuring [29], climate adaptability [30], and sustainability of rural ecosystems [31], but much less on social connectedness [32]. Therefore, some scholars argue that a more scientific and effective assessment framework that can comprehensively

and objectively evaluate the status quo of rural settlements is needed to complement the identification of the driving factors of rural settlement spatial development [32–34].

An accurate and comprehensive evaluation of traditional villages is fundamental to formulating policies for sustainable rural revitalization. Such an assessment enables a tailored approach to different regions and the efficient utilization of their internal resources [3]. Academics have developed diverse systems for evaluating criteria from different viewpoints, such as the "production–living–ecology" evaluation system [32], the "man–land areal system" [24], and the population–land–industry evaluation index system [29]. The geographical information system (GIS) plays a significant role in examining the spatial arrangements of rural settlements. Methods such as nearest-neighbor distance analysis, assessment of spatial uniformity (utilizing tools like the geographic centralization index and the Gini coefficient), and kernel density techniques, were employed to investigate the spatial distribution features and developmental statuses of targeted traditional villages in Shaanxi [27]. The topographic relief degree index was utilized to assess the terrain characteristics of both historical villages and their adjacent regions in southwest China [35]. This assessment was conducted via neighborhood analysis, employing ArcGIS software and digital elevation model (DEM) elevation data. In addition, statistical analysis methods such as Moran scatterplot correlation between altitude and distribution [35] were applied to classify rural settlements. Value evaluation function groups were applied to classify land use functions in rural areas [36]. However, the evaluation results are still not comprehensive enough, as most current studies use only one of them or combine two of them for the evaluation.

As the village industry has developed and the economy has grown, the importance of fundamental factors such as the natural environment has decreased, while socioeconomic factors like market demand have become more prominent [25]. Local economic, social, cultural, and management realities must be fully taken into account and the tailor-made proposal must be adhered to when formulating and implementing conservation plans [37]. This study aims to answer the following question: in the context of national level rural revitalization efforts, what methodologies can be used to comprehensively evaluate the vitality of traditional villages, taking into account their current spatial and cultural characteristics and economic development?

Through research on 206 cases in Hebei Province, this article contributes to:

(1) An index system that can take into account the capacity of both the conservation of cultural heritage and rural development.
(2) A methodology that combines morphological study, the GIS method, and statistical analysis on the basis of large samples.
(3) An assessment framework that can be used to quantitatively assess both the vitality and the balance of vitality between protection and development.

This research endeavors to develop a comprehensive evaluation framework aimed at comprehending the vitality and attributes of traditional villages across China's administrative divisions, serving as a foundation for sustainable revitalization. In line with the imperative of sustainable rural revitalization, we investigate the composition of indices and assessment methodologies applicable to diverse village contexts. This research helps to formulate targeted heritage protection and development planning strategies as needed, and further contributes to the rational allocation of resources and narrows the gap between urban and rural development.

2. Study Area and Data Source

2.1. Study Area

Hebei Province, situated in North China, encompasses 11 prefecture-level cities and covers an area of 188,800 square kilometers. Bordered by the Bohai Sea to the east, the Taihang Mountains to the west, and traversed by Hai River and Luan River, Hebei Province exhibits diverse geographic features with a varied landscape. In the context of the coordinated development of the Beijing–Tianjin–Hebei region, Hebei Province is experiencing

accelerated urbanization. This rapid urbanization has led to significant population loss, rendering some villages increasingly impoverished. Simultaneously, due to lagging conservation awareness and excessive commercial development, many cultural relics have suffered severe damage, compromising the traditional character of these villages.

As of January 2023, Hebei Province boasts 206 cases listed among Chinese traditional villages, representing 3% of the country's total [28]. Predominantly situated in the eastern foothills of the Taihang Mountains and the southern slopes of the Yanshan Mountains, these cases exhibit a distribution pattern skewed towards the north and tapering off towards the west, as illustrated in Figure 1. Since 2016, governments at all levels in Hebei Province have prioritized the protection and preservation of those villages. The protection planning system, regulations, and policy measures have been continuously improved. An in-depth exploration of the cultural connotation has been carried out with a subsidy of CNY 426 million from the central government. In this process, 779 salvage and protection projects have been implemented. The traditional villages in Hebei Province exhibit varying degrees of vitality due to the economic influence of the Beijing–Tianjin–Hebei region and differences in their protection and development capabilities. As a result, county governments and administrations have faced challenges in identifying the basic unit for sustainable rural revitalization and heritage conservation policies based on individualized village development. Hence, recognizing the necessity of assessing village vitality levels and acknowledging its potential implications, this study opts to focus on traditional villages in Hebei Province as the primary subjects of analysis.

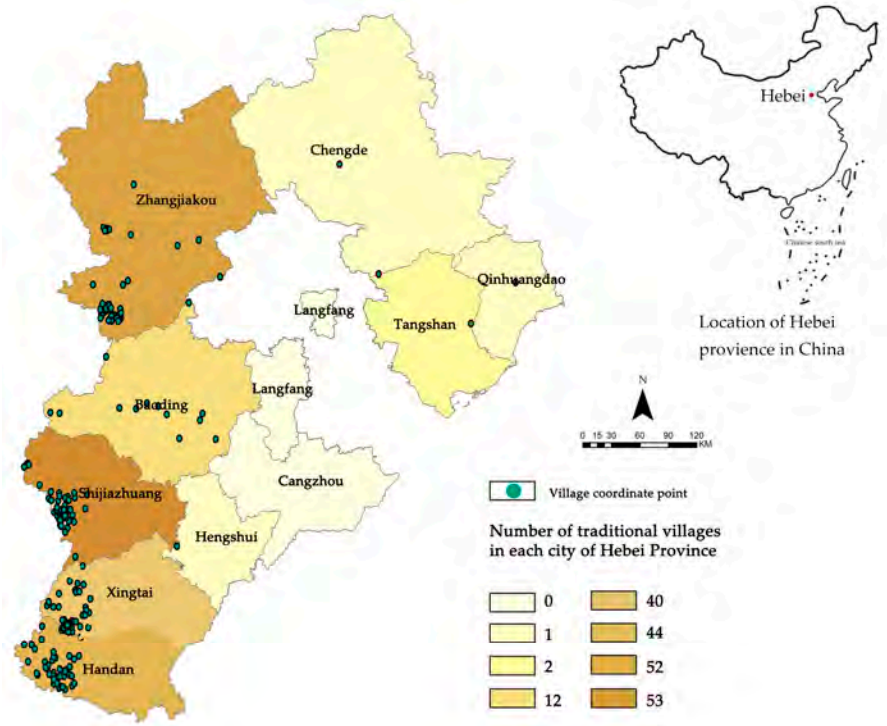

Figure 1. Location of traditional villages in Hebei province in 2022. (Data source: The Ministry of Housing and Urban–Rural Development of the P.R.C. Map Source: http://bzdt.ch.mnr.gov.cn/, accessed on 5 November 2023).

2.2. Data Sources

The data used in this article mainly come from the following sources:

1. Maps, including city and county administrative divisions and ecological environment geographical information data, come from the National Geographic Information Resources Directory Service System [38] and China's 1:4 million basic geographical elements data set [39];

2. Statistical data such as population, proportion of employees in various industries, economy, tangible and intangible cultural heritage, etc., are derived from the 2022 traditional village survey registration form [40], and the 2019 China's population spatial distribution released by the Resource and Environmental Science and Data Center website and GDP spatial distribution kilometer grid data set [41];
3. Data such as traditional village rating results and related protection policies refer to "*China Statistical Yearbook 2023*" [42], "*Atlas of Historical and Cultural Towns, Famous and Traditional Villages in Hebei Province*" [43], and socioeconomic data and policy documents of prefecture-level cities in Hebei Province.
4. Data acquisition in the production system and living system is mainly based on questionnaire surveys, supplemented by interviews with village cadres.

3. Method

Scholars have pointed out that a multidimensional quantitative framework should be used to comprehensively reflect the dynamic changes and future development potential of traditional villages over a period of time, including agricultural production activities, social life, and ecological environment changes [44–47]. However, many rural vitality index systems only take into account economic, demographic, social/cultural factors, and other factors related to development [3], while not directly considering factors related to the preservation. Meanwhile, other index systems, such as "social and cultural vitality indicators" [48] and "cultural heritage vitality indicators" [49], are inadequate at representing the variations in cultural heritage preservation and rural construction and development capabilities. This is the primary cause of regional disparities in rural vitality levels. Further research is required to identify the indicator dimensions suitable for rural vitality assessment (RVA). This will provide an objective and systematic basis for the protection and development of traditional villages.

In this study, we integrate attribute spatial data by applying normalization and weighting procedures. In order to ensure consistency and comparability, attribute data indicators are normalized to a standardized scale. The significance of spatial data layers in determining the vitality of villages is determined through the application of statistical methodologies, such as the analytic hierarchy process, which are employed to weight the layers. Subsequently, geographic information system (GIS) software(ArcGIS 10.8) is employed to visualize RVA outcomes through thematic maps, charts, and graphs, thereby facilitating the recognition of spatial patterns and the analysis of spatial correlations. This integrated approach enables the RVA framework to comprehensively combine attribute and spatial data for the holistic assessment and monitoring of traditional village vitality. Such an approach offers insights that are of value to policymakers, planners, and local communities engaged in efforts to achieve sustainable development and cultural preservation.

3.1. Interpretation of the RVA

In light of China's central government's emphasis on rural revitalization, traditional villages have gained significant opportunities for conservation and development. In 2008, Jixiang Shan, the former head of China's State Administration of Cultural Heritage, highlighted the importance of tangible cultural heritage as a witness to history and culture. Such heritage still serves its original function and continues to play a role in modern social life [50]. The conservation of traditional villages not only meets the livelihood needs of the residents but also brings significant economic benefits [51]. In addition, the preservation of rural cultural heritage should not only serve the functions of inheritance and edification but also provide practical value in line with the development of the times [47]. Thus, this study defines RVA as a comprehensive assessment of the ability to conserve rural heritage and develop rural areas.

3.2. Assessment Index System of RVA

3.2.1. The Multidimensional Evaluation Index System

Previous attempts to develop indicator systems for traditional villages have typically concentrated on specific metrics, such as production, livelihood, ecology, population, land, and industry. For instance, Liu et al. evaluated the vitality of traditional villages in Lishui through an analysis of thirteen indicators. This analysis addressed both developmental and protective aspects, with a particular emphasis on demographic, environmental, and land-related factors [3]. Building on the aforementioned foundation, the present study introduces novel components pertaining to cultural heritage and the impact of the cultural/ecological environment on traditional villages. Furthermore, this paper enhances the evaluation framework by integrating data from the "Traditional Village Evaluation and Identification Indicator System (Trial)" [52] and chose 57 indicators (X1~X57) for quantitative evaluation (available in Supplementary Materials). This establishes a comprehensive assessment system based on six dimensions as follows: rural industry, living environment, natural ecology, cultural ecology, development conditions, and development potential (see Table 1).

Table 1. Six dimensions of the RVA framework.

Dimension	Description	Ref.	Aspect
Rural industry	Rural industry focuses on transforming traditional mono-farming and integrating new industries and tools to improve the efficiency of rural economic production in order to increase villagers' income and participation.	[44,53]	Land use Labor force/employees Tools and products
Living environment	It encompasses historical buildings and remains, such as traditional architectural styles, historic sites, and cultural heritage values and traditional customs, such as unique ethnic characteristics, culture, or craftsmanship, and newly constructed living spaces.	[47]	New constructions Historic buildings Traditional customs
Natural ecology	The ecosystem is defined by the interaction between spatial and temporal patterns in ecological processes of the environment of traditional villages. It refers to the landscape-scale ecosystem and ecological sensitivity, which considers the possible negative impact of the interaction between landscape patterns and ecological processes, taking into account spatial patterns and heterogeneity.	[54]	Ecological sensitivity Ecological environment
Cultural ecology	It refers to a comprehensive perspective of the cultural ecosystem based on the recognition of heritage value. This perspective interconnects the elements of material, behavioral, and spiritual culture that characterize the heritage itself with the environment, encompassing both the tangible and intangible heritage.	[55]	Tangible heritage Intangible heritage
Development conditions	Development conditions primarily refer to the current situation that affects the development of the village, including its geographical location, foundational economic elements, and human resources. The main conditions that affect village development are a favorable geographic setting for economic growth, a robust and stable overall income, a healthy population, and a well-maintained and accessible public infrastructure.	[44]	Human resources Economic foundations Geographical location Infrastructure
Development potential	Development potential is primarily analyzed by considering the local and extra-local factors that affect the village's growth. Local factors include its level of classification and travel-friendly period, while extra-local factors include government initiatives to attract talent, new employment opportunities, external investment, and more. The development potential of a village can be evaluated based on several indicators, including strong social and urban influence, natural and environmental resources, beneficial external funding, an inclusive management system, and strategically implemented policies.	[34,44]	Cultural heritage and scenic spots Talent quantity and quality Investment attraction Government policy

3.2.2. The Multidimensional Evaluation Index System

This study establishes index weights using a combined weighting method that includes both objective and subjective weight (see Figure 2). The analytic hierarchy process (AHP) is used to determine subjective weight, while the entropy weight method is used for objective weight. The weighting method is tailored to the distinct attributes of each index. The AHP is utilized to deconstruct the concept of RVA into its constituent components, indicators, and sub-indicators [3]. These indices are compared pairwise across three levels to ascertain their relative significance. Based on specific considerations such as the quantity and nature of evaluation objects, the RVA of traditional villages in Hebei Province is graded accordingly (see Table 2). Subsequently, the evaluation process is iterated for elements within each criterion, followed by indices within each element [3].

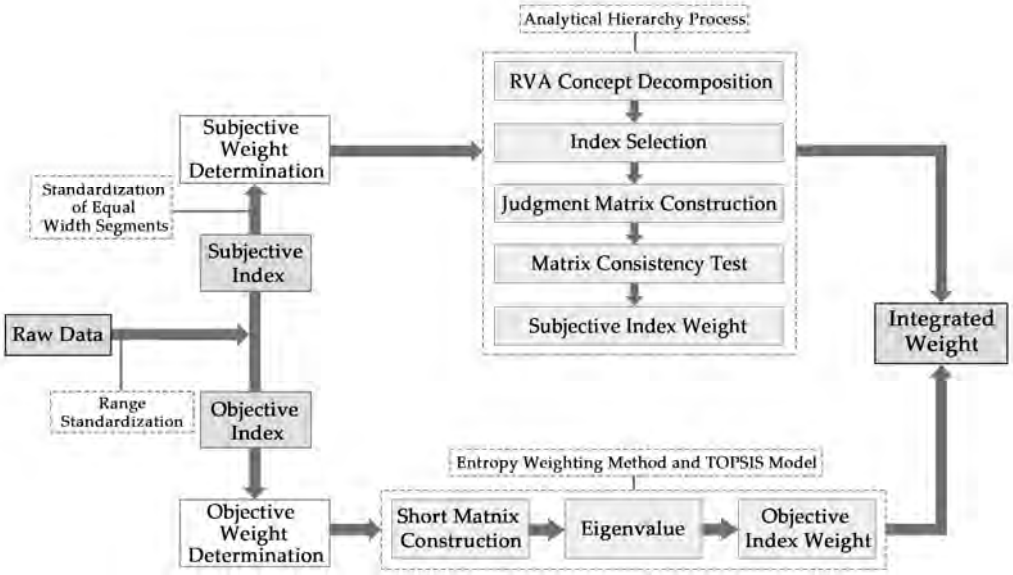

Figure 2. Analysis flow of the combined weighting method.

Table 2. Classification of traditional villages' vitality development levels.

No.	Threshold of Vitality Development Level	Level
V1	$80 \leq Xi \leq 100$	High
V2	$70 \leq Xi < 80$	Middle-high
V3	$50 \leq Xi < 70$	Intermediate
V4	$30 \leq Xi < 50$	Middle-low
V5	$Xi < 30$	Low

This study conducted questionnaire surveys and interviews with local residents, officials familiar with selected cases, and experts with many years of work experience in related fields. A total of 180 responses were collected, including 165 questionnaires and 15 interviews with academic and government personnel. The fieldwork was conducted from January 2023 to February 2024, spanning a total duration of 13 months. Thirty-minute interviews were conducted with government officials responsible for township construction and expert professors in traditional village preservation. Additionally, twenty-minute interviews were held with local resident representatives, focusing on issues such as the inheritance of traditional village culture, the status of architectural preservation, and the current state of the ecological environment and infrastructure. All interviews were recorded.

After several rounds of scoring, a judgement matrix was created and input into yaanp2.5 software for consistency inspection (CI) and weight calculation. The inspection results indicated that the matrix passed the consistency test (all items were lower than

0.1). Subsequently, a subjective weight index system was established based on these results. Furthermore, the EW method involved constructing an original data matrix based on the evaluation framework indicators. The TOPSIS model was then used to calculate the eigenvalues and entropy values, resulting in the objective weight indicators (refer to Section 3.2.5 for a detailed description). Table 2 displays the final weights of both subjective and objective indicators.

3.2.3. Index Scoring and Index Weighting Method

According to the index attributes and data types in the evaluation framework established by our team [3], the authors deeply studied the backwardness of typical traditional villages with better protection and development, and combined the national standards, experts', and villagers' opinions, setting five evaluation standards (1, 2, 3, 4, 5) for scoring (see Table 2). $0 < X \leq 1$ had a lower correspondence degree, with an assignment of 1 point; $4 < X \leq 5$ had the highest correspondence degree, with an assignment of 5 points.

3.2.4. Index Data Binning

All 57 indexes were analyzed by the range standardization method, finding the maximum (Xmax) and minimum (Xmin) of the index, calculating the range (R = Xmax − Xmin), and then subtracting the minimum (Xmin) from each observed value (X) of the variable and dividing by the range (R).

$$X' = (X - \text{Xmin})/(\text{Xmax} - \text{Xmin})$$

Following the application of the range standardization method, each observed value of the variable underwent a numerical transformation to ensure it fell within the range of $0 < X < 1$, irrespective of its original positive or negative status. This process enabled both positive and inverse indices to be uniformly converted into positive indices, streamlining subsequent weight calculation and comprehensive score determination.

Then, 18 indexes, such as vegetation coverage rate, were treated in equal width segments, and specific scores were obtained (see Table 3). The remaining 39 indicators were scored according to the actual survey data.

Table 3. Subjective indexes after standardization of equal width segments.

No.	Dimension	Index No.	Level
A3	Natural ecology	X20	$4 < X \leq 5$
		X21	$3 < X \leq 4$
		X22	$3 < X \leq 4$
A4	Cultural ecology	X23	$3 < X \leq 4$
		X25	$4 < X \leq 5$
		X27	$2 < X \leq 3$
		X29	$1 < X \leq 2$
		X31	$1 < X \leq 2$
		X32	$1 < X \leq 2$
		X34	$2 < X \leq 3$
		X35	$1 < X \leq 2$
		X38	$2 < X \leq 3$
		X39	$2 < X \leq 3$
		X44	$1 < X \leq 2$
A6	Development potential	X52	$1 < X \leq 2$
		X53	$0 < X \leq 1$
		X54	$0 < X \leq 1$
		X55	$1 < X \leq 2$

3.2.5. Assessment Analysis

Entropy Weight (EW) Method and TOPSIS Model

The EW method, also referred to as the technique for order preference by similarity to ideal solution (TOPSIS) model, operates as a distance-based evaluation technique. At its core, it gauges the distance between the evaluated object and both the optimal and worst values available [56]. Then, it calculates the proximity between the evaluated object and the ideal value, facilitating the ranking of advantages and disadvantages. This study's specific requirements, characterized by a small sample size and high objectivity, deemed it suitable. The EW-TOPSIS model represents an enhancement of the TOPSIS model, incorporating the entropy weight method to ascertain the weight of individual evaluation indices and evaluate the significance of each objective evaluation index [57]. The TOPSIS model was then used to rank the decision objectives. The EW-TOPSIS model was used in this paper to calculate the index weights at all levels. The following section outlines the calculation steps:

(1) Construct the evaluation index system matrix (M). Assuming that there are m evaluated objects and each evaluated object has n indexes, the evaluation index system matrix is:

$$M = (x_{ij})_{m\times n}(i = 1, 2, \cdots, m; j = 1, 2, \cdots, n) \quad (1)$$

where i is the evaluated object; j is the evaluation index [58].

(2) Standardization of index matrix:

$$R = (r_{ij})_{m\times n}(i = 1, 2, \cdots, m; j = 1, 2, \cdots, n) \quad (2)$$

where R is the standardized evaluation index system matrix; r_{ij} is the standard value of the i-th evaluated object on the j-th evaluation index; m is the total number of evaluation objects; n is the total number of evaluation indexes [58].

(3) Calculate the entropy:

$$E = -k\sum_{n}^{m} p_{ij} \ln P_{ij} \quad (3)$$

where E_j is the entropy; $p_{ij} = r_{ij}/\sum I = 1 m r_{ij}$; k is a constant term, $k = 1/\ln m$ [57]; p_{ij} is the proportion of index value under the j evaluation index of the i-th evaluated object of matrix R [58].

(4) Determine the objective index weight:

$$w_j = \frac{1 - E_j}{\sum_{j=1}^{n}(1 - E_j)} \quad (4)$$

where w_j is the weight of index j; E_j is the entropy of index j [58].

(5) Calculate the normalized entropy weight matrix (O):

$$O = (o_{ij})_{m\times n,} o_{ij} = w_j r_{ij}(i = 1, 2, \cdots, m; j = 1, 2, \cdots, n) \quad (5)$$

where o_{ij} is the value of the i-th evaluated object after the j-th evaluated index standardization [58].

(6) Determine the optimal solution ($o_i{}^+$) and the worst solution ($o_i{}^-$) [58]:

$$\begin{cases} o_i{}^+ = \max\limits_{j}(o_{ij})(i = 1, 2, \cdots, m; j = 1, 2, \cdots, n) \\ o_i{}^- = \min\limits_{j}(o_{ij})(i = 1, 2, \cdots, m; j = 1, 2, \cdots, n) \end{cases} \quad (6)$$

(7) Calculate the Euclidean distance between the target object and the optimal and the worst solutions [58]:

$$r_j{}^+ = \sqrt{\sum_{i=1}^{m} w_i (o_{ij} - o_i{}^+)^2} \quad (7)$$

$$r_j{}^- = \sqrt{\sum_{i=1}^{m} w_i (o_{ij} - o_i{}^-)^2} \quad (8)$$

(8) Calculate the integrated evaluation index:

$$C_j = r_j^- / \left(r_j^+ + r_j^-\right) \quad (9)$$

where C_j is the closeness between the evaluated object and the optimal solution, and the larger the value, the better the evaluated object [57].

Analytic Hierarchy Process (AHP)

AHP is used to calculate the weights of subjective indexes assigned to different evaluation factors [59]. The consistency ratio (CR) is utilized to assess the consistency of pairwise comparisons of classes and subclasses. CR can be calculated using the following equation [60]:

$$CR = \frac{CI}{RI} \quad (10)$$

where RI is the random index indicating the consistency index of the randomly generated pairwise matrix shown in Table 2 and CI is the consistency index which is computed using following formula [61].

$$CI = \frac{\lambda max - n}{n - 1} \quad (11)$$

where λmax is the largest matrix eigenvalue; n is the number of thematic layers. CR less than 0.10 indicates acceptable consistency of pairwise comparison and weight calculation. If CR is more than 0.10, the pairwise comparison has to be modified until it is reduced below 0.10 [60].

ArcGIS Superposition Analysis

Employing the raster calculator tool of ArcGIS 10.8 and applying the weighted superposition method, this study conducts a comprehensive analysis of each evaluation index. The calculation method is as follows [62]:

$$RVA = \sum_{i=1}^{n} \omega_i \cdot Y_i \quad (12)$$

where ωi signifies the weight of the i-th index, and Y_i denotes the standardized value of the i-th index [62]. A higher RVA value corresponds to a heightened level of vitality, while the reverse holds true. The value should consistently remain within the range of 0 to 100.

Coefficient of Variation Method

The coefficient of variation method is a statistical measure that assesses the extent of variation among observed values in a dataset. When the unit of measurement aligns with the mean, the standard deviation can be directly utilized. However, if the unit differs from the mean, comparing the variation degree using the standard deviation becomes inappropriate. In such cases, the ratio of the standard deviation to the mean should be employed for comparison [28]. The formula for calculating the coefficient of variation is as follows:

$$c = \frac{x}{\varphi} \times 100\% \quad (13)$$

where c is the coefficient of variation, x is the standard deviation, and φ is the mean [28].

Kernel Density Analysis

The spatial distribution of traditional villages across Hebei Province exhibits non-uniformity, which fluctuates according to the area under consideration [28]. This method operates on the assumption that events can potentially transpire anywhere within a given space, each with varying probabilities across different locations. Moreover, the intensity of the designated reference point correlates with the likelihood of an event taking place, where a greater intensity signifies a heightened probability of occurrence. In this study, we

utilize kernel density analysis to visually illustrate the clustering and dispersion patterns. The kernel density is computed using the following formula:

$$f_n(x) = \frac{1}{nh}\sum_{i=1}^{n} k\left(\frac{x - x_i}{h}\right) \quad (14)$$

where $k(\frac{x-x_i}{h})$ is the kernel function; h is the search bandwidth; $(x - x_i)$ represents the distance from the estimated point x to the event x_i [63].

Interpretative Phenomenological Analysis (IPA)

IPA is a methodological approach that falls under importance expressiveness analysis, typically represented in a four-quadrant diagram format, providing a visual representation of each objective within these quadrants. It delineates a two-dimensional depiction, with the vertical axis capturing "potential value evaluation values", encompassing development conditions and development potential. The diagram presents each objective in one of the four quadrants, with the horizontal axis representing "current resource evaluation values" and factoring in three dimensions: production system, living system, and natural ecology (See Figure 3). To determine the intersection point, the average value, excluding the highest and lowest values, is computed, resulting in the coordinates (23.81, 17.35). The coordinate system is divided into four quadrants: advantage area, opportunity area, vulnerability area, and improvement area.

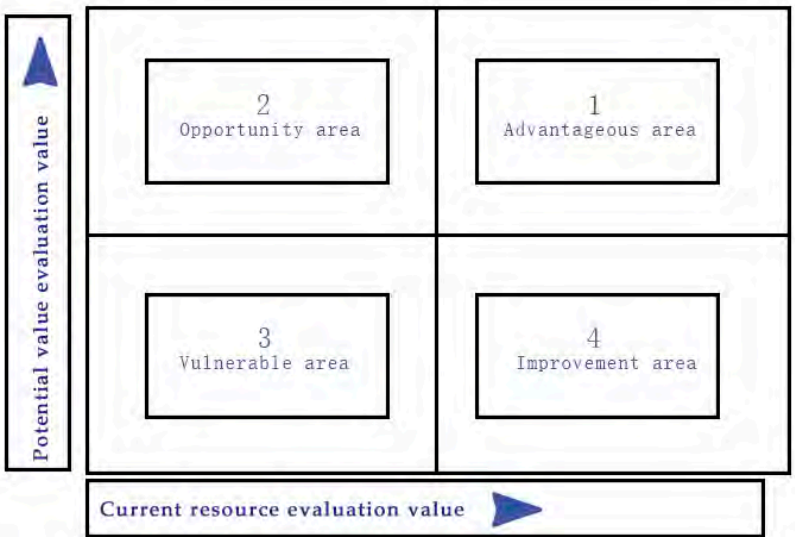

Figure 3. IPA analysis presenting four different strategic areas.

4. Results

4.1. Ratings of RVA Levels across Hebei Province

After analyzing the levels of vitality development in 206 selected cases in Hebei Province using the established evaluation model, it was clear that all evaluated entities received scores of 60 points or less. Baizhongbu Village received the lowest score of 29.50 (available in Supplementary Materials S2). The sorted scores showed a median of 40.58 points (see Figure 4). The vitality development level in Hebei Province was notably low, whether examining individual scores or the median level. This highlights the challenge of halting the continuous decline of traditional villages.

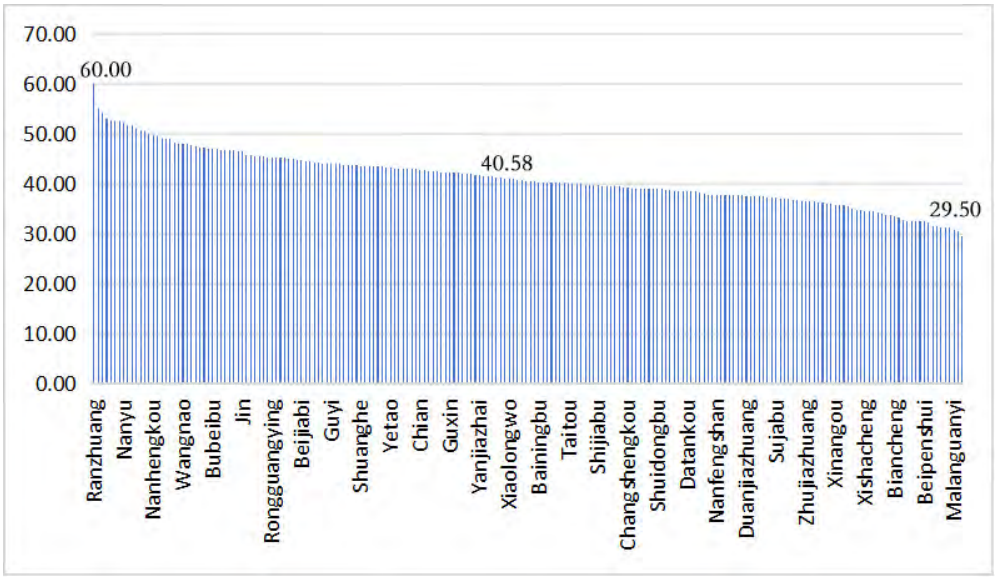

Figure 4. Ranking of RVA level of traditional villages in Hebei Province. (Data source: The Ministry of Housing and Urban–Rural Development of the P.R.C.) Note: some scores are not displayed in this chart.

4.2. Zoning Assessment

Based on the spatial distribution of traditional villages with varying levels of vitality in Hebei Province (refer to Figure 5), it became apparent that there was a concentration of objects with a middle-low level of vitality development, primarily in the southern part of Hebei, such as Shijiazhuang (no. = 53) and Zhangjiakou (no. = 52), Handan (no. = 44), and Xingtai (no. = 40). Baizhongbu Village is located in Zhangjiakou and it was the only case that exhibited a low level of the whole. For further evaluation, Hebei Province was divided into four areas based on climatic and geographical conditions: northern, central, eastern, and southern Hebei (refer to Figure 6).

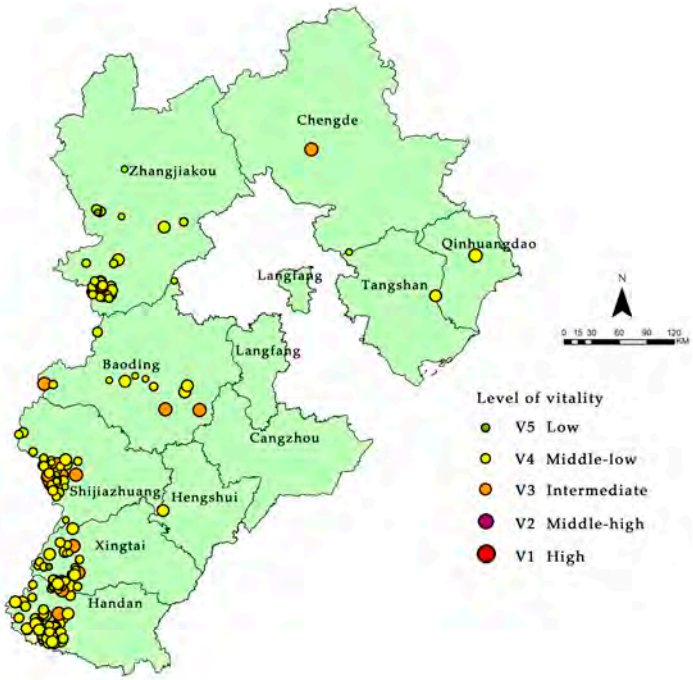

Figure 5. Spatial distribution of traditional villages with different revitalization levels in Hebei Province (Data source: The Ministry of Housing and Urban–Rural Development of the P.R.C. Map Source: http://bzdt.ch.mnr.gov.cn/, accessed on 5 November 2023).

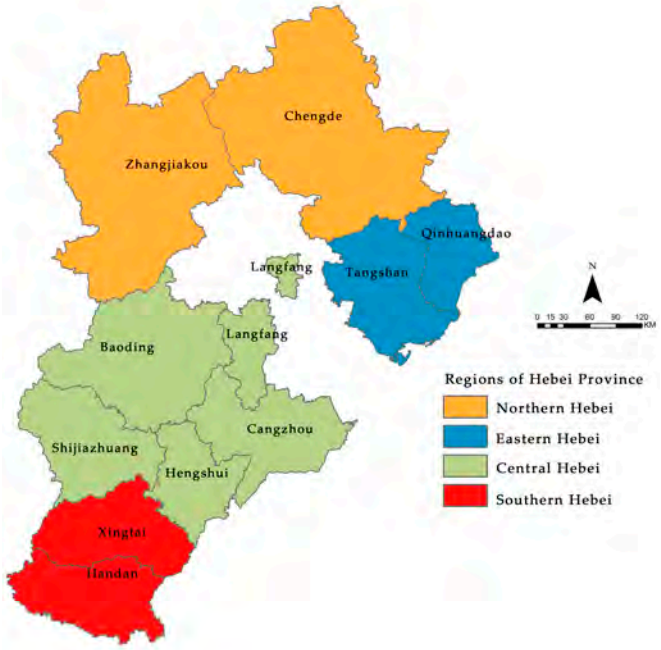

Figure 6. Four regions in Hebei Province based on climatic and geographical conditions. (Data source: The Ministry of Housing and Urban–Rural Development of the P.R.C. Map Source: http://bzdt.ch.mnr.gov.cn/, accessed on 5 November 2023).

4.2.1. Statistical RVA Results

According to the statistics for different vitality levels (refer to Table 4), it was evident that 191 villages exhibited a low vitality development level (V4), accounting for 92.72% of the total. Additionally, 14 cases had an average vitality development level (V3), accounting for 6.80% of the total. Only one village demonstrated an extremely low vitality development level (V5), making up 0.48% of the total. Traditional villages with extremely high (V1) and relatively high (V2) levels of vitality development constituted 0%.

Table 4. Statistical results after RVA evaluating traditional villages in Hebei Province (amount).

RVA Level	Northern Hebei	Southern Hebei	Central Hebei	Eastern Hebei	Total	Proportion
V1 (High)	0	0	0	0	0	0.00
V2 (Middle-high)	0	0	0	0	0	0.00
V3 (Intermediate)	1	5	8	0	14	6.80%
V4 (Middle-low)	51	79	58	3	191	92.72%
V5 (Low)	1	0	0	0	1	0.48%

It was evident that no villages in any region received ratings of V1 or V2 (refer to Table 5). Central Hebei had the highest percentage of V3 ratings at 12.12%, while the eastern Hebei region had a 100% rating for V4, followed by central Hebei at 96.22%. The northern Hebei region achieved a 100% rating for V5, with the other regions receiving a rating of zero. Southern Hebei had the highest count of traditional villages (no. = 84), while eastern Hebei had the lowest count (no. = 3) when considering the total number of villages in each district.

Table 5. Statistical results after RVA evaluating traditional villages in Hebei Province (proportion).

RVA Level	Northern Hebei	Southern Hebei	Central Hebei	Eastern Hebei
V1 (High)	0	0	0	0
V2 (Middle-high)	0	0	0	0
V3 (Intermediate)	1.89%	12.12%	5.95%	0
V4 (Middle-low)	96.22%	87.88%	94.05%	100.00%
V5 (Low)	1.89%	0	0	0
Total	53	66	84	3

4.2.2. Median Statistics Analysis

The median statistics of RVA zoning assessment results in Hebei Province across the four regions (as shown in Figure 7) indicated that eastern Hebei had the highest median development level in the province, standing at 44.03. Central Hebei and southern Hebei fell into the medium-level category, whereas northern Hebei exhibited the lowest median in the province, reaching only 39.42. These findings highlight differences in the protection and development status of villages across various regions of Hebei Province. The level of village activation in northern Hebei was particularly low and requires special attention. Additionally, the eastern, central, and southern regions of Hebei need improvements in the dynamic development of traditional villages.

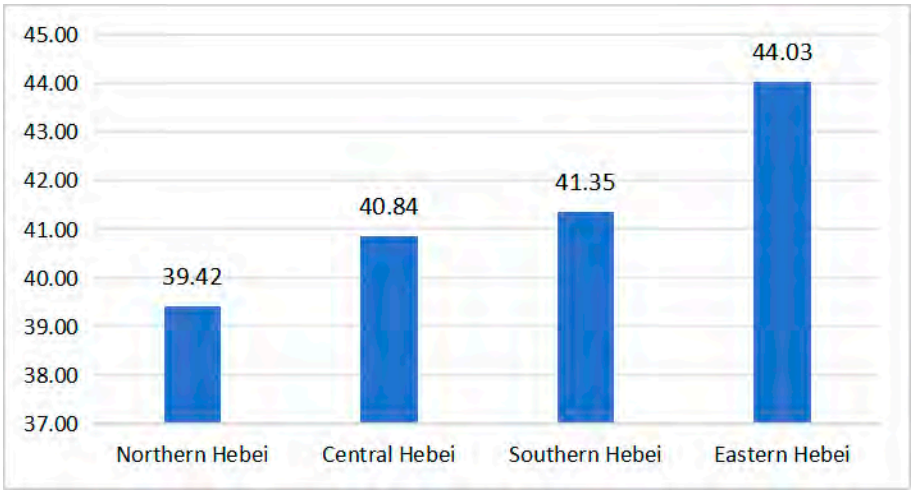

Figure 7. Median statistics of RVA zoning assessment results in Hebei Province (Data source: The Ministry of Housing and Urban-Rural Development of the P.R.C.).

4.2.3. Economic Development Analysis

An analysis of the economic development levels of cities in Hebei Province (see Figure 8) revealed that eastern Hebei had the highest per capita GDP and urbanization level in the province. Furthermore, the region had the second-highest proportion of secondary industry and the least proportion of primary industry. These findings suggest a favorable economic development status in eastern Hebei, indicating a relatively robust economic condition. In contrast, southern Hebei had the lowest per capita GDP and urbanization rate in the province, indicating a relatively less favorable economic situation in the region, while the eastern region experienced high levels of economic development. However, the limited number of preserved traditional villages contributes to an overall poor revitalization and development situation. Conversely, the other regions struggle with lower levels of economic development, resulting in poor RVA outcomes.

Our analysis suggests that the dynamic development of traditional villages is intricately linked to the level of economic development. However, a more rigorous demonstration of this correlation is necessary. Future research should incorporate statistical analyses, including correlation coefficients and regression models, to substantiate these conclusions and provide a more robust understanding of the relationship between the dynamics of traditional villages and economic development levels.

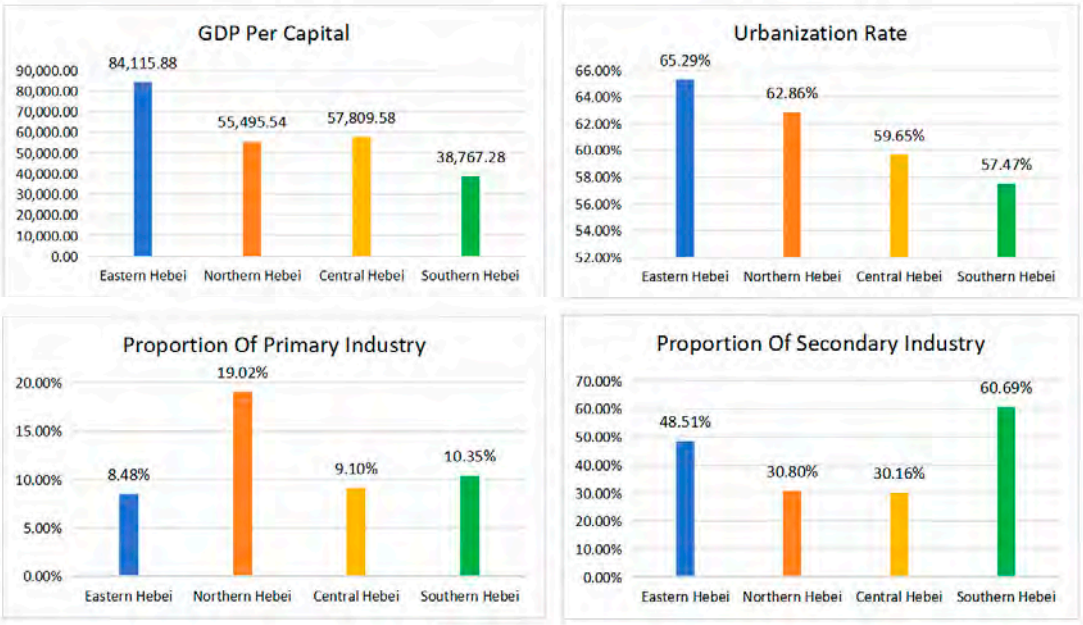

Figure 8. Regional economic development level of Hebei Province. (Data source: Statistical Yearbook of Hebei Province 2022).

4.3. Multidimensional Scoring

According to the scores of traditional villages in the four subdivisions of Hebei Province across six dimensions (see Figure 9), eastern Hebei performed better than the average in both ecosystem and development conditions, while the northern region significantly lagged behind the average. Concurrently, the living system and cultural ecological dimensions across each district closely aligned with the average values, showing no significant differences. The cultural ecology dimension had the highest rating from an average score perspective. This indicates that there is commendable preservation of material heritage, robust inheritance of intangible cultural heritage, and favorable foundational conditions for the development of rural cultural industries. The development conditions dimension received a high score, indicating that traditional villages in Hebei Province have advantageous conditions in terms of location, infrastructure, population, and economic foundation. This positions them favorably to align with rural revitalization policies and contribute to sustainable rural development. However, the remaining indicators, namely living environment, rural industry, natural ecology, and development potential, received lower scores. This indicates outdated production methods in those cases, underutilization of historical buildings, and suboptimal ecological conditions.

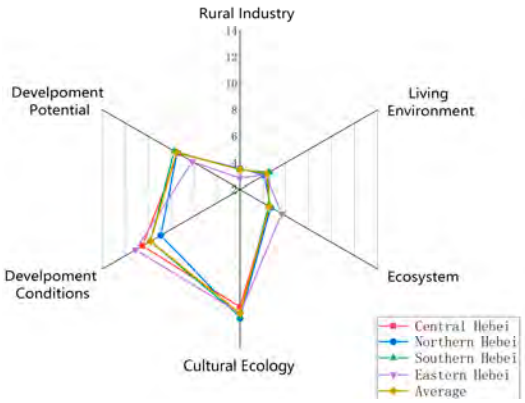

Figure 9. Scores of the six dimensions of RVA in Hebei Province. (Data source: The Ministry of Housing and Urban–Rural Development of the P.R.C. Map Source: http://bzdt.ch.mnr.gov.cn/, accessed on 5 November 2023).

4.4. Kernel Density Analysis

Utilizing ArcGIS 10.8, we conducted a spatial visualization of vitality levels across six dimensions, as depicted in Figure 10 (see Figure 10). The distribution characteristics within these six dimensions revealed a consistent pattern, shaping a bimodal activation spatial structure with elevated levels in the central and southern regions and diminished levels in the northern part of the province. Predominantly situated in the cities of Shijiazhuang, Handan, Xingtai, Baoding, and Zhangjiakou, the villages exhibited a clustered distribution in two primary areas. Notably, a concentration was observed in the western Xingtai-Handan region and the central-southern Shijiazhuang area, indicating higher vitality. Conversely, the southern part of Zhangjiakou showcased a concentration of villages with relatively lower vitality.

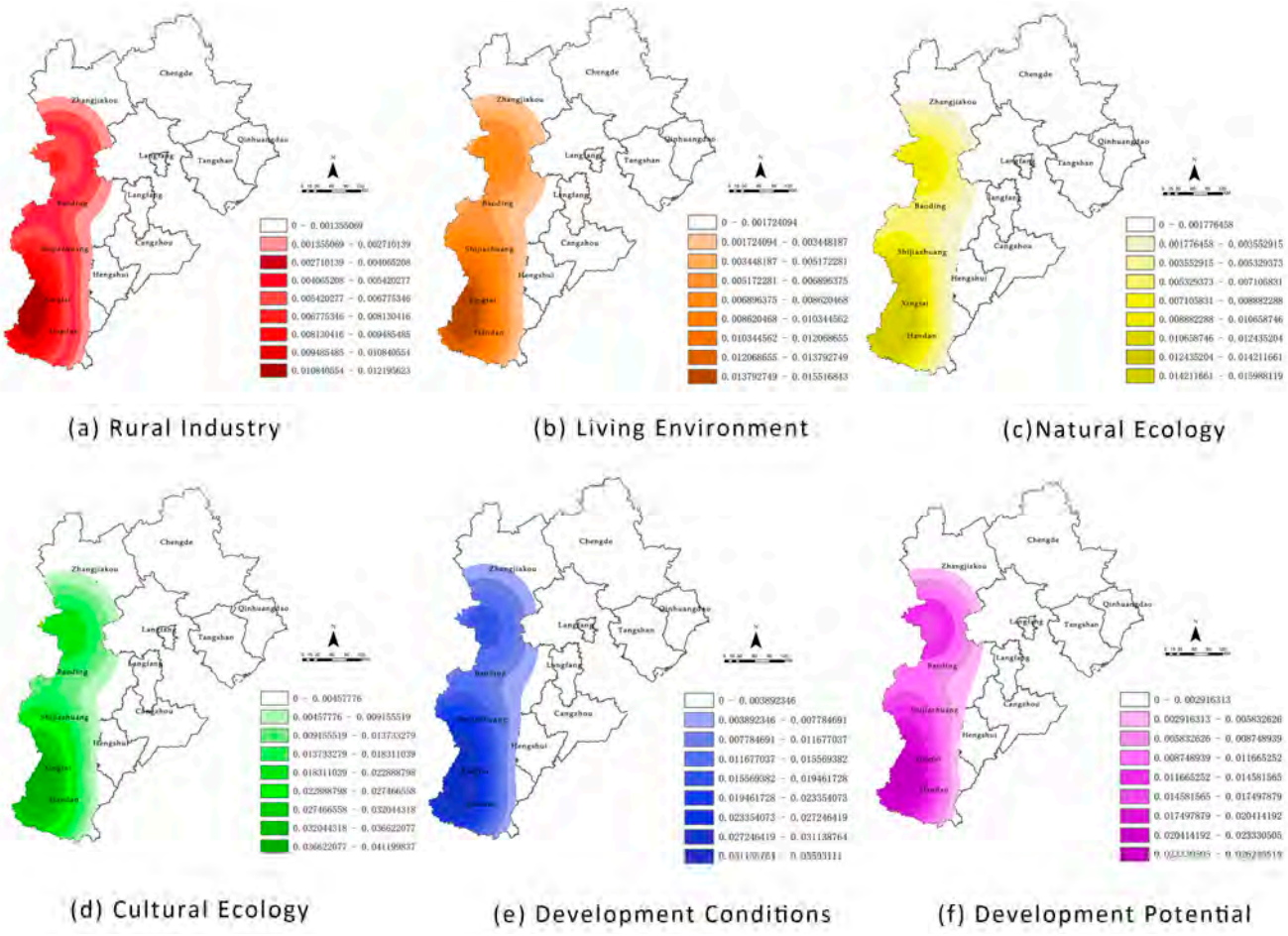

Figure 10. Kernel density analysis of the multidimensional RVA of traditional villages in Hebei Province. (Data source: The Ministry of Housing and Urban–Rural Development of the P.R.C. Map Source: http://bzdt.ch.mnr.gov.cn/, accessed on 5 November 2023).

While kernel density analysis merely demonstrated the geographical clustering of traditional villages, IPA analysis was essential for evaluating and categorizing the development potential and preservation status of the 206 traditional villages. To further understand the spatial distribution and density of features, an IPA (importance performance analysis) was included in a subsequent section of this paper and was treated separately to highlight the specific insights that IPA offers.

4.5. Importance Performance Analysis (IPA)

This article utilizes IPA diagrams to visually represent a comprehensive analysis of the protection status and development potential of traditional villages. The horizontal

axis represents the current situation of rural heritage protection in the three dimensions of production system, living system, and ecological system. The vertical axis represents the prediction of village development potential in the two dimensions of development conditions and development potential. The intersection point (23.81, 17.35) is determined by taking the average value after removing the highest and lowest values. The coordinate system is then divided into four quadrants: advantage, opportunity, vulnerability, and improvement (see Figure 11). The specific definition and implications for each strategic area are listed below:

(a) Advantageous area (first quadrant): This quadrant encompasses traditional villages that exhibit high levels of vitality. These villages exhibit a number of advantages in terms of their cultural, ecological, and environmental aspects when compared with other villages. The robust vitality observed in these areas is indicative of the maintenance of cultural heritage and the sustenance of a robust ecological environment. This suggests that these areas are already thriving and require continued support to maintain their advantageous status.

(b) Opportunity area (second quadrant): The villages in this quadrant demonstrate a relatively high level of vitality and possess considerable development potential. These traditional villages are in a favorable position to undergo growth and improvement, given their existing resources and conditions. Strategic interventions in these areas should focus on leveraging their potential to enhance their cultural and ecological attributes further, thereby transitioning them into the advantageous category.

(c) Vulnerable area (third quadrant): The quadrant encompasses traditional villages with low levels of vitality, characterized by fragile cultural and ecological environments. It is imperative that these villages receive protection and preservation efforts without delay. It is imperative that immediate and targeted measures are implemented to safeguard the cultural heritage and improve the ecological conditions of these vulnerable villages in order to prevent further deterioration.

(d) Improvement area (fourth quadrant): The traditional villages in this quadrant exhibit a moderate level of vitality, with both cultural heritage and environmental conditions requiring attention and enhancement. It is recommended that strategic efforts be directed towards holistic development, with a focus on the preservation and enhancement of cultural and ecological assets in order to boost their vitality levels.

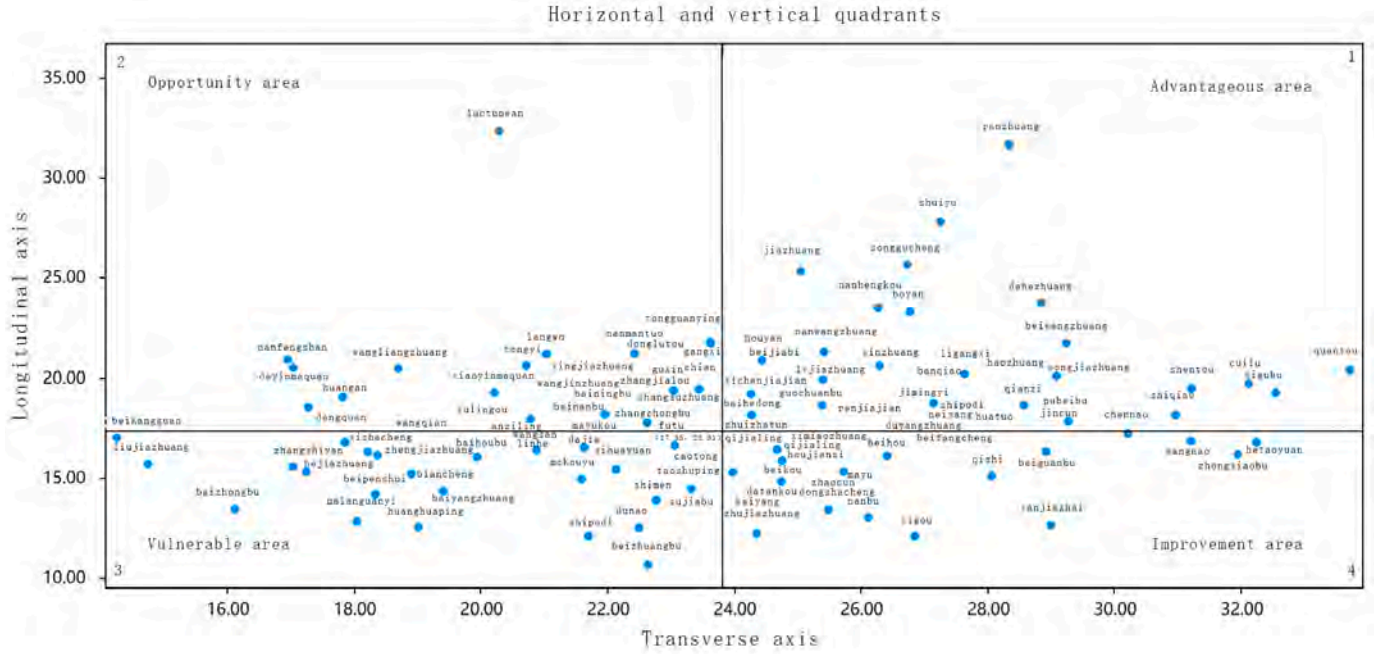

Figure 11. IPA analysis of current resource evaluation and potential value. (Data source: https://www.gscloud.cn/, accessed on 5 November 2023).

4.6. Equilibrium Analysis

Analysis of the degree of dispersion of RVA in the four regions employed the coefficient of variation to illustrate the equilibrium of rural conservation and development (see Figure 12) and is further visualized in Figure 13. A higher coefficient of variation denotes increased dispersion and a poorer balance, while a lower value indicates better balance. Figure 12 reveals that southern Hebei exhibited the smallest coefficient of variation, indicating the highest level of balance. Central Hebei and northern Hebei fell in the mid-range with average balance, while eastern Hebei displayed the largest coefficient of variation, distinct differentiation characteristics, and the least favorable balance.

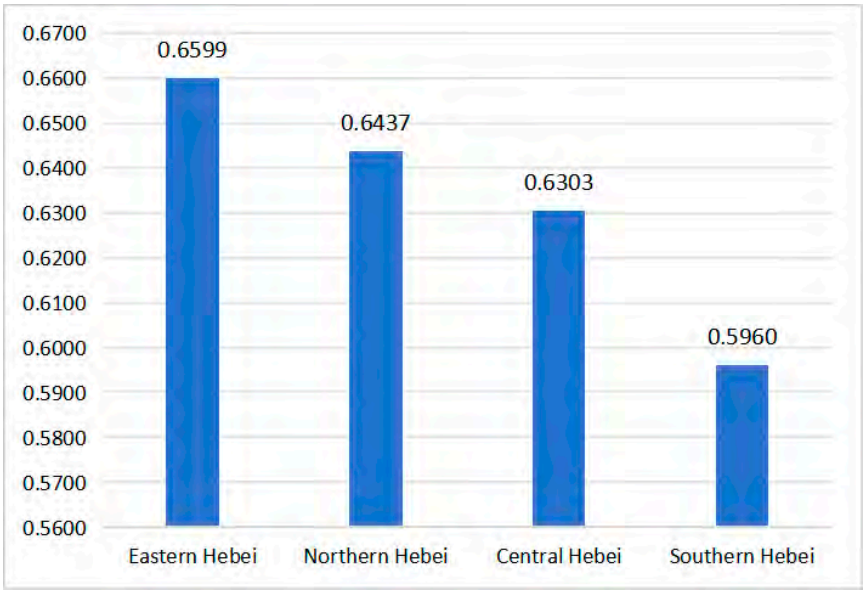

Figure 12. Coefficient of variation of the revitalization development level of traditional villages in the four regions (Data source: https://www.gscloud.cn/, accessed on 5 November 2023).

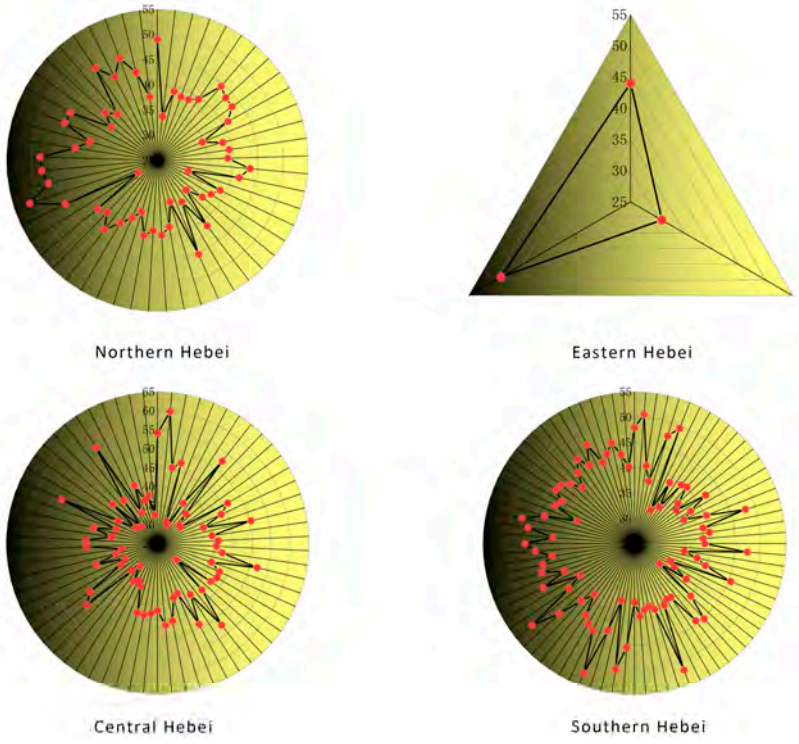

Figure 13. RVA scores of traditional villages in the four regions of Hebei Province. (Data source: https://www.gscloud.cn/, accessed on 5 November 2023).

4.7. Regional Activity Analysis

Cultural landscape changes and population mobility are primarily influenced by macro-social life and economic construction activities. To reflect the spatial distribution characteristics and correlation degree of regional activities in Hebei Province, three factors—population, GDP, and road network density—were selected and plotted (see Figure 14).

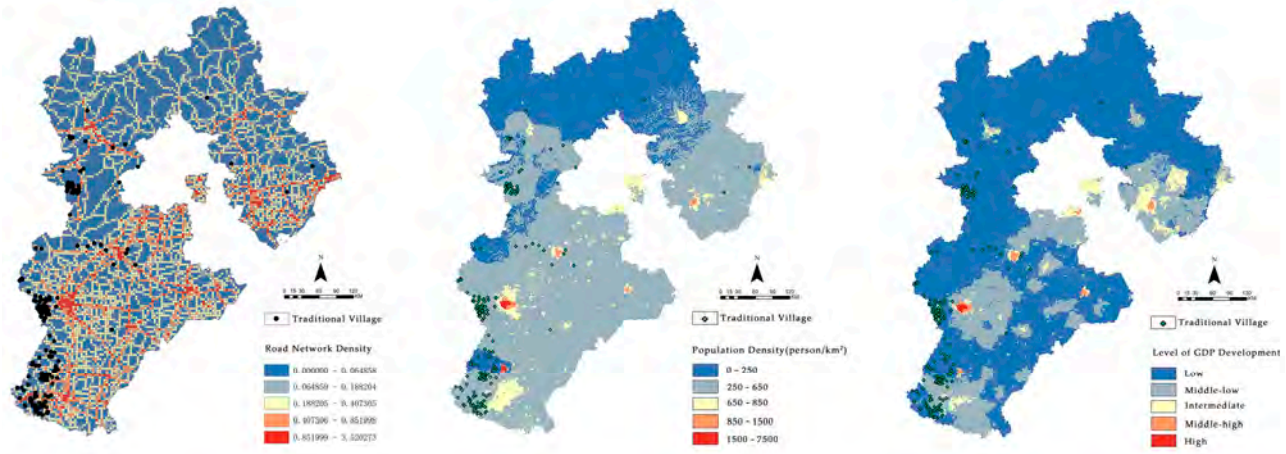

Figure 14. Coupling diagram of the regional activity analysis and traditional villages in Hebei Province (Data source: https://www.gscloud.cn/, accessed on 5 November 2023).

Eastern Hebei has a high spatial density of road networks, an average population density, and elevated GDP levels. The area has widespread distribution, significant social and economic activity, and a limited number of scattered villages. In the central and southern regions of Hebei, which are characterized by dense road networks, population density, and GDP levels, a concentration of these attributes is observed in the central core area. The region's development is uneven, with high social and economic activity and a significant presence of villages. In contrast, the western regions face challenges related to population and transportation, while development is concentrated in the north. Northern Hebei has a low spatial density in road networks, accompanied by low population, overall GDP levels, and social and economic activity. Traditional villages are concentrated in the southern part of Zhangjiakou. The level of regional activity, whether high or low, presents challenges during rural renewal. High regional activity can lead to the destruction of under-protection rural areas, while low activity may impose developmental restrictions, resulting in a generally low activation process.

In conclusion, extreme regional socioeconomic activities act as impediments to spatial protection and cultural inheritance. To revitalize these villages, it is essential to comprehensively consider the balance between the area's social and economic activity and the level of revitalization of the village in order to ensure sustainable protection and development.

5. Discussion

5.1. Construction of Evaluation Framework and Discussion on Indicators for RVA of Traditional Villages in Hebei Province

Rural communities must address conservation issues while recognizing the potential of their diverse and vibrant heritage. Existing research primarily focuses on two aspects: development elements, such as the economy, population, and social conditions [64], and the conservation of cultural heritage [47]. There is a need for comprehensive studies that consider both rural development and heritage conservation. It is urgent to develop a methodology to understand the balance between these two conflicting aspects in rural heritage.

Examining rural communities worldwide, it is evident that nature and human society have coexisted for millennia. However, there is still controversy over whether the natural ecological environment and cultural ecological elements have a significant impact

on the vitality of traditional villages. Some scholars argue that the natural ecological environment has little impact on the development of the rural area and should not be a research focus [46]. This is because traditional villages in China are typically situated in mountainous and hilly areas with relatively good natural ecosystems. While some scholars have included the natural ecological environment as a criterion for vitality assessment and have analyzed factors such as water quality, farmland density, altitude, and slope [34,65], others have also considered the morphological transformation of rural settlements [66]. Incorporating natural ecological elements into the RVA index is significant and could offer a potential solution.

Some economic indicators such as birth rate, mortality rate, and employment rate were excluded from the index selection due to the unavailability of rural-level data in China. Once more comprehensive data are released by the country, the evaluation indicators will be further improved to enhance the comprehensiveness, objectivity, and logical structure of the evaluation.

5.2. IPA analysis to Provide Guidance for Rural Revitalization

Table 6 shows the basic characteristics of each quadrant. The practical implications of the IPA results are listed below:

(1) Villages located in geographically advantageous areas often experience a higher level of revitalization, which is characterized by dominant industrial development, particularly in the form of tourism. These cases strategically leverage their traditional attributes and actively promote tourism as a means of safeguarding their cultural heritage while achieving harmonized economic, social, and ecological benefits. It is important to note that this assessment is based on objective analysis of available data rather than subjective evaluation. Combining industrial transformation with cultural characteristics appears to be a promising strategy for promoting the dynamic development of traditional villages. Ranzhuang village is one of the good examples, located in the central part of Baoding City, featuring flat terrain and a good ecological environment. The red tourism industry is thriving, cultural heritage is well preserved, villagers enjoy a high standard of living, and village infrastructure is relatively complete. It is a well-known educational base, where culture and education are integrated.

(2) Villages situated in fragile areas should focus on safeguarding and fortifying their original features. Any compromise to their architectural styles and spatial patterns could significantly impede their developmental trajectory. Furthermore, integrating cultural elements can facilitate industrial upgrading and development, attracting potential investments. Baizhongbu village is considered located in the fragile area. It is in a hilly and mountainous region, and suffers from poor transportation, noticeable issues of population aging and hollowing out, underdeveloped infrastructure, and low levels of cultural heritage preservation. It is an extremely vulnerable area in terms of dynamic evaluation.

(3) Priority should be given to protecting and strengthening the original features of villages in fragile areas, as damage to their styles and patterns can be extremely detrimental to their development. Additionally, integrating cultural elements can aid in industrial upgrading and development, which can attract investment.

(4) Villages within the improvement area have abundant resources but generally exhibit low development potential, which is intricately linked to population decline. These cases have diminished social and economic value. To prevent the decline of such villages, it is imperative to attract younger demographics back to their ancestral homes and foster entrepreneurship.

Table 6. Analysis of IPA quadrant characteristics in traditional villages in Hebei Province.

Quadrant	Region	Quantity/ Proportion	Characteristic	Typical Village
I	Advantage area	60/29.13%	The current resource evaluation and potential value evaluation are both high, with high historical value and cultural value.	Ranzhuang, Quantou
II	Opportunity area	35/16.99%	The current resource evaluation is low but the potential value evaluation is high, which seeks the breakthrough point of village multidimensional value.	Luotuowan, Rongguanying
III	Vulnerability area	61/29.61%	The current resource evaluation and potential value evaluation are very low, and priority is given to the cultural skills, historical value, and landscape features of traditional villages.	Liujiazhuang, BaiZhongbu
IV	Improvement area	50/24.27%	Existing resource evaluation is high but potential value evaluation is low, which needs to focus on improvement under the addition of current resources to expand the influence of potential value.	Wangnao, Zhongxiaobu

5.3. The promotion of the RVA Framework

The differences observed in equilibrium analysis between these regions can be attributed to several potential factors:

(a) Regional economic policies: The economic policies in eastern Hebei may prioritize industrial development and urbanization, leading to significant disparities in economic activities and infrastructure development across villages. This focus on economic growth may result in neglect of traditional village preservation, contributing to the high coefficient of variation and poor balance observed.

(b) Demographic trends: Southern Hebei, with its lower coefficient of variation, may benefit from more stable demographic trends. For instance, a relatively even distribution of population and less pronounced migration patterns can lead to more consistent levels of development and conservation efforts across villages, thus achieving a better balance.

(c) Environmental conditions: Environmental factors play a crucial role in the sustainability and development of traditional villages. Regions like eastern Hebei might experience environmental challenges, such as pollution or resource depletion, due to intensive industrial activities. These environmental pressures can create significant disparities in village vitality and preservation, leading to higher variability and poorer balance. Conversely, southern and western Hebei might have more favorable environmental conditions that support balanced rural development.

(d) Government and institutional support: The level of government and institutional support for rural development and conservation can differ significantly across regions. Southern Hebei might benefit from more equitable and comprehensive support programs, leading to a more uniform distribution of resources and better balance. Eastern Hebei, on the other hand, might face challenges due to uneven or inadequate policy implementation, exacerbating disparities and leading to a higher coefficient of variation.

By considering these factors, we gain a deeper understanding of the underlying causes of regional differences in the balance of rural conservation and development. Future policy recommendations should address these specific regional characteristics to promote more equitable and effective strategies for traditional village preservation and development.

5.4. Promotion of the RVA Framework

The results of this analysis of rural vitality can be instrumental in supporting the effectiveness of policies aimed at the sustainable revitalization of traditional villages. By

comparing the findings of this study with those from other regions of China or other countries, we can offer a broader perspective on the implications of our research. Tailored policies can be proposed based on the unique characteristics of each village to foster sustainable revitalization. Subsequently, local governments can implement customized policies according to the levels of vitality analysis and focus areas.

For instance, our study identifies preservation and development strategies for 192 cases of low vitality, aiming to prevent the extinction of traditional villages. The clusters with low vitality, such as Baizhongbu Village in northern Hebei and Liujiazhuang Village in southern Hebei, require special attention. Additionally, sustainable development and policy formulation should be the focus for the remaining 14 cases with medium-level vitality. The issues identified in the text include inadequate protection, a low proportion of historical architecture, limited preservation of the living environment, and constrained construction land. It is important to pay special attention to clusters such as Ranzhuang Village in central Hebei, traditional village groups in Jingxing County, and Boyan Village in southern Hebei.

Furthermore, the results of the RVA can serve as a foundation and methodology for evaluating the effectiveness of rural revitalization. This study collected data in January 2023 to establish a baseline for evaluating the ongoing impacts of rural revitalization. To facilitate the comparison of changes in vitality levels, spatial distribution, conservation-development balance, and adverse indicators, recurrent data collection and evaluation using the same methodology will be conducted in subsequent years. This systematic approach allows for an objective evaluation of the effectiveness of sustainable revitalization in rural areas of China. It provides a scientific basis for identifying any remaining issues and supports an assessment approach focused on promoting vitality.

5.5. Limitations

Throughout this study, we identified certain limitations warranting further investigation:

(1) The manifestation of rural vitality is dynamic, influenced not only by the spatial dimension of rural construction but also by the temporal dimension of rural development. The roster of traditional villages undergoes continuous updates, and the management and policy formulation for traditional village protection are subject to ongoing enhancements. Leveraging data from January 2023 as a reference point, this paper seeks to furnish the methodology (evaluation framework) and quantitative analysis data support for the protection of traditional villages over recent decades.

(2) Rural vitality is an inherently abstract concept, complicating the verification of vitality assessment results for 206 villages through questionnaires. As researchers are unlikely to conduct on-site visits and interview all residents, a fully objective and comprehensive judgment of the overall vitality level of these villages becomes challenging. Consequently, the outcomes of this study are representative but not exhaustive in encapsulating all village groups.

(3) Given the substantial disparity in China's economic and social development levels, the index weights established in this study rely on expert surveys familiar with cases in Hebei Province and are not directly transferable to other regions. When applying this methodology to other provinces, it is advisable to seek guidance from experts acquainted with the specific region to determine suitable index weights.

(4) This study focused on 206 selected cases in Hebei Province as the research area. However, the nation boasts a significant number of traditional villages with varying geographical locations, climatic conditions, social/cultural backgrounds, and development histories. Future research endeavors are encouraged to undertake comparative studies and analyses involving a broader spectrum of cases.

6. Conclusions

The vast number of traditional villages (and their widespread distribution) poses substantial challenges to effective government management. Current governmental measures in China for the protection and management of traditional villages are largely homoge-

neous, relying heavily on uniform financial subsidies [3]. This "one-size-fits-all" approach neglects the varying levels of vitality among traditional villages, leading to excessive competition and unnecessary resource wastage. Therefore, a comprehensive assessment to understand the unique vitalities of each village is urgently needed to enable customized and effective management strategies.

The dynamic assessment method proposed in this study effectively evaluates the vitality levels of traditional villages. The framework and methodology for comprehensively assessing natural ecological factors, cultural heritage protection, and economic development in traditional villages is in line with the robust promotion of rural revitalization. The concept of rural revitalization is divided into two core dimensions—conservation and development—which leads to the establishment of an evaluation index system. The index weights are determined using the combined weighting method, which takes into account the distinctive attributes of each index. This method has the potential for application in other regions of China, catering to various needs and providing a basis for decision making, classification, and monitoring the effectiveness of rural revitalization efforts.

Our analysis reveals notable disparities in vitality development levels across different regions. While the eastern region exhibits higher levels of economic development and vitality, the northern region faces challenges with lower activation levels. This underscores the importance of tailored strategies to address the unique circumstances of each area. It is recommended that protection strategies for traditional villages should be tailored to each specific type. For high-vitality villages, efforts should be made to develop them into key cultural villages in the region, thereby promoting employment among villagers and driving rural revitalization. For villages with a medium level of vitality, it is recommended that they actively rely on national policies and nearby key villages to enhance their protection of physical and intangible cultural heritage and their village infrastructure. For villages with a low level of vitality, it is recommended that they be guided to leverage national support and rural revitalization policies to address their developmental shortcomings, increase villagers' income, and achieve sustainable and healthy village development.

To conclude, the RVA index evaluation system plays a crucial role in identifying traditional villages that are facing significant challenges in terms of vitality and development. By pinpointing those cases with critically low vitality, it enables proactive measures to prevent their decline and cultural degradation. Conversely, the system also identifies cases with higher vitality and development levels, serving as exemplary models for others to emulate. This methodology is not limited to Hebei Province but can be adapted and applied to other domestic regions and areas with similar requirements. It provides a robust framework for classifying targeted villages and assessing the effectiveness of rural revitalization initiatives. By leveraging this evaluation system, policymakers and stakeholders can make informed decisions to prioritize resources and interventions where they are most needed, ultimately contributing to the sustainable preservation and development of traditional villages nationwide.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su16135408/s1.

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