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Research on Spatial Gene Extraction and Landscape Planning Path of Traditional Villages in Digital Countryside Based on Multidimensional Data Computing Model Analysis

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Abstract This paper integrates the multidimensional data calculation model in the landscape planning and design of traditional villages, and selects among them cluster analysis, spatial morphology distribution characterization, spatial gene genetic characterization and other methods to extract the spatial genes of traditional villages. Landscape planning and design is based on the protection and inheritance of traditional village spatial genes. Taking Jiangsu Province as an example, the layout differentiation of the spatial genealogy of its traditional villages is explored. The spatial gene protection effect of traditional village A is evaluated and analyzed. The layout of traditional villages in Jiangsu Province is generally characterized by more in the south and less in the north, and denser in the south and sparser in the north, with the proportion of traditional villages in the southern, central and northern regions of Jiangsu decreasing in order, respectively 51.69%, 29.44% and 18.88%. Traditional villages A in Jiangsu Province obtain an overall score of 0.86 in landscape planning based on spatial gene protection and inheritance, achieving better results.

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

I. Introduction

In recent years, digital technologies represented by mobile Internet, big data, cloud computing, blockchain and artificial intelligence have been developing vigorously, constantly giving rise to new business forms, new products and new models, and reshaping the way of life and production in modern society [1]. As the digital technology with the characteristics of efficiency, integration, optimization and sharing is gradually embedded in the strategy of rural revitalization, it has become an important opportunity and path for rural development [2]. Therefore, how to grasp the digital empowerment of the countryside, activate the endogenous power of the countryside, and promote the sustainable development of the countryside in the context of digital countryside has become a scientific problem that needs to be solved urgently for the development of the countryside now and in the future.

Traditional village spatial gene is a spatial combination pattern formed by various spatial elements through long-term evolution of rural settlements in a complex self-organization process [3]. The process of establishing the spatial gene database mainly contains identification coding, pattern summarization and mapping, and this process fully reflects the advantages of the spatial gene method in informatization, systematization and visualization analysis [4]. Through digital coding and pattern summarization, it can systematically record and analyze the complex geospatial relationships and landscape characteristic laws, and visually present the association and evolution between spatial elements with the help of visual display of mapping [5]. At the same time, the process can also systematically identify the characteristics of village space and provide comprehensive spatial information support.

The identification and extraction study of spatial genes in traditional villages usually adopts a combination of qualitative and quantitative methods, which is based on analytical tools with subjective judgments such as architectural typology and morphology, and gradually combines with more objective quantitative analytical tools such as spatial syntax and geometric morphology indices, thus further demonstrating the advantages of spatial gene methods in informatization and visualization [6]. Literature [7] conducted a study on the diversity of spatial genes in Dong traditional villages in southwestern Hunan, and proposed a framework for identifying and extracting spatial genes, and quantitatively analyzed their types and diversity characteristics. Literature [8] explored the spatial genes of traditional villages along the Qin-Shu Ancient Road in western China, and finally identified eight landscape genes and six cultural genes, which provided a scientific basis for the sustainable development of traditional villages. Literature [9] identified and extracted the landscape genes of 30 major traditional settlement samples based on the theory of Traditional Settlement Landscape Genes (TSLGT), and explored the spatial pattern of landscape genes of traditional villages in Hunan Province in terms of architectural genes, siting genes, and totem culture genes, providing suggestions for the conservation and sustainable development of traditional villages. Literature [10] proposed a method of parametric reconstruction of spatial patterns of traditional villages based on the concept of spatial genes and combined with the CityEngine software platform. Literature [11] introduced a quantitative model to analyze the traditional village morphology based on the spatial gene theory, and took Shiba Cave as an example to reveal the logic behind the formation of the traditional village material form. Literature [12] identifies and extracts the spatial genes of Huizhou traditional villages, including spatial morphology, village water system morphology, public space, residential architecture, sign structure, decorative materials, etc., and proposes that the protection and development of Huizhou traditional villages should focus on activating the corresponding landscape elements to form characteristic landscape effects. Literature [13] identifies and extracts the main spatial genetic features of traditional villages of the Korean ethnic group in Northeast China, and quantitatively analyzes them, i.e., the unique spatial patterns and cultural features. The complex spatial structure of traditional villages leads to high requirements for data accuracy in spatial analysis [14]. Meanwhile, relying on manual processing is less efficient and difficult to cope with the demand for spatial identification of large-scale traditional villages, especially when a large amount of data is rapidly processed and analyzed, the limitations of the above methods are particularly obvious [15], [16]. In addition, the existing studies on the spatial genes of traditional villages mostly involve the identification and extraction of ecological and living space genes or a single-dimensional exploration of living space genes, and lack the comprehensive identification, extraction and analysis of ecological, production and living space genes [17], [18].

The article tries to explore the spatial characteristics of traditional villages through multi-dimensional data computational models, and selects cluster analysis, spatial morphological distribution characterization, and spatial gene genetic characterization to extract the spatial genes of traditional villages and analyze them in depth. According to the extracted spatial genes of traditional villages, landscape planning of traditional villages is carried out, and the protection and inheritance of spatial genes are emphasized in landscape planning and design. Taking the traditional villages in Jiangsu Province as the research object, we analyze the clustering of the overall layout and the non-equilibrium of the spatial structure of the traditional villages in Jiangsu Province. Taking one of the traditional villages as an example, the effect of landscape planning based on spatial gene protection in this village is evaluated.

II. Spatial gene extraction of traditional villages based on multi-benefit data computation

II. A. Cluster analysis

By applying cluster analysis, selecting appropriate classification indexes and using relevant statistical software to classify the space of traditional villages, and identifying typical research objects from them, we can provide a basic basis for better exploring the diversity characteristics of spatial genes.

Cluster analysis is a class of statistical methods to categorize the research objects corresponding to the data [19], which is a collection of several individuals, according to some criteria into a number of clusters, and hope that the samples within the clusters are as similar as possible, while the clusters and clusters should be as dissimilar as possible.

II. B. Characterization of spatial pattern distribution

II. B. 1) Morphological indices

Based on the perspective of the relationship between the bottom of the plan, with the help of the village boundary shape index analysis method and mathematical formulas, the types of traditional village plan form are geometrically analyzed, and then the traditional village morphological characteristics are explored. The shape index formula is as follows:

$$S = \frac{P}{\left(1.5\lambda - \sqrt{\lambda} + 1.5\right)}\sqrt{\frac{\lambda}{A\pi}} \tag{1}$$

where S is the shape index of the traditional village boundary, P is the number of perimeter of the traditional village boundary, A is the area of the traditional village boundary, and λ is the aspect ratio of the boundary's minimum outer rectangle. According to the Pu-type mathematical method, set the shape index $S = 2$ as the critical value judgment value, when $S \geq 2$, the village morphology is finger-shaped village. Among them, when $\lambda < 1.5$, it is a fingered village with regimented bias; when $1.5 \leq \lambda < 2$, it is a fingered village without clear pointing. When $\lambda \geq 2$, it is a fingered village with a banded bias. When $S < 2$ and $\lambda < 1.5$, a clustered village. When $S < 2$ and $1.5 \leq \lambda < 2$, a clumped village with banded tendency. When $S < 2$, $\lambda \geq 2$, the traditional village form is a banded village. The village form of a traditional village can be categorized as A fingered (AA mass-biased fingered, AB fingered without clear directionality, AC fingered with banded tendency), B banded, and C massed.

II. B. 2) Water system sub-dimensions

Based on the geospatial data cloud 30m spatial resolution SRTMDEM data, combined with the sky map satellite images to extract the village water system after taking the box dimension method to measure the fractal dimension. Take the square block network with a measurement degree of r, set the total number of non-empty boxes of the measurement subject as $N(r)$, $N(r)$ will increase correspondingly with the decrease of the measurement degree r, and the relationship between the measurement subject and the measurement degree follows the following:

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

Taking the logarithm of equation (2) yields:

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

where c is a constant. If the measure r is linearly correlated with the total number of non-empty boxes $N(r)$ in a double logarithmic coordinate system, the subject conforms to the law of fractals, and the absolute value of the slope of the regression straight line is the fractional dimensional value D. Where, when $D \le 1.379$, the village water system is located in the low fractional dimension interval, when $1.379 \le D \le 1.504$, it is located in the middle fractional dimension interval, and when $D \ge 1.504$, it is located in the high fractional dimension interval.

II. C. Spatial genetic characterization

II. C. 1) Spatial genetic diversity index

Diversity indices are used in bioecology to measure the richness of species diversity, and the diversity indices that are widely used nowadays include the richness index, Shannon's diversity index, Simpson's diversity index, and evenness index. The concept of spatial genetic richness is borrowed from the concept of community biology, the number of species in a community or habitat is called species richness, so spatial genetic richness is related to the number and types of spatial genes.

Margalef index R:

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

The Margalef index R uses the number of species within a community as an indicator to describe community richness [20]. In the application of spatial genetic diversity, S is the number of spatial genetic species in the study sample, N is the number of individuals of all spatial genes within the study sample, and the higher the value of the Margalef index, the richer the spatial genetic species in the sample.

Shannon diversity index:

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

is an index used to describe the disorder and uncertainty in the occurrence of individuals of a community's biological species; the higher the uncertainty, the higher the diversity.

Simpson's Diversity Index:

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

It is used to assess the degree of dominance of common populations in a community, and is a hypothetical derivation of the probability that they belong to the same species, based on a certain biome, with two individuals randomly selected. The higher the number of species in the community, the more evenly distributed the various individuals are, corresponding to the higher Simpson's diversity index, which represents the higher diversity of the community [21].

In the above formula, p_i is the proportion of spatial genes of category i to the total number of spatial genes in the village overall research sample, S is the number of spatial gene species in the sample, n_i is the number of individuals of spatial genes of category i, and N is the number of individuals of all the spatial genes within the research sample, then there are:

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

Species evenness refers to the distribution of the number of individuals of all species in a community or habitat [22], reflecting the uniformity of the distribution of the number of individuals of each species. The value of evenness ranges from 0 to 1. The closer the value is to 1, the higher the genetic evenness of each space is, i.e., the relative proportions of the number of genetic components in each space are basically equal.

Uniformity index:

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

II. C. 2) Relative importance of spatial genes

Importance value index in plant ecology is a comprehensive quantitative index reflecting the role and position of a plant species in a community, and is commonly used in the current field of community genetics research in ecology. The Curtis IV formula is as follows:

$$IV(curtis) = \frac{D_r + P_r + C_r}{3} \tag{9}$$

where D_r is relative density, P_r is relative dominance, and C_r is relative cover. And the Japanese scholar Numata Zhen thinks P_r should synthesize four indicators, namely $P_r = A_r(\text{Relative multiplicity}) + C_r + F_r + H_r$.

From the convenience and practicability of spatial gene statistics, we try to construct the formula of relative importance value of spatial genes based on IV formula. Finally, two quantitative indexes, relative multiplicity A_r and relative frequency F_r, were chosen to construct the formula for the importance value of spatial genes:

$$IV(\text{Water-adapted spatial genes}) = \frac{(A_r + F_r)}{2} \tag{10}$$

Relative multiplicity A_r:

$$A_r = \frac{\text{Number of individuals of a gene}}{\text{Total number of individuals of a gene}} \tag{11}$$

Relative frequency F_r:

$$F_r = \frac{\text{Number of samples in which a spatial gene occurs}}{\text{Number of samples in which all spatial genes occur}} \tag{12}$$

II. C. 3) Characterization of genetic distance

Genetic distance usually refers to the genetic difference determined by some function of gene frequency The larger the value of genetic distance, the lower the genetic consistency between populations, that is, the more distant the kinship between populations [23]. Now, the formula of genetic distance is applied to the spatial analysis study of different traditional villages, and Nei and Li similarity coefficient is selected to determine the Nei and Li genetic distance between villages, and its calculation formula is as follows:

Nei and Li similarity coefficient $GS_{(NL_{cij})}$:

$$GS_{(NL_{cij})} = \frac{2N_{11}}{\left[(N_{11} + N_{01}) + (N_{11} + N_{10})\right]} \tag{13}$$

Genetic Distance GD:

$$GD = 1 - GS \tag{14}$$

Where i and j represent two different villages, N_{11} is the number of alleles appearing in both villages, N_{10} is the number of alleles appearing only in village i, N_{01} is the number of locus genes appearing only in village j, and N is the total number of alleles. In the process of statistical calculation, a minimum of five village spaces of each type were taken for analysis and study, and for less than five village spaces in villages, all of them were involved in the statistics and calculation of genetic distance. The minimum value of genetic distance is 0 and the maximum value is 1. 0 indicates the highest degree of genetic consistency between the two, the larger the value proves that the degree of genetic consistency between the two is lower, and 1 indicates that there is no genetic similarity between the two.

III. Landscape planning path based on conservation and inheritance

III. A. Traditional Village Landscape Conservation and Renewal from the Perspective of Landscape Genetics

The inheritance and development of traditional villages should be based on the main principles of maintaining the integrity, authenticity and continuity of the internal landscape of the village. Integrity protection mainly refers to the history of the village and its historical value, and the protection of the existing physical landscape within the village; historical protection includes the protection of the architectural pattern and spatial environment of the village itself. Original authenticity protection is to protect the authenticity of the production life of the villagers, aiming to show the reality of daily life; holistic protection is to realize the continuation and renewal of the village through the overall design, in order to achieve the goal of keeping the original style unchanged. Continuity protection mainly refers to the inheritance and promotion of traditional culture, the protection of the ecological environment and economic development, and the realization of sustainable development.

III. A. 1) Protecting the genetic integrity of traditional village landscapes

Traditional villages are not a separate entity, but are closely related to history, culture and economy. Throughout the landscape of traditional villages, it often contains a large number of landscape genes and cultural information, which have their own characteristics and values. Therefore, it is very important to preserve the characteristics of the village itself and make it form a complete whole. Consideration is given to the aspects of streets, plants, public spaces and businesses to complete the spatial pattern of the village and its traditional cultural connotations.

III. A. 2) Protecting the genetic originality of traditional village landscapes

The concept of "authenticity" was first used in medieval Europe to preserve the authenticity of religious classics and artifacts. Its meaning has changed over time: the architectural and historical aspects of the heritage have been changed based on their historical authenticity, and the form or physical space of the heritage has been preserved. The original genes of the traditional village landscape in the protection and reconstruction of the village is a witness of history and irreplaceable, is a valuable cultural heritage. Therefore, while protecting the intangible historical and cultural heritage of villages, neither aesthetic value nor practical interests should be prioritized, nor utilitarian purposes, otherwise the authenticity of village landscape will be damaged.

III. A. 3) Protecting the genetic continuity of traditional village landscapes

The word "continuity" means continuity. Maintaining the continuity of traditional villages is also maintaining the possibility of their sustainable development, which includes the continuity of protection and utilization. To realize the sustainable development of traditional villages is the primary purpose. In order to maintain the sustainable development of traditional villages, the most fundamental thing is to maintain the continuity of their landscape genes and to pass them on in specific landscape forms.

III. A. 4) Controlling landscape genetics for rational and effective renewal

While planning and designing without destroying the history and culture of traditional villages, the village landscape should be protected and renewed under reasonable, effective and strict control, and the extent and scope of protection and renewal should be clearly established. The village landscape genes are controlled through spatial planning repair, spatial form control of streets and lanes, and creation of public space nodes.

III. B. Landscape enhancement planning and design

III. B. 1) Optimization of the natural landscape of villages at the level of the natural environment

In planning for the protection and use of traditional villages, the concept of ecological civilization should be firmly established, taking into account ecology, production and life, promoting a virtuous cycle of ecosystems, and striving to build ecological security barriers for villages. Traditional villages can survive for a long time in the long river of history, it is the people for thousands of years will be "the unity of heaven and mankind" concept of human habitat construction. Traditional villages in response to the new rural construction and urbanization process sweeping, the most important thing is that we are located in the natural environment should be appropriate to maintain a sense of reverence.

For the natural environment in which the village is located, each village is divided into three levels of construction areas: the village is divided into core protection areas, construction protection areas and construction control areas. The core protection area is limited to the traditional village building boundaries, the historical traditional houses for key protection and repair; adjacent to the core area around the designation of the construction of the protection zone, which is the village of the historical buildings, to protect and build equal importance, the new building to continue the characteristics of the historical style, transformation and traditional style far from the built buildings, and the coordination of the historical style; environmental coordination zone is mainly to the environmental protection and remediation, the poor quality of the building to be demolished, and the construction control area is mainly for environmental protection and remediation. Buildings with poor architectural quality should be demolished to open up open space.

III. B. 2) Optimization of spatial structure enhancement at the village ontology level

Space revitalization and transformation design, fully undertake the above planning, based on the above planning and site research and analysis of the traditional village public service space planning and design, through the combing of traditional village cultural resources, industrial resources, architectural style and landscape landscape pattern characteristics of the village, digging out the traditional village of the vernacular cultural connotation, combined with the regional cultural lineage and the humanistic spirit to enhance the overall appearance of the village, the formation of the following key points. Establishing the planning theme of "Tracing Roots, Charming Treasures", through the investigation and analysis of the site, combining the local regional culture and farming culture of the ancient villages, guiding the new spirit of sustainable development of rural economy, cultural heritage and eco-tourism.

III. B. 3) Optimization of spatial landscape enhancement at building unit level

In traditional villages, residential buildings are classified into three categories, namely, protected buildings, repaired buildings and remodeled buildings, on the basis of the historical age, preservation status and historical and heritage value of the historical buildings. For new residential buildings, the scale of local traditional architectural units is taken as the standard, and their scale is strictly controlled. In terms of building height, the maximum limit is two floors, and the overall height, including the ridge of the sloping roof, does not exceed 7 meters. Where the style is not in line with traditional architecture, it is required to be rectified in accordance with the traditional form. When replacing doors, windows, beams, pillars, bricks and tiles and other components, the materials and forms used need to be matched with the original form, and when modern materials must be used, they should also be given a surface treatment, and the period shapes, colors and textures should be closer to the traditional form.

IV. Analysis of spatial morphology of traditional villages and evaluation of spatial gene conservation

This paper takes Jiangsu Province as the research object, extracts spatial genes from its traditional villages, and carefully analyzes the spatial characteristics and spatial gene conservation of traditional villages in Jiangsu Province.

IV. A. Spatial differentiation of the spatial spectrum of traditional villages

IV. A. 1) Clustering of the overall layout

Firstly, the spatial pattern information of traditional villages in Jiangsu region was entered into Excel 2013 table. Secondly, the latitude and longitude information was converted into WGS-84 coordinates, and the crowd samples were imported into the geographic information system Arc Map software in the element point mode. Next, the data information in the Excel table is associated with the point elements in the Arc Map software to construct the spatial distribution database of traditional villages in Jiangsu; then the Density tool in the ToolBox of the GIS Arc Map software is used to analyze the kernel density of the traditional villages in Jiangsu, and the detection method can identify and analyze the hot spots and cold zones, and derive the spatial level of the The overall layout of traditional villages in Jiangsu Province is characterized. The results of city-level statistics on the number of traditional villages in Jiangsu are shown in Figure 1, and the results of district-level statistics on the number of traditional villages in Jiangsu are shown in Figure 2.

From the statistical results of traditional villages in Fig. 1 and Fig. 2, the overall spatial distribution of traditional villages in Jiangsu Province has significant north-south differences. From the perspective of the three geographic regions of North Jiangsu, Central Jiangsu and South Jiangsu, traditional villages show a gradual increase from north to south, and South Jiangsu, which is not superior in terms of geographical area and rural population, has the largest number of traditional villages and a high density, with 230 traditional villages, accounting for 51.69% of the total number of traditional villages, of which Wuzhong District of Suzhou is the most important, with a total of 38 villages. The traditional villages in central Suzhou (29.44%) and northern Suzhou (18.88%) are fewer in number and tend to have a decentralized layout, except for Yangzhou and Taizhou, where the number of villages and the degree of agglomeration are slightly superior in the region. The overall layout of traditional villages in Jiangsu Province is characterized by fewer traditional villages in the south and fewer traditional villages in the north, and denser traditional villages in the south and sparser traditional villages in the north.

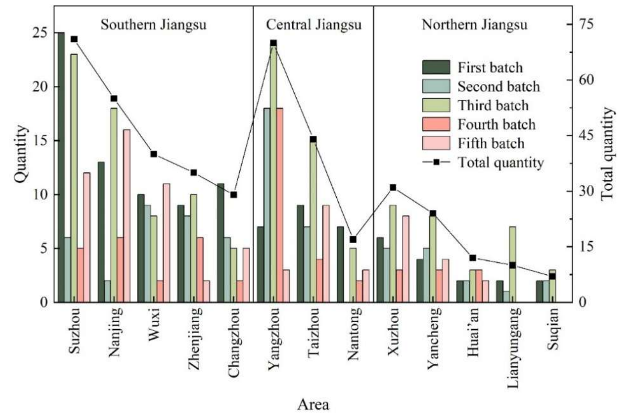
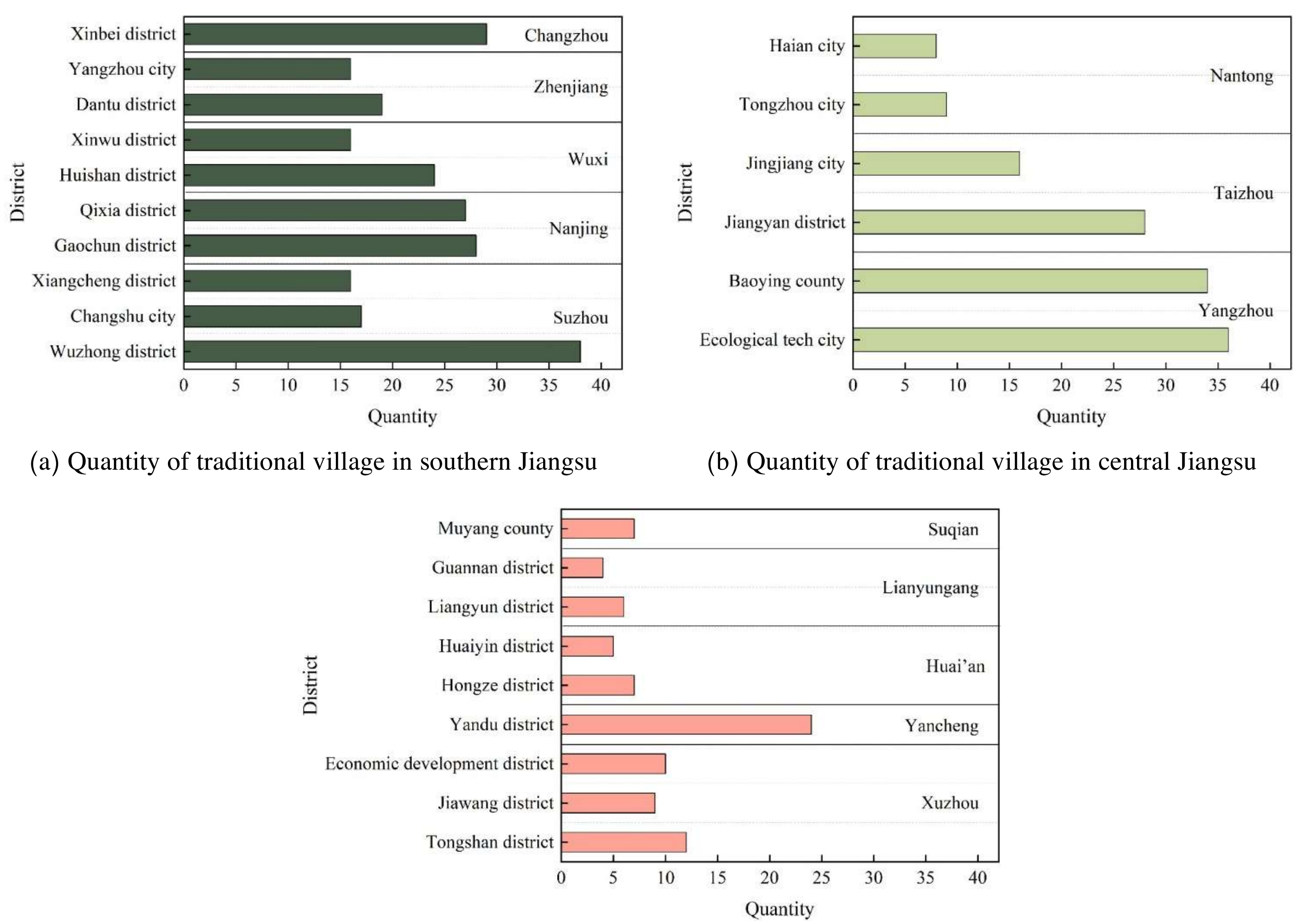


Figure 1: Municipal statistics of the quantity of traditional villages in Jiangsu province



(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

IV. A. 2) Non-equilibrium in spatial structure

The results of traditional villages municipal statistics in Jiangsu Province are shown in Table 1. The overall distribution density of traditional villages in Jiangsu Province is 47 per 10,000 km². On the whole, the density of traditional villages in the five cities in southern Jiangsu Province is maintained at a high level of more than 65 villages per 10,000 km², among which Zhenjiang has the highest distribution density of 90 villages per 10,000 km². The second is Wuxi, with a distribution density of 82 per 10,000km². Among the three cities in central Jiangsu, the density of traditional villages in Yangzhou is at the top of the 13 cities, as high as 95 per 10,000km², and Taizhou also exceeds 79 per 10,000km². The geographic density of traditional villages in northern Jiangsu is generally low, with the exception of Xuzhou, which is higher than 20 per 10,000 km², and the density of village distribution in the rest of the cities is no more than 15 per 10,000 km².

Table 1: Municipal statistics of traditional village in Jiangsu province

Area	City	Village number	Rank	Percentage (%)	Area (km²)	Density (/10^4 km²)
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

IV. B. Spatial gene conservation analysis

This paper carries out landscape planning and design based on the protection and inheritance of a traditional village (No. A) in Jiangsu Province, in order to obtain the viewer's perception of the spatial gene protection of the traditional village, constructs an evaluation index system based on the protection and inheritance of the traditional village as shown in Table 2, and explores the spatial gene protection and landscape planning effect of the traditional village in depth.

Table 2: Evaluation index system based on traditional village protection and heritage

	Primary index	Secondary index	Tertiary index
The evaluation of traditional village protection and heritage	Soundness (A)	Natural element soundness (A1)	Mountain ecological condition (A11)
			Drainage ecological condition (A12)
			Farmland ecological condition (A13)
			Woodland ecological condition (A14)
		Artificial element soundness (A2)	Carrier retention (A21)
			Structural member soundness (A22)
	Completeness (B)	Formation completeness (B1)	Skeletal formation completeness (B11)
			Axial formation completeness (B12)
			Street formation completeness (B13)
			Architectural formation completeness (B14)
		Pattern completeness (B2)	Environmental pattern completeness (B21)
			Node structure completeness (B22)
			Courtyard pattern completeness (B23)
	Coordination (C)	Environmental space coordination (C1)	The integration of the settlement and various natural elements (C11)
			The integration of human elements and natural environment (C12)
		Internal space coordination (C2)	Street interface coordination (C21)
			Boundary interface coordination (C22)
			Settlement texture coordination (C23)
		Building space coordination (C3)	Building color and style coordination (C31)
			Building height coordination (C32)

Using the hierarchical analysis method to calculate the weights of the indicators in the evaluation index system for the protection and inheritance of traditional villages, the results are shown in Table 3.

Table 3: Evaluation index weight based on traditional village protection and heritage

	Primary index	Weight	Secondary index	Weight	Tertiary index	Weight
The evaluation of traditional village protection and heritage	A	0.365	A1	0.685	A11	0.248
					A12	0.248
					A13	0.263
					A14	0.241
			A2	0.315	A21	0.500
					A22	0.500
	B	0.314	B1	0.523	B11	0.235
					B12	0.275
					B13	0.263
					B14	0.227
			B2	0.477	B21	0.356
					B22	0.342
					B23	0.302
	C	0.321	C1	0.324	C11	0.492
					C12	0.508
			C2	0.358	C21	0.374
					C22	0.312
					C23	0.314
			C3	0.318	C31	0.526
					C32	0.474

Table 4: Evaluation results of space gene protection and heritage of traditional village A

	Primary index	Score	Secondary index	Score	Tertiary index	Score
The evaluation of traditional village protection and heritage (0.86)	A	0.88	A1	0.91	A11	0.88
					A12	0.90
					A13	0.87
					A14	0.98
			A2	0.83	A21	0.84
					A22	0.81
	B	0.83	B1	0.76	B11	0.77
					B12	0.69
					B13	0.83
					B14	0.77
			B2	0.91	B21	0.98
					B22	0.83
					B23	0.92
	C	0.88	C1	0.91	C11	0.87
					C12	0.95
			C2	0.92	C21	0.86
					C22	0.96
					C23	0.96
			C3	0.82	C31	0.94
					C32	0.69

In this paper, we use a questionnaire to comprehensively grasp the cognitive status of various groups of people on specific spaces. In the content setting of the questionnaire, we help respondents form a cognitive framework by describing in detail various types of spaces and their attributes carrying spatial genetic characteristics, and make them give corresponding scores to the descriptions in the questionnaire based on their own understandings and perceptions. In terms of the scoring mechanism, the evaluation factors are subdivided into five levels based on the principle of Likert scale, and specific scores are set for each level, including 1, 0.75, 0.5, 0.25, and 0, which represent very good, good, average, not so good, and very bad, respectively. The scores are set with the aim of quantifying the respondents' cognitive level based on the attribute characteristics of the factors in order to accurately measure the cognitive depth and breadth of various types of spatial genes in the socio-cultural dimension.

According to the traditional village evaluation system constructed in the previous section and the defined evaluation criteria, 10 experts and scholars from human geography, rural sociology, rural economics, cultural heritage, architecture, landscape architecture and urban and rural planning, and other related research and practice fields were mainly invited to evaluate the actual situation of the carrier space of traditional village A that can characterize its spatial gene features. Through the comprehensive scoring of each evaluation index and the calculation of its average value, the current protection status of spatial genes at the physical space level and the existing problems were comprehensively understood. The evaluation results of the landscape planning for the protection and inheritance of spatial genes in traditional village A are shown in Table 4.

From the evaluation results in Table 4, it can be seen that the best performance of traditional village A in Jiangsu Province in the first-level indicators of landscape planning for protection and inheritance is the degree of intactness and coordination, with a score of 0.88, followed by the degree of completeness, with a score of 0.83. In the second-level indicators with a score range of [0.76,0.98], the best performance is the ecological status of woodland and the completeness of the environmental pattern, and the lowest scores are the completeness of axial form and the degree of coordination of building volume. The lowest score is the degree of coordination of building volume. The overall evaluation score of traditional village A spatial gene protection and inheritance is 0.86, which achieves better results.

V. Conclusion

The article utilizes multidimensional data computation methods such as cluster analysis, spatial morphological distribution characterization, and spatial gene genetic characterization to extract spatial genes from traditional villages. Taking traditional villages in Jiangsu Province as an example, the spatial genealogy analysis is carried out and their landscape planning based on spatial gene protection is evaluated.

The distribution of traditional villages in Jiangsu Province shows the layout characteristics of more in the south and less in the north, with the number of traditional villages in the southern part of Jiangsu Province exceeding half of the total number of traditional villages, while the proportion of the central and northern parts of Jiangsu Province decreases in the order of 29.44% and 18.88%, respectively. In terms of the layout of spatial structure, the overall distribution density is 47 per 10,000km^2. Overall the southern Jiangsu region are maintained above 65 / 10,000km^2. Yangzhou among the three cities in central Jiangsu is the city with the highest density of traditional villages in the province of Jiangsu, with 95/ten thousand km^2. The geographic density of traditional villages in northern Jiangsu is generally lower. The overall score of traditional village A in Jiangsu province in the protection and inheritance landscape planning is 0.86, and this traditional village has achieved good feedback on spatial gene protection and inheritance.

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