Study on the Evolution of Spatial Forms of Rural Settlements in Xiangjiang River Basin

Fang Li and Shao-yao He
School of Architecture, Hunan University, China
*Corresponding author

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Abstract. The spatial pattern of rural settlements in the Xiangjiang River Basin has changed greatly in both boundary and internal spatial forms. The spatial form of rural settlements has expanded or abruptly evolved, and the internal pattern has changed to varying degrees. This is the natural environment at that time. The economic environment and the social environment are closely related. This paper summarizes the rural settlements and takes the Xiangjiang River Basin as an example. Through the literature analysis and case analysis method, the general situation of the Xiangjiang River Basin and the spatial form of rural settlements are studied. At the same time, the evolution of the settlement form of the Xiangjiang River Basin is quantified. The analysis shows the diversified settlement evolution mechanism. Finally, it discusses the future of the rural settlements in the Xiangjiang River Basin and hopes to promote the sustainable development of the village.

Preface

Compared with foreign countries, the domestic eye corners of rural settlements and their spatial forms are relatively late. Since the introduction of the relationship between rural settlements and the natural environment in China in the 1930s, Lin Chao studied the classification of rural settlements in 1938 and pointed out that land is closely related to the development of rural settlements. Until the founding of New China, scholars' research on rural settlements was mostly related to the natural environment, and most of them were mainly investigational and descriptive research. After the founding of New China, due to historical and cultural factors, the study of rural settlements was in a blank stage for a long time. Until the end of the 1970s, Jin Qiming, Li Zhenquan and others conducted a comprehensive study on the formation and influencing factors of rural settlements. In the 1980s, Dong Wei discussed the influence of the religious culture system on the spatial form of Huizhou rural settlements. After entering the 1990s, scholars' research on the spatial form of rural settlements has gradually increased, covering a wide range, covering rural settlement buildings, rural settlement environment construction, and the extreme evolution of rural settlements[1].

Theoretical Analysis and Research Methods

Rural Settlements

Rural settlements refer to rural residential areas with agricultural economic activities as the main body, covering all villages and rural market towns with a small number of industrial, commercial and commercial service facilities but still have some gaps with urbanization standards. From a range perspective (Table 1)[2].

| Settlement type | population size                | organizational structure         |
|-----------------|--------------------------------|---------------------------------|
| Grassroots village | one household or dozens of households | /                               |
| Central Village   | 1000-2000 people               | Village Committee               |
| Township          | about 2000 people              | township government, town government |
Research Objects

Overview of the Xiangjiang River Basin

Natural Conditions

The Xiangjiang River is in the east longitude, and the north latitude—the entire Xiangjiang River is bordered by the Xiangluo Mountain-Luojing Mountain Range and the Poyang Lake water system. The south is connected to Guangxi by the Xiangjiang River and the Pearl River Watershed, and the Hengshan Mountain Range is adjacent to the Zishui River. North of Dongting Lake (Figure 1). As an important water system in Hunan, the length of the Xiangjiang River is 844 kilometers and the drainage area is 94,000 square kilometers. As shown in Table 2, the Xiangjiang River Basin covers a wide area, including Changsha, Zhuzhou, Xiangtan, Hengyang, Zhangzhou, Yongzhou, Yueyang and Loudi. Cities, 70 counties and cities, 935 townships (streets), 10,907 villages (3). The Pacific monsoon humid climate is the natural climate of the Xiangjiang River Basin, so it is very advantageous in terms of lighting conditions, heat and water resources, which also provides convenience for residents to a certain extent. From the aspect of geomorphology, it is mainly based on hills, hills and plains.

Social and Economic Conditions

As the most densely populated area in Hunan Province, its overall economic development is relatively high. As shown in Figure 2, the total population of the Xiangjiang River Basin is 37.754 million, accounting for 55.65% of the province's population. Among them, the total urban population is 18.427 million, and the total rural population is 19.325 million (4). In recent years, the industrial structure of the Xiangjiang River Basin has contributed an important force to the economy within the region, especially the primary industry in Ningxiang County. In 2018, it reached 6.342 billion yuan. As the most important economic belt in Hunan Province, the Xiangjiang River Basin has made an important contribution to the overall economic development of Hunan Province, and the industry is playing an important role.

Figure 1. Xiangjiang river.

Figure 2. The proportion of urban population and rural population in the Xiangjiang River Basin to the population of Hunan Province in 2018.
Source: Hunan Statistics Bureau Pipe Network Data
Quantitative Analysis of the Evolution of Settlement Patterns

Evolution of Rural Settlement Boundary Morphology

This study makes an in-depth analysis of the boundary form of rural settlements in the Xiangjiang River Basin. The core areas and the whole are collected from the sample settlements. The core area refers to the original core part of the rural settlement. The house building is refurbished from the original house, and the boundary form does not occur. A big change, the whole part is the new regional sum established with the changes of the local times and economic development, the core part of the settlement and the outward spread. The rural settlement boundary index analysis method and its formula are used to quantitatively analyze the boundary shape and scale of the Xiangjiang River Basin.

In this formula, \( S \) is the rural settlement boundary shape index, \( P \) refers to the perimeter of the rural settlement boundary, and \( A \) refers to the area, which refers to the ratio of the length of the boundary to the width.

\[
S = \frac{p}{(1.5^\lambda - \sqrt{\lambda + 1.5}) \sqrt{A\pi}}
\]

As shown in Table 3, through data comparison, it is found that the spatial form evolution of rural settlements in Xiangjiang River Basin is in an extended and abbreviated state. For example, the settlement forms of Yueshan Village, Xieping Village and Yushi Village are all extended development, while the settlement size and boundary of Yunpan Village have been reduced. The reason is that the original land occupied by rural settlements is not large, and the group-like rural settlements are formed due to factors such as family blood and religion. Due to the influence of the river veins in the Xiangjiang River Basin, the belts gradually evolved. In addition, due to the further construction of rural roads, the transportation hub has changed, which has promoted the local economic development. Therefore, the boundary and scale of rural settlements in the Xiangjiang River Basin have gradually expanded. In recent years, although the size of the rural settlements of Yunpan Village has increased, the disadvantages of the terrain have caused the traffic to be relatively closed. Many villagers gradually migrated to increase the family income, thus forming new villages or moving to other economic development. In the village, Yunpan Village gradually became a “hollow village”.

| Country name | settlement boundary | settlement scale(ha) | Aspect ratio | shape index S | boundary shape conclusion                        |
|--------------|---------------------|----------------------|--------------|---------------|--------------------------------------------------|
| Yueshan Village | Core Area          | 3.6                  | 1.367        | 1.045         | Group-shaped settlement                           |
|               | Overall             | 23.2                 | 2.163        | 3.974         | Banded settlement                                 |
| Xieping Village | Core Area          | 8.1                  | 1.821        | 1.019         | Group-shaped settlement                           |
|               | Overall             | 11.5                 | 1.967        | 2.427         | Less obvious banded-shaped settlement             |
| Yunpan Village | Core Area          | 3.21                 | 3.124        | 1.013         | Point-like settlement                             |
|               | Overall             | 4.2                  | /            | /             | Enclave Enclave Enclave development               |
| Yushi Village  | Core Area          | 9.2                  | 1.124        | 1.392         | Band-shaped settlement                            |
|               | Overall             | 46.4                 | 1.497        | 4.813         | Concentrated settlement                           |

Evolution of Internal Spatial Form of Rural Settlements

Using fractal theory, the fractal dimension of the common space map of rural settlements is analyzed, and then the spatial concentration and structure of rural settlements are studied. Using the fractal dimension calculation formula, the fractal dimension of the sample rural settlement core area and the
overall public space is calculated. At the same time, combined with factors such as building density, floor area ratio and building orientation, the paper analyzes the internal spatial evolution of rural settlements in the Xiangjiang River Basin.

\[ D = \frac{2 \lg \left( \frac{P}{4} \right)}{\lg(A)} \]

In the formula: \( D \) is the public co-construction fractal dimension, \( A \) is the plaque area, and \( P \) is the sum of the inner circumference of the plaque and the outer perimeter.

According to the data, as shown in Table 4, the fractal dimension of the common space in the traditional core area of the Xiangjiang River Basin is higher than 1.5, and its fractal dimension is higher, indicating that the spatial structure in the core area is stronger and the spatial structure is played. The economic role and other functions are large. However, from the perspective of the overall spatial fractal dimension, each rural settlement has a different degree of decline, indicating that the public space of the newly built area is relatively poor in structure. In terms of building density, they are all higher than 50% and belong to high-density settlements. However, the building density in the newly built area is less than 35%, and the building density in the core area is weaker, which means that the spatial form of dense rural settlements changes due to agricultural production, and people no longer only resist foreign enemies or concentrate production agriculture. Set up a settlement based on it.

Table 4. Quantitative analysis table of internal space of some rural settlements in Xiangjiang River Basin.

| Country name | spatial range | building density | floor area ratio | public space fractal dimension |
|--------------|---------------|------------------|-----------------|-------------------------------|
| Yueshan Village | Core Area | 51%              | 0.96            | 1.563                         |
|               | New area     | 33%              | 0.49            | Ignore                        |
| Xieping Village | Core Area | 56%              | 0.82            | 1.568                         |
|               | New area     | 31%              | 0.29            | Ignore                        |
|               | Overall      | 39%              | 0.43            | 1.526                         |
| Yushi Village  | Core Area   | 62%              | 0.79            | 1.571                         |
|               | New area     | 29%              | 0.32            | Ignore                        |
|               | Overall      | 33%              | 0.45            | 1.49                          |

Source: Hunan Statistics Bureau Pipe Network Data

Evolutionary Mechanism of Spatial Patterns of Rural Settlements in Xiangjiang River Basin

“Banded” to “Centralized” Evolution

The differentiation of the spatial form of rural settlements is closely related to the regional topography and the river water source. (Figure 3) On the one hand, topographic conditions have a great influence on the pattern and distribution of rural settlements. In general, in areas with an elevation of more than 500 meters in the Xiangjiang River Basin, due to weak infrastructure facilities, poor transportation convenience and relatively low elevation areas, the population is not too large, so the distribution is more scattered.

Figure 3. Belt-shaped settlement evolution trend.
“Single Group Type” Evolved to “Close Group Type”

With the continuous development and change of the social form, the settlements gradually migrated from other surnames, but the whole is still dominated by a certain surname, and the other surnames are mixed. At the same time, the small village may become smaller as the population size increases (Figure 5). The concentration of the towns has also changed. The settlement formed by the bloodline of the clan is very obvious to the ancestors. Therefore, the distribution of the settlement must be built around a certain core building. At the same time, combined with the traditional concept of Feng Shui, the villagers attach great importance to the location of the settlement [6]. The rural settlements evolved from the rented “single group-shaped” spatial form to the “tight group-like shape”, and the internal spatial form also changed.

“Security Defense” Evolves to “Convenience in Transportation”

With the social transformation and development, the security defense of war is no longer a consideration for the location of modern rural settlements and the layout of houses. The internal and external structures of the settlement space are gradually changing [6]. From the perspective of the transportation hub of the Xiangjiang River Basin, rural residents live along the main roads or waters in the region. When the transportation network changes, the scale, speed and shape of the rural settlements have undergone major changes. In recent years, with the advancement of the urbanization process, the transportation network of some rural settlements has gradually improved, and the resulting benefits of population and economy have changed the form of settlement. As the most important economic region in Hunan, the Xiangjiang River Basin has greatly facilitated the transportation and information transmission of local residents.

![Figure 4. Schematic diagram of the evolution of cluster-like settlements in the Xiangjiang River Basin.](525)

Evolution of “Land Intensive” to “Economic Development”

As early as the Song Dynasty, after the political center and the economic center moved southward, the northern population migrated to Hunan. The economic and cultural development of the Xiangjiang River Basin has been greatly improved, only slightly lower than the lower reaches of the Yangtze River [7]. Therefore, it is not difficult to see that the different types of rural settlements are related to the size of the population, and the changes in spatial patterns are the embodiment of the changes in human activities. The urbanization construction is one of the projects that are highly valued in the current national development strategy. The economics of many rural settlements have been greatly developed. With the improvement of people's living standards, the development of the settlement space form has been further promoted.

“Occlusion” to “Open” Evolution

The spatial form of rural settlements is reflected in the changes in its layout and scale, and the political strategy of the country plays an important role here. For example, land planning, adjustment and optimization of industrial organization structure, planning adjustment of administrative areas, and so on. In recent years, the planning adjustment of the administrative area in the Xiangjiang River Basin and the layout of the settlement space have also changed. Some rural settlements not only preserve
the original spatial form, but also establish various public facilities in the village, and other commercial services. Facilities have also been established. This is true of some rural settlements in Chenzhou City (Figure 5). The spatial pattern of rural settlements is “fish-bone”, which is different from the traditional “checkerboard”. The density of streets in newly built areas is greater than that of traditional villages, and the open space of streets and lanes has also changed. However, if the public space of the settlement is poor, the streets will be occupied, and thus there may be traffic safety hazards.

Figure 5. “Fish-bone” skeleton of some rural settlements in Xiangjiang River Basin.

Discussion - The Future of Rural Settlements in the Xiangjiang River Basin

As an important economic region of Hunan, the Xiangjiang River Basin has a large proportion of the rural population in the region. Studying the evolution of the spatial form of rural settlements will help improve the living environment and production environment of farmers. The spatial form of rural settlements changes with various factors, making it unrealistic to keep it still. According to the development of Xiangjiang River Basin, different planning methods are adopted for different types of rural settlements. First, some rural settlements that are already in a serious “hollow” or no longer livable are determined by whether they contain certain value. The original appearance of the space form, such as Yangshan Village in Guiyang County, through the expansion of tourism development, etc., the settlement space form is not only maintained, but its social value is further reflected; secondly, for villages with small social value and unsuitable for villagers to live in, It should be highly connected with the modern social and urban construction to further promote the process of urbanization and industrialization; preferably, for settlements that are suitable for natural conditions and suitable for villagers, it is better to use sustainable development as a strategy to optimize their spatial structure and form to promote Rural settlement construction.

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