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# EXTRACTING SPATIAL "GENES" AND DEVELOPING LANDSCAPE PLANNING PATHWAYS FOR TRADITIONAL VILLAGES IN DIGITAL-RURAL REVITALIZATION THROUGH MULTIDIMENSIONAL DATA MODELING

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*This study applies multidimensional data-computing models to the landscape planning and design of traditional villages. Using techniques such as cluster analysis, spatial morphological distribution profiling, and spatial-gene inheritance characterization, it identifies and extracts the key spatial "genes" that define traditional village form and structure. The proposed planning approach is anchored in conserving and transmitting these spatial genes as the foundation for landscape protection and renewal. Using Jiangsu Province as a case study, the research investigates regional differentiation in the spatial genealogy of traditional villages and evaluates the effectiveness of spatial-gene protection in Traditional Village A. Results indicate a clear spatial pattern across Jiangsu: traditional villages are more numerous and more concentrated in the south, and fewer and more dispersed in the north. The shares of traditional villages decrease from southern to central to northern Jiangsu, at 51.69%, 29.44%, and 18.88%, respectively. In addition, Traditional Village A achieves an overall score of 0.86 in landscape planning performance under the spatial-gene conservation and inheritance framework, indicating strong outcomes.*

*Index Terms* — multidimensional data calculation, spatial gene extraction, spatial genealogy, landscape planning

## INTRODUCTION

In recent years, a wave of digital innovation—driven by mobile Internet, big data analytics, cloud computing, blockchain, and artificial intelligence—has accelerated rapidly. These technologies continuously generate new business formats, products, and operational models, while profoundly transforming contemporary modes of living and production [1]. As digital tools characterized by efficiency, integration, optimization, and sharing are increasingly incorporated into rural revitalization strategies, "digital empowerment" has emerged as a major opportunity and practical route for rural progress [2]. Accordingly, an urgent scientific and practical question for rural development today and in the future is how to leverage digital rural initiatives to strengthen endogenous rural vitality and promote long-term, sustainable development.

The *spatial genes* of traditional villages refer to stable spatial-combination patterns that arise from the long-term evolution of rural settlements through complex self-organizing processes [3]. Constructing a spatial-gene database typically involves three key stages: identification and coding, pattern abstraction and summarization, and mapping-based expression. This workflow highlights the strengths of the spatial-gene approach in informatization, systematic organization, and visual analysis [4]. By means of digital encoding and pattern generalization, complex geospatial relationships and landscape-structure regularities can be recorded and examined in a structured manner, while mapping-based visualization can intuitively reveal associations among spatial elements and their evolutionary trajectories [5]. At the same time, such a database supports comprehensive recognition of village spatial characteristics and provides integrated spatial-information assistance for planning and conservation.

Research on identifying and extracting spatial genes in traditional villages commonly combines qualitative and quantitative approaches. Early work often relied on interpretive tools such as architectural typology and morphological analysis, while more recent studies increasingly incorporate objective quantitative techniques, including space syntax and geometric morphology indices. This methodological shift further demonstrates the informatization and visualization advantages of spatial-gene approaches [6]. For example, prior studies have examined the diversity of spatial genes in Dong traditional villages in southwestern Hunan and proposed structured frameworks for identification and extraction with quantitative analysis of gene types and diversity features [7]. Other work has investigated villages along the Qin–Shu Ancient Road, identifying multiple categories of landscape and cultural genes that support sustainable development decision-making for traditional settlements [8]. In addition, research grounded in the Traditional Settlement Landscape Gene Theory (TSLGT) has extracted landscape genes from representative settlement samples and analyzed spatial patterns from the perspectives of architectural genes, siting genes, and totem-culture genes, providing guidance for protection and sustainable development [9]. Parametric reconstruction methods have also been proposed by combining spatial-gene concepts with platforms such as CityEngine [10]. Quantitative models based on spatial-gene theory have been used to interpret traditional village morphology and uncover formation logic using case studies such as Shiba Cave [11]. For Huizhou villages, studies have extracted genes spanning spatial form, water-system morphology, public spaces, residential architecture, signage structure, and decorative materials, arguing that protection and development should activate corresponding landscape elements to create distinctive spatial effects [12]. Research on Korean ethnic traditional villages in Northeast China has likewise identified and quantified key spatial genetic features, revealing distinctive patterns and cultural characteristics [13].

Despite these advances, the intricate spatial organization of traditional villages imposes high demands on data accuracy in spatial analysis [14]. Manual processing is often inefficient and struggles to meet the needs of large-scale village identification, especially when extensive datasets must be processed and analyzed rapidly; under such conditions, the limitations of conventional approaches become increasingly evident [15, 16]. Moreover, many existing studies focus on identifying ecological and living-space genes or explore living-space genes from a single dimension, while comprehensive identification, extraction, and analysis spanning ecological, production, and living-space genes remain insufficient [17].

To address these gaps, this paper investigates the spatial characteristics of traditional villages using multi-dimensional data-driven computational models. Specifically, cluster analysis, spatial-morphology distribution characterization, and spatial-gene genetic characterization are employed to extract and interpret traditional-village spatial genes in depth. Based on the extracted gene features, the study further develops a landscape-planning pathway that emphasizes protection and inheritance of spatial genes throughout planning and design. Traditional villages in Jiangsu Province are selected as the research context. The analysis examines clustering patterns of overall layouts and the non-equilibrium properties of spatial structure across Jiangsu villages. Finally, one representative village is used as an example to evaluate the effectiveness of landscape planning guided by spatial-gene conservation.

## SPATIAL GENE EXTRACTION OF TRADITIONAL VILLAGES BASED ON MULTI-DIMENSIONAL DATA COMPUTATION

### *Cluster Analysis*

Cluster analysis is adopted to classify traditional villages by selecting appropriate classification indicators and applying statistical software tools. By grouping village spatial samples into clusters and then identifying representative cases from each cluster, the approach provides a foundational basis for investigating diversity in spatial genes.

In general, cluster analysis refers to a class of statistical techniques that partitions a set of objects into multiple clusters according to selected criteria [18]. The goal is to maximize similarity among samples within the same cluster while maximizing dissimilarity between different clusters.

### *Characterization of Spatial Pattern Distribution*

#### Morphological Indices

From the perspective of plan-form and boundary relationships, this study applies a village boundary shape-index method and corresponding mathematical formulations to geometrically analyze the plan-form types of traditional villages, thereby supporting exploration of village morphological characteristics. The shape index is defined as:

$$S = \frac{P}{(\lambda^{1.5} - \lambda^{-1.5})\sqrt{\pi A}}, \tag{1}$$

where $S$ is the boundary shape index of a traditional village, $P$ is the boundary perimeter, $A$ is the enclosed area, and $\lambda$ is the aspect ratio of the minimum bounding rectangle.

Following the Pu-type mathematical classification rule, $S = 2$ is used as a threshold. When $S \geq 2$, the village is classified as a *finger-shaped* settlement. Within this category, if $\lambda < 1.5$ the form is finger-shaped with a mass-oriented tendency; if $1.5 \leq \lambda < 2$ the finger form shows no strong directionality; and if $\lambda \geq 2$ it exhibits a banded tendency. When $S < 2$ and $\lambda < 1.5$, the form is classified as *clustered*; when $S < 2$ and $1.5 \leq \lambda < 2$, it is clustered with a banded tendency; and when $S < 2$ and $\lambda \geq 2$, it is a *banded* settlement. Overall, village forms can be summarized into three main groups: finger-shaped (subtypes AA, AB, AC), banded (B), and massed/clustered (C).

### Water-System Fractal Dimension

Using geospatial data (SRTM DEM at 30 m resolution) combined with satellite imagery, village water-system features are extracted and evaluated via the box-counting dimension method to estimate fractal dimension. For a square grid with scale $r$, let $N(r)$ denote the number of non-empty boxes covering the measured object. As $r$ decreases, $N(r)$ increases, and the relationship can be expressed as:

$$N(r) \propto r^{-d}, \tag{2}$$

Taking logarithms yields:

$$\lg N(r) = -D \lg r + c, \tag{3}$$

where $c$ is a constant and $D$ is the estimated fractal dimension (the absolute slope of the fitted line in log–log coordinates). If $\lg r$ and $\lg N(r)$ show linear correlation, the subject exhibits fractal characteristics. The water-system dimension is categorized as: low when $D \leq 1.379$, medium when $1.379 \leq D \leq 1.504$, and high when $D \geq 1.504$.

*Spatial Genetic Characterization*

### Spatial Genetic Diversity Indices

Diversity indices in bioecology are widely used to quantify richness and diversity in communities. Common measures include richness indices, Shannon diversity, Simpson diversity, and evenness. This study adapts these ideas to define *spatial genetic richness* and *spatial genetic diversity*, where gene richness corresponds to the number and types of spatial genes present.

The Margalef richness index is defined as:

$$R = \frac{S-1}{\ln N}, \tag{4}$$

where $S$ is the number of spatial-gene categories in the sample and $N$ is the total count of spatial-gene individuals in the sample. Larger $R$ indicates greater richness [19].

Shannon diversity is:

$$H = -\sum_{i=1}^{S} p_i \ln p_i, \tag{5}$$

which captures uncertainty in the occurrence of categories; larger values indicate higher diversity.

Simpson diversity is:

$$D = 1 - \sum_{i=1}^{S} p_i^2, \tag{6}$$

which reflects dominance structure and the probability structure of randomly selected individuals; higher $D$ generally indicates more even distributions and greater diversity [20].

Here,

$$p_i = \frac{n_i}{N}, \tag{7}$$

where $n_i$ is the count of individuals belonging to spatial-gene category $i$, and $N$ is the total number of spatial-gene individuals.

Evenness reflects how uniformly individuals are distributed across categories, ranging from 0 to 1 [21]. The uniformity (evenness) index is:

$$J = \frac{H}{\ln S}. \tag{8}$$

### Relative Importance of Spatial Genes

In plant ecology, the importance value index quantifies a species' role and status within a community. A classical form is the Curtis importance value:

$$IV_{\text{Curtis}} = \frac{r_D + r_P + r_C}{3}, \tag{9}$$

where $r_D$ is relative density, $r_P$ is relative dominance, and $r_C$ is relative cover. Some scholars further view $r_P$ as a synthesis of multiple indicators.

To improve practicality for spatial-gene statistics, this study constructs a relative importance index using two measurable components: relative multiplicity $r_A$ and relative frequency $r_F$. The importance value is defined as:

$$IV = \frac{r_A + r_F}{2}. \tag{10}$$

Relative multiplicity is:

$$r_A = \frac{\text{number of individuals of a given gene}}{\text{total number of spatial-gene individuals}}, \tag{11}$$

and relative frequency is:

$$r_F = \frac{\text{number of samples in which a spatial gene occurs}}{\text{total number of gene-occurrence samples}}, \tag{12}$$

### Genetic Distance Characterization

Genetic distance describes differences between populations as a function of gene-frequency variation; larger distance implies lower similarity and more distant relationships. This concept is introduced here to compare spatial-gene compositions among different traditional villages. The Nei–Li similarity coefficient is adopted:

$$GS_{ij} = \frac{2N_{11}}{N_{11} + N_{10} + N_{01} + N_{11}}, \tag{13}$$

and genetic distance is defined as:

$$GD = 1 - GS_{ij}. \tag{14}$$

In these expressions, $i$ and $j$ denote two villages; $N_{11}$ is the number of gene "alleles" appearing in both villages; $N_{10}$ is the number appearing only in village $i$; $N_{01}$ is the number appearing only in village $j$; and $N$ represents the total number of alleles considered. For statistical robustness, at least five village samples of each type are used; where fewer than five are available, all samples are included in the computation. The genetic-distance range is $[0,1]$: $GD = 0$ indicates maximal similarity, larger values indicate decreasing similarity, and $GD = 1$ indicates no similarity.

## LANDSCAPE PLANNING PATH BASED ON CONSERVATION AND INHERITANCE

*Traditional Village Landscape Conservation and Renewal from a Landscape-Genetics Perspective*

The safeguarding and adaptive development of traditional villages should adhere to core principles that preserve the village landscape as a coherent cultural system. In practice, this means maintaining the *integrity*, *authenticity*, and *continuity* of the internal landscape structure. Integrity-oriented protection emphasizes the village's historical narrative and heritage value, focusing on conserving the existing tangible landscape carriers and the overall architectural pattern and spatial setting. Authenticity-oriented protection aims to retain the genuineness of villagers' production and daily life so that the lived reality of the village can be truthfully expressed, rather than replaced by staged or overly commercialized representations. Continuity-oriented protection highlights the intergenerational transmission of traditional culture, ecological stewardship, and coordinated livelihood development, thereby supporting long-term sustainability. In addition, renewal should be undertaken through holistic design that enables appropriate upgrading and ongoing use while keeping the village's essential character and spatial identity stable.

### Safeguarding the Genetic Integrity of Traditional Village Landscapes

A traditional village should be understood not as an isolated artifact, but as an evolving place embedded in historical, cultural, and economic networks. Across its streets, public spaces, vegetation systems, building ensembles, and local commerce, the village landscape often encodes dense "genetic" information that reflects distinct spatial logic and cultural meaning. Protecting genetic integrity therefore requires preserving the village's characteristic elements and their relationships as a unified whole. This includes completing and reinforcing the village's spatial pattern by coordinating streets and lanes, planting structures, public-space organization, and everyday business activity, so that the landscape framework and associated cultural connotations remain legible and complete.

### Safeguarding the Genetic Authenticity of Traditional Village Landscapes

The notion of *authenticity* originally emerged in medieval Europe in the context of preserving the genuineness of religious texts and artifacts. Over time, its meaning expanded toward heritage protection, emphasizing the faithful retention of historically grounded attributes, including architectural form, spatial organization, and material evidence. For traditional villages, original landscape genes are irreplaceable historical witnesses and constitute valuable cultural heritage. Consequently, while protecting intangible cultural memory and lived traditions, renewal should not privilege superficial aesthetic effects, short-term economic gains, or utilitarian redevelopment goals. Otherwise, the village risks losing the authenticity of its landscape identity and the credibility of its historical continuity.

### Safeguarding the Genetic Continuity of Traditional Village Landscapes

Continuity refers to the ability of a system to persist and develop over time. Preserving continuity in traditional villages is inseparable from sustaining their future viability, including continuity in both protection and use. The fundamental objective is sustainable development: maintaining the continuity of landscape genes and ensuring that they are carried forward through concrete spatial forms, everyday practices, and culturally meaningful environments. In this sense, continuity protection is not static "freezing" but a guided process of inheritance in which traditional genes remain active, interpretable, and adaptable within appropriate limits.

**Controlled Renewal through Rational Landscape-Genetic Governance**

Renewal should proceed under clear boundaries and rigorous control, ensuring that necessary upgrading does not damage the village's historical-cultural foundation. This requires defining the scope, intensity, and permissible forms of intervention. Practical control measures include spatial repair strategies within overall planning, morphological regulation of streets and lanes (e.g., scale, alignment, interface), and the creation or refinement of public-space nodes that strengthen community life. Through such tools, landscape genes can be protected, interpreted, and renewed in a rational and effective manner.

*Landscape Enhancement Planning and Design*

**Optimizing the Natural Landscape at the Environmental Level**

Landscape protection and utilization planning should be guided by ecological-civilization principles, integrating ecological protection with production and daily life, promoting healthy ecosystem cycles, and strengthening ecological-security buffers for villages. The long-term survival of traditional villages is closely linked to historically accumulated wisdom of human settlement—often expressed as the idea of harmony between humans and nature. In the context of new rural construction and rapid urbanization, planning should therefore maintain an appropriate sense of respect for the village's natural setting and environmental constraints.

From the perspective of environmental governance, village space can be organized into three tiers: *core protection zones*, *construction protection zones*, and *construction control zones*. The core protection zone is generally limited to the traditional built boundary, with historically significant houses prioritized for strict protection and repair. Surrounding the core, the construction protection zone emphasizes both conservation and appropriate new construction; new buildings should continue the historical style's key characteristics, and renovations should remain compatible with traditional forms while avoiding incompatible modern expressions. The outer environmental coordination/control zone prioritizes environmental remediation and landscape improvement; buildings of poor quality should be removed where appropriate to release open space and improve spatial and ecological conditions.

**Enhancing Spatial Structure at the Village Ontology Level**

On the basis of the above zoning and field-based analysis, spatial revitalization and transformation should focus on public-service space planning and the strengthening of village spatial structure. This includes systematically organizing cultural resources, industry resources, architectural styles, and landscape-pattern characteristics, and extracting vernacular cultural meanings embedded in local life. By integrating regional cultural lineage with humanistic spirit, the overall village image can be enhanced and presented through a coherent planning narrative. For example, a theme such as "Tracing Roots, Charming Treasures" can be established to connect site findings with local regional culture and farming traditions, while guiding a renewed development direction that coordinates rural economy, cultural heritage inheritance, and eco-tourism.

### Enhancing Spatial Landscape at the Building-Unit Level

At the building scale, residential structures in traditional villages can be categorized into three groups—*protected buildings*, *repair buildings*, and *remodel buildings*—based on historical age, preservation condition, and heritage value. For new residential construction, the scale of local traditional architectural units should serve as the benchmark, and building size should be strictly controlled. In terms of height, a two-storey limit is recommended, with total height (including the ridge of sloped roofs) not exceeding 7 m. Buildings whose appearance deviates from traditional character should be rectified to align with local vernacular forms. When replacing components such as doors, windows, beams, columns, bricks, and tiles, materials and forms should match the original as closely as possible. Where modern materials are unavoidable, surface treatments should be applied so that the resulting shapes, colors, and textures remain visually compatible with traditional expressions and avoid disrupting the village's architectural continuity.

## ANALYSIS OF SPATIAL MORPHOLOGY OF TRADITIONAL VILLAGES AND EVALUATION OF SPATIAL-GENE CONSERVATION

Taking Jiangsu Province as the study area, this work extracts spatial genes from its traditional villages and then investigates their spatial-morphological features and the effectiveness of spatial-gene conservation in planning practice.

*Spatial Differentiation of the Spatial Spectrum of Traditional Villages*

### Clustering Characteristics of Overall Layout

First, spatial-pattern attributes of Jiangsu traditional villages were compiled in an Excel 2013 dataset. The recorded latitude and longitude were converted to the WGS–84 coordinate system, and village samples were imported into ArcGIS (ArcMap) as point features. By linking attribute records to the point layer, a spatial distribution database was established. Kernel density analysis (ArcMap Toolbox `Density`) was then applied to identify aggregation hot spots and sparse zones, thereby revealing the hierarchical structure of the provincial layout. City-level and district-level statistics are summarized in Fig. 1 and Fig. 2.

The results indicate a pronounced north–south contrast in Jiangsu. When the province is divided into Northern Jiangsu, Central Jiangsu, and Southern Jiangsu, both the number and density of traditional villages generally rise from north to south. Southern Jiangsu contains the largest share (230 villages; 51.69% of the provincial total), and Suzhou's Wuzhong District forms the strongest local cluster (38 villages). Central Jiangsu (29.44%) and Northern Jiangsu (18.88%) show fewer villages and a more dispersed pattern overall, although Yangzhou and Taizhou display comparatively stronger clustering within the central region. In short, the province exhibits a "dense south, sparse north" configuration.

### Non-Equilibrium of Spatial Structure

Municipal statistics (Table 1) show clear imbalance in the spatial structure of traditional villages. At the provincial scale, the average distribution density is 47 villages per 10,000 km$^2$. Southern Jiangsu maintains high densities (typically $> 65$ villages per 10,000 km$^2$), with Zhenjiang (90) and Wuxi (82) particularly prominent. In Central Jiangsu, Yangzhou reaches the highest density among the 13 cities (95), and Taizhou

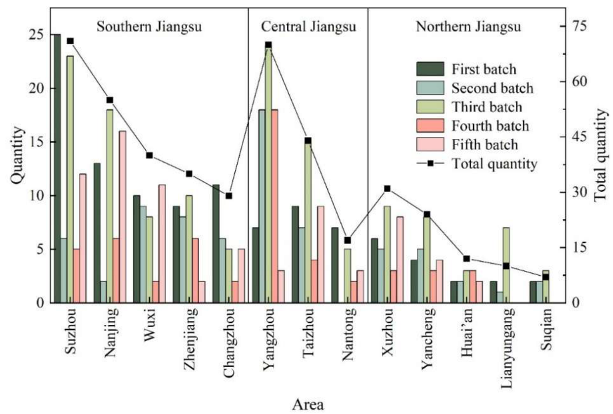
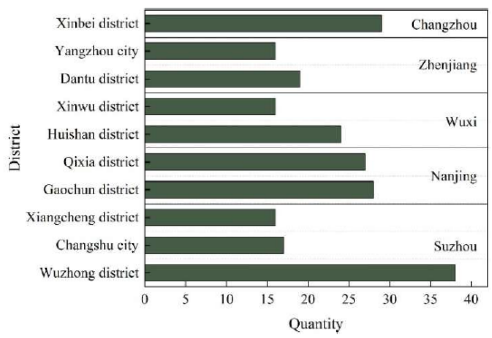
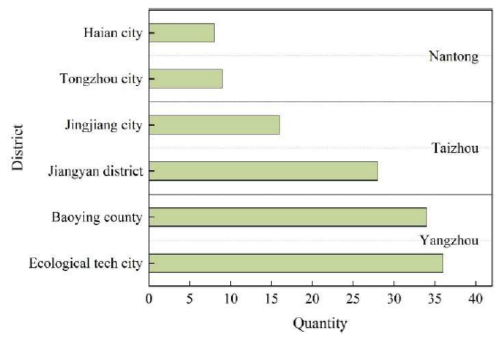


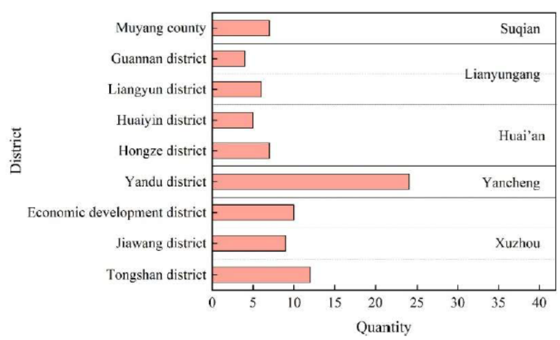

Figure 1: Municipal statistics of the quantity of traditional villages in Jiangsu Province.




(a) Quantity of traditional village in southern Jiangsu




(b) Quantity of traditional village in central Jiangsu




(c) Quantity of traditional village in northern Jiangsu

Figure 2: District statistics of the quantity of traditional villages in Jiangsu Province.

also exceeds 79. By contrast, Northern Jiangsu is generally low-density; only Xuzhou is above 20, and most other northern cities are at or below 15. These results confirm strong spatial non-equilibrium across Jiangsu.

*Spatial-Gene Conservation Evaluation*

To assess how spatial-gene protection performs in practice, this study carried out landscape planning and design for a representative traditional village in Jiangsu (Village A). To capture observers' and experts' perceptions of spatial-gene conservation, an evaluation index system was constructed with three primary dimensions: *Soundness (A)*, *Completeness (B)*, and *Coordination (C)*. Indicator weights were computed using

Table 1: Municipal statistics of traditional villages in Jiangsu Province.

| Area | City | Village | Rank | Pct. (%) | Area (km$^2$) | Density (/10$^4$ km$^2$) |
|---|---|---|---|---|---|---|
| Southern Jiangsu | Suzhou | 71 | 1 | 15.95 | 8657 | 78 |
| | Nanjing | 55 | 3 | 12.36 | 6587 | 79 |
| | Wuxi | 40 | 5 | 8.99 | 4627 | 82 |
| | Zhenjiang | 35 | 6 | 7.86 | 3840 | 90 |
| | Changzhou | 29 | 8 | 6.52 | 4372 | 67 |
| | **Sum** | **230** | – | **51.68** | **28083** | **79** |
| Central Jiangsu | Yangzhou | 70 | 2 | 15.73 | 6591 | 95 |
| | Taizhou | 44 | 4 | 9.89 | 5788 | 79 |
| | Nantong | 17 | 10 | 3.82 | 10507 | 22 |
| | **Sum** | **131** | – | **29.44** | **22886** | **59** |
| Northern Jiangsu | Xuzhou | 31 | 7 | 6.97 | 11765 | 30 |
| | Yancheng | 24 | 9 | 5.39 | 17718 | 17 |
| | Huai'an | 12 | 11 | 2.70 | 10030 | 15 |
| | Lianyungang | 10 | 12 | 2.25 | 7626 | 15 |
| | Suqian | 7 | 13 | 1.57 | 8524 | 10 |
| | **Sum** | **84** | – | **18.88** | **55663** | **14** |
| **Total** | – | **445** | – | **100** | **107223** | **47** |

the Analytic Hierarchy Process (AHP), as shown in Table 2.

A questionnaire was used to measure cognitive recognition of gene-carrying spaces. Respondents scored each described factor using a five-level Likert-style scale (1, 0.75, 0.5, 0.25, 0), representing very good, good, average, not so good, and very bad, respectively. For expert appraisal, ten specialists from human geography, rural sociology, rural economics, cultural heritage, architecture, landscape architecture, and urban–rural planning evaluated the on-site carrier spaces of Village A. Averaged scores were calculated for each indicator, yielding the overall evaluation results in Table 3.

The results show that Village A performs strongest on *Soundness* and *Coordination* (both 0.88), followed by *Completeness* (0.83). Among secondary indicators (range $[0.76, 0.98]$), woodland ecological condition and environmental-pattern completeness rank highest, while axial formation completeness and building-volume coordination rank lowest. The comprehensive score for spatial-gene protection and inheritance in Village A is 0.86, indicating generally favorable conservation outcomes alongside targeted areas for improvement.

## CONCLUSION

This study applies multidimensional data-computation approaches—including cluster analysis, spatial morphological distribution characterization, and spatial genetic characterization—to identify and extract the spatial genes of traditional villages. Using traditional villages in Jiangsu Province as a representative case, the paper further conducts a spatial genealogy analysis and evaluates the effectiveness of landscape planning strategies that prioritize the protection and inheritance of spatial genes.

The results reveal a clear north–south differentiation in the distribution of traditional villages across Jiangsu. Traditional villages are more concentrated in Southern Jiangsu, which contains more than half of the provincial

Table 2: AHP-based weights for the evaluation index system.

| Level | Indicator | Sub-indicator | Weight |
|---|---|---|---|
| Primary | A | Soundness | 0.365 |
| Secondary | A1 | Natural element soundness | 0.685 |
| Tertiary | A11 | Mountain ecological condition | 0.248 |
| Tertiary | A12 | Drainage ecological condition | 0.248 |
| Tertiary | A13 | Farmland ecological condition | 0.263 |
| Tertiary | A14 | Woodland ecological condition | 0.241 |
| Secondary | A2 | Artificial element soundness | 0.315 |
| Tertiary | A21 | Carrier retention | 0.500 |
| Tertiary | A22 | Structural member soundness | 0.500 |
| Primary | B | Completeness | 0.314 |
| Secondary | B1 | Formation completeness | 0.523 |
| Tertiary | B11 | Skeletal formation completeness | 0.235 |
| Tertiary | B12 | Axial formation completeness | 0.275 |
| Tertiary | B13 | Street formation completeness | 0.263 |
| Tertiary | B14 | Architectural formation completeness | 0.227 |
| Secondary | B2 | Pattern completeness | 0.477 |
| Tertiary | B21 | Environmental pattern completeness | 0.356 |
| Tertiary | B22 | Node structure completeness | 0.342 |
| Tertiary | B23 | Courtyard pattern completeness | 0.302 |
| Primary | C | Coordination | 0.321 |
| Secondary | C1 | Environmental space coordination | 0.324 |
| Tertiary | C11 | Settlement–nature integration | 0.492 |
| Tertiary | C12 | Human–environment integration | 0.508 |
| Secondary | C2 | Internal space coordination | 0.358 |
| Tertiary | C21 | Street interface coordination | 0.374 |
| Tertiary | C22 | Boundary interface coordination | 0.312 |
| Tertiary | C23 | Settlement texture coordination | 0.314 |
| Secondary | C3 | Building space coordination | 0.318 |
| Tertiary | C31 | Building color/style coordination | 0.526 |
| Tertiary | C32 | Building height coordination | 0.474 |

total, while the shares of Central and Northern Jiangsu decline to 29.44% and 18.88%, respectively. In terms of spatial-structural intensity, the overall distribution density reaches 47 villages per 10,000 $km^2$. Cities in Southern Jiangsu generally maintain densities above 65/10,000 $km^2$. Within Central Jiangsu, Yangzhou exhibits the highest density in the province, reaching 95/10,000 $km^2$. By comparison, Northern Jiangsu shows comparatively low geographic densities overall.

Finally, the evaluation of landscape planning for a representative case (Traditional Village A) indicates a comprehensive score of 0.86, suggesting that the proposed planning approach achieves favorable outcomes in spatial-gene conservation and inheritance, and receives broadly positive feedback in terms of safeguarding key spatial characteristics while guiding appropriate renewal.

Table 3: Evaluation results for spatial-gene protection and heritage of Village A (overall score: 0.86).

| Level | Indicator | Score |
|---|---|---|
| Primary | A (Soundness) | 0.88 |
| Secondary | A1 (Natural element soundness) | 0.91 |
| Tertiary | A11 | 0.88 |
| Tertiary | A12 | 0.90 |
| Tertiary | A13 | 0.87 |
| Tertiary | A14 | 0.98 |
| Secondary | A2 (Artificial element soundness) | 0.83 |
| Tertiary | A21 | 0.84 |
| Tertiary | A22 | 0.81 |
| Primary | B (Completeness) | 0.83 |
| Secondary | B1 (Formation completeness) | 0.76 |
| Tertiary | B11 | 0.77 |
| Tertiary | B12 | 0.69 |
| Tertiary | B13 | 0.83 |
| Tertiary | B14 | 0.77 |
| Secondary | B2 (Pattern completeness) | 0.91 |
| Tertiary | B21 | 0.98 |
| Tertiary | B22 | 0.83 |
| Tertiary | B23 | 0.92 |
| Primary | C (Coordination) | 0.88 |
| Secondary | C1 (Environmental space coordination) | 0.91 |
| Tertiary | C11 | 0.87 |
| Tertiary | C12 | 0.95 |
| Secondary | C2 (Internal space coordination) | 0.92 |
| Tertiary | C21 | 0.86 |
| Tertiary | C22 | 0.96 |
| Tertiary | C23 | 0.96 |
| Secondary | C3 (Building space coordination) | 0.82 |
| Tertiary | C31 | 0.94 |
| Tertiary | C32 | 0.69 |

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