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Optimization Design Practice of Rural Public Space Based on Public Participation: Taking Jiaoyuan Village in Zhaoqing City as an Example

Qinghui Sun[1,a,*]

[1]*Faculty of Construction, Guangdong Technology College, Zhaoqing, Guangdong, China*
[a]*848766457@qq.com*
[*]*Corresponding author*

Abstract: *With the acceleration of urbanization, the design of rural public spaces is becoming increasingly prominent. This article took Jiaoyuan Village in Zhaoqing City as an example to explore the practice of optimizing rural public space design based on public participation. Through the analysis of the current situation of public space in Jiaoyuan Village, a design concept guided by public demand was proposed. Public opinions were collected through questionnaire surveys, interviews, and other methods to investigate the suggestions of Jiaoyuan Village villagers and tourists on optimizing rural space. The survey results showed that 22.2% of people believed that traditional places should be combined with modern style, so that rural areas can achieve healthy development without deteriorating. This indicates that Jiaoyuan Village should improve various public facilities based on its own characteristics, and carry out spatial optimization design around ancient trees and existing buildings.*

Keywords: *Public Participation, Public Space, Jiaoyuan Village, Rural Optimization*

1. Introduction

Driven by the process of urbanization, modern society has gained a new understanding of the value of rural areas. In this process, the role played by rural public spaces is receiving increasing attention from people. In rural areas, public spaces are not only the intersection of rural life, but also the spiritual bond of rural communities. As an important component of rural residents' lives, it is of great significance for improving the quality of life of rural residents and promoting rural socio-economic development. There are many problems with its design in China, such as unreasonable design and lack of practicality. Therefore, how to optimize spatial design has become an urgent problem to be solved.

The optimization design of rural public spaces is a new phenomenon and trend that would inevitably form and gradually improve after the development of social governance concepts and practices to a certain stage. Currently, scholars have conducted extensive research on digital space. Sara Solarova discussed the feasibility of facial recognition technology and demonstrated the difference between semi open public spaces and open public spaces [1]. Rhiannon Stephanie Bettivia explored the relationship between digital public spaces and target groups, and then explored the tension generated by the integration of public spaces and digital culture. Some scholars have also conducted research on the safety of public spaces [2]. Zhitong Ma believed that the use of safety guards in large public spaces is a research with broad application prospects. The existing methods mainly rely on manual design methods, which are neither effective nor flexible for large scenes [3]. However, there is relatively little research on the optimization of rural public spaces, and this article conducted a brief investigation on it.

This article provided a brief analysis of the name source, village characteristics, spatial problems, and optimization measures of Jiaoyuan Village, the first village in ancient trees. At the same time, the importance of rural public space and the characteristics of public participation were described. This article also analyzed the current spatial situation and needs of the village, and recorded the opinions of tourists and villagers through surveys, enabling preliminary public participation and obtaining spatial optimization plans.

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2. Public Space Design of Jiaoyuan Village in Zhaoqing City

2.1. Zhaoqing Ancient Tree First Village

Gushu First Village is located in Jiaoyuan Village, Dinghu District, Zhaoqing City. Its original site was a banana orchard, which is why it is called "Jiaoyuan Village". This village is famous for its ancient and famous trees. The lush area of ancient trees exceeds 16000 square meters, and many of them have rich ecological resources and historical and cultural value. The village layout is negative Yin baoyang, back mountain face stream, beautiful natural environment. The village has a beautiful natural environment, beautiful scenery and fresh air, which is a good place for leisure vacation and ecological tourism. The village includes ancient buildings such as folk houses, small churches, and libraries. In addition, the village has abundant agricultural resources and high-quality agricultural products that are popular in the market. The distribution of ancient tree resources in Jiaoyuan Village is shown in Table 1.

Table 1: Distribution of ancient tree resources in Jiaoyuan village

	Maximum tree age(year)	Tree-height(cm)
Ficus microcarpa	635	90~165
May tea	565	35~75
Autumn maple	625	50~90
Park Tree	625	20~75
Kapok	595	80~95
Murmuring and withering trees	595	10~20
Jacaranda tree	565	40~50
Face saving	475	45~145
Pen tube banyan	275	50~115
Silver firewood	195	50
Shuiweng	195	40

Jiaoyuan Village is based on ancient trees and famous trees, numerous historical sites and buildings, beautiful environment, and profound historical and cultural heritage, fully creating a characteristic tourism village. However, in the construction of public spaces, there are also some problems in the first village of ancient trees. The imperfect construction of public facilities, such as narrow roads and lack of parking lots, all bring inconvenience to tourists and residents. Insufficient public health facilities, such as non-standard garbage classification and disposal, have affected the cleanliness and environmental hygiene of villages. In addition, the lack of cultural activity venues and public leisure facilities limits residents' cultural entertainment and social exchanges.

In order to improve these issues, it is necessary to strengthen the construction of public facilities and enhance the planning and construction level of roads and parking lots. At the same time, efforts should also be made to strengthen garbage classification and treatment work, and improve the environmental sanitation level of villages. In addition, cultural activity venues and public leisure facilities should be increased to provide residents with more opportunities for cultural entertainment and social exchange.

2.2. Rural Public Space

The concept of rural public space does not only refer to places for villagers to gather and entertain, such as squares, parks, etc. [4-5]. More profoundly, it refers to areas that play a role in communication, exchange, and sharing in rural life, including but not limited to farmland, forest trails, lakes, ponds, etc. These spaces are not only physical carriers of rural life, but also manifestations of rural culture.

On the one hand, rural public spaces provide villagers with opportunities for leisure and entertainment [6-7]. In these places, villagers can exchange and share life experiences with each other, as well as establish and maintain interpersonal relationships. Under the shade of trees at the entrance of the village, on the village square, and in the fields, there are places where villagers can communicate and engage in activities. Public spaces are also places for various folk activities, such as temple celebrations, festivals, etc. [8-9]. These activities not only enrich the cultural life of villagers, but also deepen their identification with rural communities. On the other hand, rural public spaces are also important places for agricultural production. Public spaces such as farmland, forest roads, lakes, and ponds are not only tools for farmers, but also places for communication and cooperation. Here, farmers

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face the natural environment together and solve problems together, thus establishing deep trust and friendship. This collaborative relationship based on joint work plays an important role in maintaining rural social harmony and stability [10-11].

In the form of village public space, roads connect with different classes of spaces [12-13]. The design of public space is often closely attached to linear structures such as streets and lanes, and around these structural layouts, including similar spaces such as village committees, movie theaters, and cultural squares. The advantage of this design is that it provides high accessibility and facilitates communication and interaction between residents and visitors. The village level refers to the formal public space that has been relatively strong for a long time in a village. This category includes fixed public spaces such as ancient temples, sun drying fields, local temples, village councils, and markets. The residential neighborhood level includes areas such as courtyard facades, street and alley spaces, as well as node spaces such as ancient trees and wells. Due to the daily needs of villagers, they often participate in public communication activities. The agricultural unit layer is the space most commonly used by villagers. Rural farms are diverse, serving as both production venues and entertainment venues for various public activities.

2.3. Public Participation

The design of rural public spaces should fully listen to the public's opinions and suggestions, and involve the public in the decision-making process, which can be achieved through holding symposiums, questionnaire surveys, and other methods. In this process, full consideration should be given to the needs and preferences of the public to make the design more practical and in line with their needs [14-15]. The public should be encouraged to actively participate and work, which can be achieved through organizing voluntary labor, volunteer activities, and other means. Public participation can not only improve the design quality and construction speed of public spaces, but also enhance the public's sense of belonging and identity. In the process of using rural public spaces, a supervision and co management mechanism should be established to allow the public to participate in the daily management of public spaces [16-17]. This is achieved through the establishment of volunteer teams and the establishment of public facility administrators. Supervision and co management can ensure the safe and hygienic use of public spaces, and improve the utilization rate of public spaces.

It is necessary to strengthen publicity and education in order to increase public awareness and participation in the optimization design of rural public spaces [18-19]. This can be achieved through promotional activities, distribution of promotional materials, and other means. It is needed to improve the supervision and co management mechanism, and establish a volunteer team and public facility administrator system to strengthen the daily management and supervision of rural public spaces. By introducing technological means such as intelligent monitoring equipment and remote control systems, intelligent management of rural public spaces can be achieved [20].

3. Space Status and Requirement Analysis

3.1. Problem Evaluation

Rural public spaces should pay attention to the accessibility of villagers and tourists, making them easy to access and use. The building area of village committee, retail stores, etc., is mainly linearly distributed on both sides of the main street, and there is no built-in vacant space in the entire village. Affected by the modernization of internet communication, blind imitation and modularization in materials, aesthetics, technology, and other aspects have led to the construction of "One Thousand Villages" public buildings. The lack of use of local materials and architectural techniques has led to significant differences in architectural style and surrounding natural landscapes. The existing public space does not cross a single boundary and cannot meet the needs of different people at different times. The efficiency of space utilization is low, and the overall bearing capacity of buildings is low. The construction of existing public spaces in the village is managed by the government and investors. It is necessary to awaken the awareness of villagers and stimulate their creativity to achieve the joint construction of public spaces. The existing public space is not guaranteed in terms of future governance [21].

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3.2. Requirement Analysis

There are very few middle-aged young people in the village, and village surveys are mainly conducted through offline interviews and online questionnaires. The elderly in the village communicate and bask in the sun on street corners during the day. Children and young people in the village usually have free time for entertainment after 7:30 pm. However, the existing entertainment rooms in the village are located inside village committee, and indoor entertainment rooms are not open to employees after work. The reinforced vacant space on the main square has been reduced and cannot meet the needs of the villagers. In order to better understand the actual needs of villagers and tourists, relevant questionnaires were designed. A total of 200 valid questionnaires were collected, and respondents typically hold a bachelor's degree or higher. Youth is an important group in the rural tourism industry, involving multiple professions.

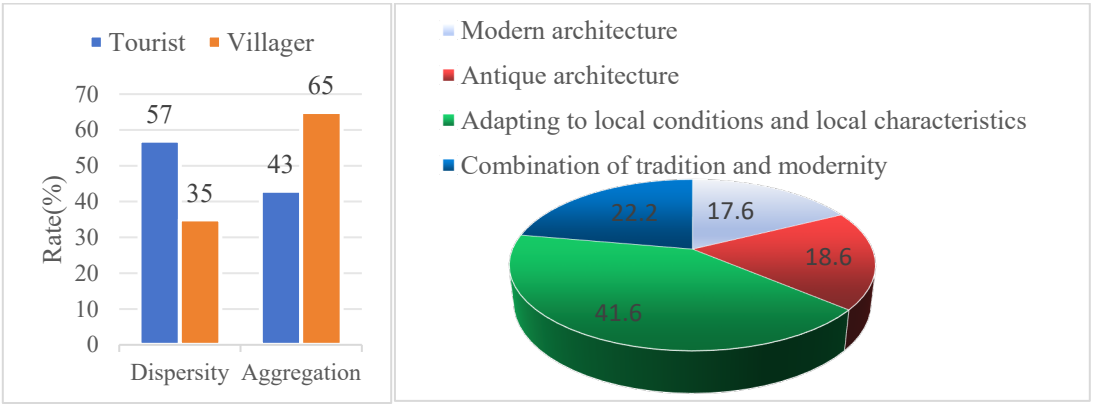

Figure 1: Tourists' expectation for the site location of public space construction and architectural appearance

In Figure 1, 57% of tourists hoped that the public space in rural areas should be scattered throughout the village, while 43% of tourists hoped that the space construction should have clustering. Most villagers believed that public spaces should have clustering, with only 35% of villagers feeling the need for dispersed public spaces. In addition, 41.6% of the public in the survey on the appearance expectations of public space buildings believed that it is necessary to adapt to local conditions to make the space design more rustic. Anticipators for antique architecture accounted for 18.6%, while those for modern architecture accounted for 17.6%. This indicated that ancient buildings have significant value in rural construction. This data indicates that the majority of tourists tend to prefer the scattering of public spaces throughout rural areas, allowing them to enjoy the convenience and comfort of public spaces in different corners of the village. Meanwhile, most villagers lean towards public spaces that have a certain degree of clustering, possibly because they desire social interaction and opportunities for activities within a specific area.

Furthermore, in the survey regarding the expectations for the appearance of public space buildings, the majority of respondents believe that it is important to adapt to local conditions and design spaces that embody rural characteristics. This highlights a preference for adaptability and local authenticity in the design of public spaces in rural areas. Additionally, a portion of the respondents expressed higher expectations for antique architecture, indicating its significant value and importance in rural construction. On the other hand, expectations for modern architecture were relatively lower, possibly due to the perception that antique buildings align better with the rural environment and historical culture.

In Figure 2, there was a significant demand for homestays, rural memory centers, and reception centers in terms of service facilities. Moreover, there was a need for agricultural experience venues and public restrooms. 60% of people hoped for the construction of homestays, and 50% expected a reception center. Another 53% of people said that the resources of ancient buildings and trees need to be well utilized. Another 35% of people want a public space for rest. Expecters for tea rooms, entertainment facilities, and landscape facilities accounted for 20%, 24%, and 29%, respectively.

Tourists were not satisfied with the scale, quality, regional characteristics, landscape, and rest of the existing public spaces in the village. In addition, they were more concerned about the functionality of the site and the provision of infrastructure. According to on-site interviews with tourists, most people believed that the most important area to improve in rural tourism was environmental hygiene. They

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believed that the number of homestays in the village was insufficient, and there was a lack of reception centers and public toilets.

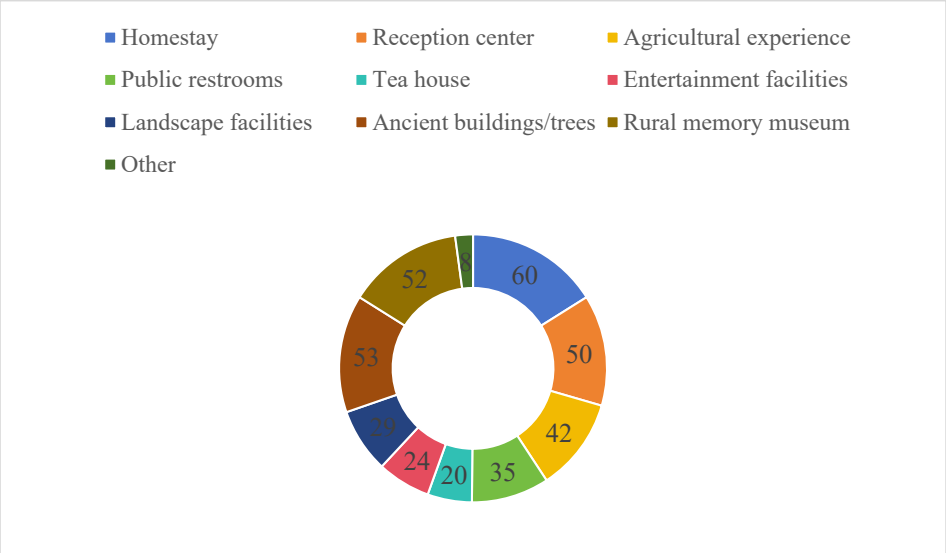

Figure 2: Tourists' expectation for the function of the public space

3.3. Optimization Plan

Before conducting quantitative evaluation of sampled villages, it is necessary to establish a graded evaluation system. The inherent hierarchical structure of the evaluation system is the target level, standard level, and indicator level. The current situation of public spaces in demonstration villages must be evaluated based on three criteria: road traffic space, leisure and entertainment communication space, and landscape greening space. Analytic hierarchy process can be used to calculate the weights of various indicators. The consistency indicators are:

$$CI = \frac{\alpha - m}{m - 1} \tag{1}$$

α is the maximum feature root, and m is the only non zero feature root. Formula (1) results close to 0 indicating satisfactory consistency. The consistency ratio is:

$$CRandom = \frac{CI}{RandomI} \tag{2}$$

The random consistency index is represented by RandomI, and its normalized feature vector is used as the weight vector. The consistency ratio of sub total sorting is:

$$CRandom = \frac{x_1 CI_1 + x_2 CI_2 + \cdots + x_n CI_n}{x_1 RandomI_1 + x_2 RandomI_2 + \cdots x_n RandomI_n} \tag{3}$$

The weight vector of the lowest level to the highest level total sorting was calculated.

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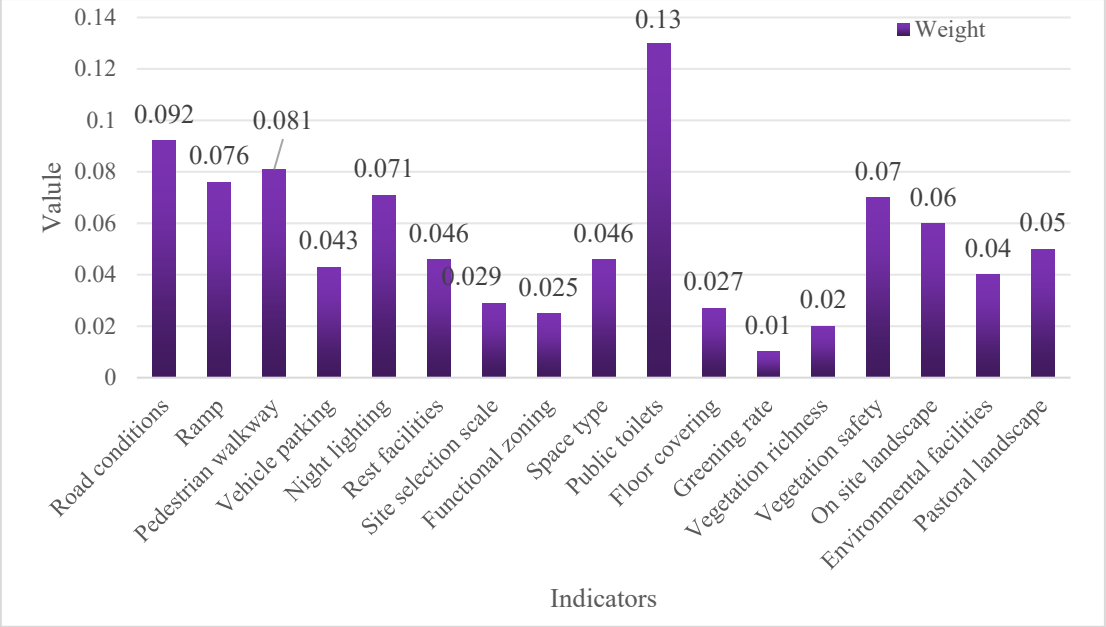

Figure 3: Evaluation index weight results

In Figure 3, it is evident that the weight value of public toilets is the highest, which means that the existence and construction of public toilets are indispensable in public spaces. The minimum weight value of green plant proportion is because this village is famous for green plants, so there is no shortage of trees, and the characteristics of the village have always been maintained. The weight values of road related indicators are relatively high, so Jiaoyuan Village should strengthen the construction of roads and facilities. The vegetation safety has the highest weight value in the green plant space.

Based on the design concept of public demand orientation, this article collected public opinions through questionnaire surveys, interviews, and other methods. After a centralized call to the villagers of Jiaoyuan Village, they were asked questions on-site to understand their needs and construction expectations for public spaces. From the scene, it can be seen that the majority of the villagers are middle-aged and elderly people, with fewer middle-aged people, so their needs are also showing signs of aging. That is to say, villagers have a greater demand for elderly care environment and facilities and equipment.

In Figure 4, most villagers are dissatisfied with the road traffic space, with only 12% satisfied with the road construction in rural areas. There is a mix of pedestrians and vehicles, a lack of pedestrian systems, and most public activity areas are arranged along the main roads, resulting in a large traffic flow. Therefore, it is necessary to design pedestrian routes to achieve pedestrian and vehicle separation, and improve road accessibility construction. Elderly people have reduced responsiveness, so pedestrian walkways should be smooth, slip resistant, and meet a certain traffic width. If there is a height difference between the pedestrian path and the road intersection, a curb ramp needs to be designed. The exercise system of the elderly has deteriorated, making it difficult to stand or walk for a long time. Therefore, it is necessary to arrange recreational facilities reasonably and create street parking spaces. It is necessary to design decentralized parking spaces and add centralized parking lots. There are also a majority of villagers who are not satisfied with the entertainment and communication space, with only 18% of people being relatively satisfied with the entertainment space. It is necessary to clarify the spatial hierarchy planning and improve the utilization rate of neighborhood cluster space. It is also necessary to improve the functional zoning of the square and create a multifunctional composite space. It is necessary to add aging friendly supporting service facilities to achieve accessible space design. The villagers have a good attitude towards the landscape greening space, as there are many green plants and more ancient trees in this village. However, 21% of people are still dissatisfied. It is necessary to configure age-friendly landscape plants to enrich the landscape hierarchy. In order to leverage the unique advantages of rural landscapes and inherit local characteristics, it is necessary to properly protect and design traditional local landscapes such as ancient trees, wells, and stone bridges that remain in the village. By adding leisure tables and chairs around its space and building vine racks, it can provide a landscape space for sightseeing and recreation.

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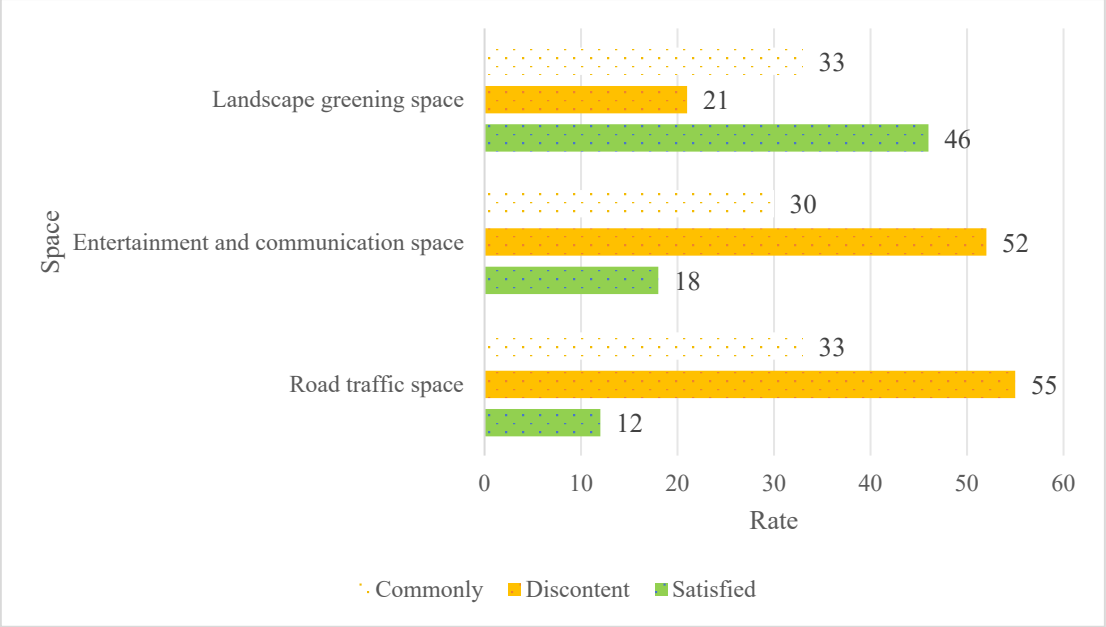

Figure 4: Attitude analysis of spatial optimization

4. Optimization of Public Space in Jiaoyuan Village

The functional composition of rural public spaces is an important feature of rural characteristics. At the Cultural Square, villagers can not only exercise and entertain themselves, but also dry their food during the harvest period. The planning is diverse and complex, and through the reasonable combination of functions, new public spaces are utilized to create a rural activity atmosphere and promote the emergence of various social activities. In today's rural construction, the design of public villages often overlooks the inherent rural characteristics of traditional spatial structures. Renovation should respect the usage habits of villagers and focus on the large-scale use of existing village public spaces to pursue pleasant spatial scales and textures, creating comfortable and humanized public spaces. By protecting and transforming the architectural and spatial elements of the area, the rural characteristics of the village can be inherited. By creating a rural atmosphere, forgotten rural culture can be revitalized; by designing public spaces that reflect rural characteristics, villagers can restore their memories of past life, psychological identity, and spatial belonging to the current living environment. Rural landscape elements are an important manifestation of rural public spaces. By highlighting and strengthening landscape elements such as ancient trees and wells, the uniqueness of the village is highlighted. Optimizing rural public spaces requires the participation of villagers in the entire construction process. Only by participating in the entire building can the emotions of villagers be firmly anchored in the physical space, which can restore abandoned and lifeless public spaces, revitalize them, and highlight the rural characteristics of public spaces. Villagers should be encouraged to actively participate in the construction process, unleash their sense of ownership and provide them with a sense of participation and satisfaction, ultimately contributing to the development and revitalization of the village together. By actively encouraging villagers to organize traditional folk activities with rural characteristics, the rural public space can be enriched at the spiritual level with rural characteristics and the continuation of folk cultural heritage.

5. Conclusion

Rural public space is the intersection of rural life and the spiritual bond of rural communities. It not only provides a place for leisure and entertainment for villagers, but also an important place for agricultural production. From the perspective of public space layout, combined with the overall urban planning, this article proposed an optimization path that is in line with the actual situation, taking into full consideration factors such as socio-economic development and urbanization level, as well as village construction needs, government function transformation, and public service supply. Public participation has improved the practicality and aesthetics of rural public space design. Accurate public opinions were collected through methods such as questionnaire surveys and interviews. Space optimization can improve the quality of life of rural residents. This article found that there are obvious problems of segmentation and dispersion in the overall planning of public space in Jiaoyuan Village. In

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the optimization design of public spaces, full consideration should be given to the needs of villagers, enabling them to actively participate, support, and cooperate with rural construction space work.

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