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Research on Rural Human Settlement Environment Transformation Based on Participatory Design Concept

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Abstract. With social and economic development, the rural habitat is constantly improving and developing in terms of infrastructure, landscape style, environmental health, cultural heritage, and information technology. At the same time, rural human settlements are facing a number of problems and challenges, such as the urbanization of rural landscapes, the serious commercialization of rural landscapes, the weak awareness of environmental health protection, the reduction in the diversity of rural cultures, and the existence of the digital divide and the spread of technology. Based on the above problems, this paper takes Hongmiao Village, Mahe Town, Hubei Province, China, as the research object, and through the field research on the village, we understand the current situation of local development and potential problems. On this basis, the strategy of empowering participatory design in rural habitat transformation is proposed. Starting from the design of the public space in front of and behind the house, the field transformation is carried out mainly through digital technology to break the spatial limitation of traditional art, and mobilizing the joint participation of multiple subjects to enhance the villagers' main consciousness. Finally, through the methods of return survey, corresponding questionnaire, and inductive analysis, this study proves that participatory design provides new theoretical support for the transformation of the rural habitat environment and has important reference value for the improvement of the rural habitat environment.

Keywords. Participatory design, village, human settlements, environmental modification, digital technology

1. Introduction

Upgrading the rural habitat is an urgent expectation of farmers, an important part of building an ecologically livable environment, and a core task in promoting rural revitalization. Numerous scholars have put forward the current situation and problems of China's rural habitat from different perspectives. Dipankar Ghosh et al [1]. found that the main factors affecting the quality of rural habitats are sewage and garbage. Ally Rajab Mketo et al [2]. argue that the importance of community participation in improving sanitation for rural development has not been given the importance it deserves. Jianying Wang et al [3]. argue that villagers' spatial awareness and identity have declined under

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the influence of crowded public spaces, loss of cultural space, and over-commercialization of residential space. Despite the fact that the countryside has been governed for many years, there are still many problems in all aspects of rural habitat. In the final analysis, this is due to the fact that there are few paths that can really be rationally and effectively implemented and that villages do not have enough self-generated motivation to carry out sustainable development.

Traditional design models tend to be top-down. It is difficult for the subjectivity of rural residents to function. This has led to a detachment of decision-making from reality and has caused serious damage to natural ecosystems. It is difficult to achieve real results in rural revitalization, and even more difficult to form a replicable model. For example, in 2016, in Shanxi Province, White Deer Plains Folk Culture Village using the traditional design mode [4], the local government built antique scenic spots, destroying the original natural scenic spots, ultimately leading to a lack of folk cultural connotations of the village, homogenization, commercialization, serious, was dismantled in 2020.

The research value of participatory design and rural habitat transformation is to provide research objects, examples, and practical experiences for the fields of social sciences, design and planning, sustainable development, and community development, and to promote the development of theories and practices in related fields(Table 1 details the characteristics, strengths, and limitations of participatory design versus traditional design). In this context, the article takes the opportunity of the participatory rural habitat design workshop conducted by the Ministry of Housing and Construction of China in Hubei Province. Field survey methods, household research, semi-structured interviews, and voting rules were used to identify existing problems in the villages. Decisions are made by all villagers and all results are publicized to enhance villagers' trust and participation. Forming design teams centered on villagers and involving multiple subjects to ensure information and knowledge sharing. Collecting primary data and proposing rural habitat upgrading solutions using hand-drawn sketches, 3D modeling techniques, CAD drawing techniques, and PS layout techniques.

Table 1. Traditional vs. Participatory Design Models in Hongmiao Village

Name	Traditional Design Patterns	Participatory Design Paradigm
Participating entity	Government; Design team	Multiple subject
The direction of development	Government	Villagers; Government
Source of funds	Government	Villagers; Government; Social forces
Project implementation	Government	Multiple subject
Maintenance management	Government	Villagers
Effectiveness evaluation	Government	Villagers
Dominance	Stable construction quality; Mature working methods; High degree of standardization	Stable capital; High efficiency; High satisfaction of villagers; Strong initiative of villagers; High cultural integrity
limitations	Difficult to copy; difficult to promote; template; high cost; low maintenance rate; no democratic mechanism	Difficult to stimulate the enthusiasm of villagers; difficult to enhance the awareness of villagers

2. Participatory Design Concepts and Workshops

2.1. Participatory Design Philosophy

In 1960, the American philosopher Arnold Kaufman proposed "participatory democracy", a theory that advocates extending the scope of "politics" to areas other than government, and that participation begins at the grassroots level, in the community [5]. Participatory design was inspired by the "participatory democracy" movement of the time. Participatory design seeks to include and actively involve stakeholders, especially future users or beneficiaries, as design partners or co-designers[6] [7]. Over the years it has evolved from participatory design, co-design and co-creation to collaborative design and design thinking, and it has been used extensively in research and industry [8]. Participatory design of communities emphasizes that residents are the primary decision makers, as they have a shared responsibility for the future of the community[9]. They usually play the roles of user and designer, where the designer "strives to understand the reality of the user's situation, while the user strives to articulate their desired goals and learn from them[10]. Participatory design in the community encourages collaboration between marginalized communities, government agencies, and multidisciplinary academic teams[11]. One of its distinguishing features is not the participatory activity itself, but the process in which the public participates, the nature of the results sought, and the manner in which the effects are sustained[12].It has been proven that wider public representation in governance processes and participatory decision-making contributes to less conflict, greater acceptability, and fairness, and can improve the quality of decisions taken [13]. With adequate support, public scrutiny and activism can help reduce the regulatory burden on local governments while still achieving desired outcomes [14].

2.2. Participatory Design Philosophy

With the development and popularization of the digital age, China's urban-rural construction model has been transformed into a "dualistic structure" (the urban-rural dualistic structure refers to the obvious difference and antagonistic relationship that exists between urban and rural areas). The issue of rural construction has become a key issue in China's transition from an "urban-rural dualistic structure" to a "modern economic structure" [15]. In order to further promote changes in urban and rural development, the Government has proposed and implemented the concept of "common building", and has launched a participatory rural habitat design workshop to explore the practice of social governance at the grass-roots level. The workshop focused on three aspects, namely, enhancing villagers' democratic awareness, improving villagers' organizational capacity, and building good infrastructure. The specific content is the cultural propaganda of participatory design, the development of various activities of self-government organizations, and the improvement of the human environment in front of and behind villagers' houses.

3. Case study of the workshop on "Co-Creation of a Better Environment and a Happier Life" in Hongmiao Village, Mahe Town, Hubei Province

3.1. Status of Hongmiao Village

- Surroundings

  Hongmiao Village is located in the north of Mahe Town, far away from the city. It is mainly planted with lotus flowers and lotus roots. The natural scenery is beautiful. Garbage in the village is exposed and usually piled up in front of home ponds. The utilization rate of public space is low.

- Demographic characteristics

  Hongmiao Village has 6 villager' groups, 409 households, 1,554 people, 340 permanent residents, 20 children aged 4-10, 30 young men aged 20-55, 60 women aged 20-55, and 130 elderly people aged 65 or above.

- Self-governing organizations

  There is one village committee organization with a total of five members, which is mainly responsible for the day-to-day management and operation of Hongmiao Village, and the formulation and implementation of the village's development plan. There is one recreational organization, the Red Temple Village Waist Drum Team, which conducts relevant cultural activities on its own initiative during traditional holidays.

3.2. Design strategies

- Household visits and semi-structured interviews

  The workshop team used the research method of household research and semi-structured interviews to analyze the data of the villagers in Hongmiao Village. The main purpose of the interviews was to understand the current situation of the village, the villagers' ideas and concerns about the transformation of the front and back of the house, the level of awareness of participatory design, the support rate of the participatory design model, etc., as well as to popularize and publicize the participatory design workshop. A total of 70 villagers were visited for informal interviews, and 50 valid interview samples were finally obtained. During the course of the interviews, alternative questions were revised in a timely manner, based on the interview outline and the respondents' answers. Each interview lasted about 30 minutes, with individual in-depth conversations lasting up to three hours. After obtaining the consent of the respondents, the interviews were recorded by means of questionnaires and audio recordings. Due to the serious aging of the population in Hongmiao Village, among the 50 villagers who participated in this research, 32% of the villagers are 20-40 years old, 32% of the villagers are 40-60 years old, and 36% of the villagers are 60-80 years old. Secondly, the problem of labor shortage in Hongmiao Village has seriously hindered the development of local basic industries such as agriculture and construction. Therefore, the design and construction of public places in the village are all funded by the government in this remodeling, while the cost of

remodeling the villagers' houses is paid by the government and the villagers in the ratio of 3:7 respectively, but still only 18% of the villagers are willing to fund the remodeling. 88% chose the traditional design model, while only 12% supported the participatory design model, and all of them were young. In addition, 40% of the villagers had no opinion on the design and renovation of the community and adopted the suggestions of the designers and builders, while 60% of the villagers put forward their own opinions and hoped that the builders would optimize the design and renovation based on them (Fig .1).

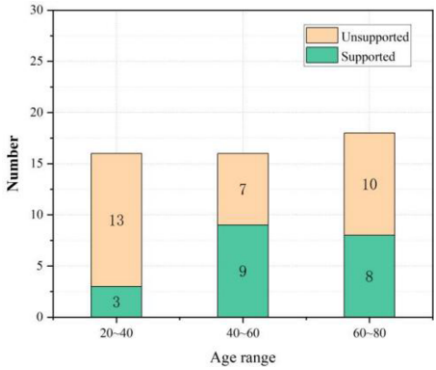

Figure 1. Hongmiao Village villagers' views on the reconstruction of the front and back of the house.

With a total of 50 research samples, there are 9 specific design modification recommendations (Table 2). In the end, according to the data statistics and analysis from high to low, the three nodes that the villagers want to renovate the most were selected. 28% of the people wanted to renovate the front yard of the villagers' homes, 26% wanted to renovate the village bay roundabout, and 18% suggested renovating the signage at the village entrance. In the process of communication, the villagers all hoped to highlight the characteristics of Hongmiao Village and retain a certain local flavor. The workshop team utilized the visit survey to communicate directly with the villagers face-to-face. This ensured that the workshop team fully understood the actual needs, concerns, and problems of the villagers.

The form of voting was used to count the transformation nodes that best meet the villagers' wishes, emphasizing democratic participation and equality of opinion. It helps the workshop team to provide them with design solutions that are more in line with their expectations according to their actual needs. At the same time to a certain extent, it enhances the villagers' sense of subjectivity and the degree of cognition of participatory design.

Table 2. Hongmiao Village villagers for the village environment transformation suggestions

No	Suggestion	Total	Scale(%)
1	Renovate villagers' front and back yards	14	28
2	Village bay roundabout	13	26
3	The logo design of the entrance of village Bay is added	9	18
4	Build a public recreation pavilion	5	10
5	Add physical exercise facilities	3	6
6	Improve water mains	3	6
7	Add a dance hall	1	2
8	The roads are lined with flowers	1	2
9	Add activity space for children	1	2

- Data collection and field research

With the assistance of the village committees, villagers with design experience and certain craftsmanship and those who wish to participate in the workshop are recruited to join the workshop team to ensure that every villager is guided by a professional at every step of the process. Villagers participate and learn the whole design process. The workshop team collects relevant information in advance including land use, vegetation distribution, topography, building structure, and other information. Professional designers use drone tools to assist in the integration of geospatial data and morphological features of Hongmiao Village, providing accurate maps and spatial analysis functions, a better understanding of the geographic environment, and conceptual design, and the determination of the overall layout, main body and style. We expressed the creativity and ideas of the design through hand-drawn sketches (Fig .2), CAD software to draw floor plans (Fig .3), 3DMAX software to render model drawings (Fig .4), PS software to design layout drawings (Fig .5), etc., and printed the renderings for exhibition. Volunteers removed garbage around the renovation nodes to ensure a clean environment on site produced participatory design science posters and publicized and explained them.

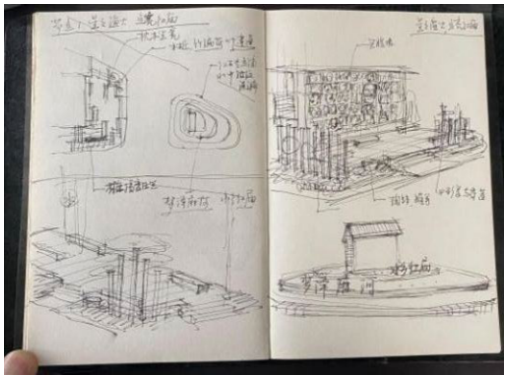

Figure 2. Hand-drawn sketch of Hongmiao Village.

Figure 3. Plan of Triangle Vegetable Garden in Red Temple Village.

It is worth noting that data collection and field research is an essential part of the environmental design process. This part can provide accurate environmental information and help the workshop team to identify possible problems. In addition, local villagers can provide valuable knowledge and experience to help the workshop team better integrate the local habitat and cultural and folkloric elements, and work together to develop sustainable and adaptable design solutions.

- Organizational incubation and event planning

  The workshop held a villagers' meeting to assist in the establishment of the Hongmiao Village Environmental Protection Association, the Hongmiao Village Care Association, the Hongmiao Village Community Volunteers Association, and the Hongmiao Village Recreation Association. And improve the system of self-organization and prepare the constitution. The main services of Hongmiao Village Environmental Protection Association are to beautify the environment, strengthen environmental publicity, publicize environmental information and raise environmental awareness, and organize villagers to hold regular activities to clean up and maintain the environment in the village; Hongmiao Village Caring Association, whose main service targets are the elderly, the disadvantaged, and the children, provides them with support, financial assistance, and care; community volunteers, whose main services are to care for the neighbors, provide classroom tutoring, cultural and recreational activities for young people, and to assist in establishing the Hongmiao Village Cultural and Recreational Association. The main services of the Community Volunteers are to care for the neighbors, provide tutoring for the youth, provide cultural entertainment, publicize legal education, and maintain the environment, etc.; the main services of the Hongmiao Village Recreation Association are to carry out various kinds of cultural and recreational activities and to undertake weddings and funeral ceremonies and performances during traditional holidays in the village and the surrounding areas, etc. (the main sources of funding come from donations, government subsidies, revenues from the activities or services carried out within the approved scope of business, and other lawful incomes).

3.3. Public Participation in Rural Habitat Transformation Content

- Hongmiao Village Signage Renovation

The merit monument at the entrance of the village is an important symbol that directly reflects the spirituality and cultural practices of Hongmiao Village. However, the area around the monument is currently disorganized and lacks design features and aesthetics. First, repair the damaged part of the monument, and remove graffiti and piles of debris. Secondly, focusing on the excavation and display of local water town cultural characteristics, around the existing wall of the shadow wall of the "water rhyme Mahe, Lotus Red Temple" theme to carry out the development of redesign. Render the rendering using 3DMAX software to create a unique large-scale public art installation to enhance the image and attractiveness of the village (Fig .4). Finally, collect the photos of all villagers who participated in this workshop, and use PS graphic software to design a wall facing the entrance of the village bay for joint participation in the construction of the wall (Fig .5), so that each villager can feel their importance and participation, and it is also a way to display the village culture and the results of the workshop, to enhance the village cultural self-confidence and sense of identity, and to contribute to the development of the village and publicity.

Figure 4. 3D rendering of the signage of the Merit Monument in Hongmiao Village.

Figure 5. Co-creation wall effect of the Merit Monument in Red Temple Village.

- Triangle Vegetable Garden Renovation

The triangular vegetable garden at the roundabout in Hongmiao Village has been piling up garbage for years and is only fenced off with a simple fishing

net, affecting the beauty of the village environment and vehicle traffic. Many villagers came forward to demolish the abandoned building and clean and organize the surrounding area. The design and renovation of the triangular vegetable garden is functionally oriented, dividing it into an ornamental area and a functional area. The functional area accounts for 3/4 of the total area, preserving the traditional lifestyle of the villagers (Fig. 6). In response to the above renovation plan, the first step is to harden the road, make a fence using red bricks, and set a gate on the right side of the vegetable garden. In addition, incorporating the characteristic traditional cultural elements of Mahe Town of Hanchuan City, Hanchuan Lotus Moon and Lotus Flower, etc., and drawing relevant patterns on bamboo fences, which will be used to display the local village culture.

Figure 6. Triangle Vegetable Garden Renovation (a: Triangle Vegetable Garden before renovation, b: Triangle Vegetable Garden after renovation).

- Wangshi Vegetable Garden Makeover

"Wangshi" means fisherman, symbolizing the traditional fishing culture of Hongmiao Village. Their vegetable garden is selected for transformation to serve as a demonstration and at the same time drive more villagers to participate (Fig .7). The designer transforms the homeowner's vegetable garden into a public space that meets the residents' leisure needs and demonstrates the concept of green living. Using 3D MAX software to render the rendering (Fig .8), the area of the vegetable plot and leisure area is divided evenly to ensure the functionality of the vegetable plot and the comfort of the leisure area. In the center of the recreation area, a 2.98m X 5.43m pavilion is set up, which adopts the design form of a fishing net, with the meaning of "the land of fish and rice". The pavilion is made of local wood and is surrounded by a local red brick walkway and green lawn to enhance the greening effect and provide better visual enjoyment and comfort. In addition, a 3.3m X 2m sandpit is added to the recreation area for children. Seats and benches are added around the pavilion for the convenience of residents' leisure use. The perimeter of the functional area is decorated with bamboo fences, in line with the countryside style.

Figure 7. Participation of villagers in designing the renovation.

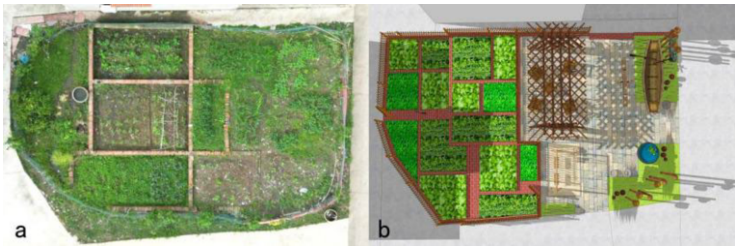

Figure 8. Retrofitting of the Wangshi vegetable garden (a: Wangshi vegetable garden before retrofitting, b:Wangshi vegetable garden after retrofitting).

4. Discussion

After the workshop, a return survey was conducted for the previous 50 villagers. An effectiveness evaluation form was designed for data collection and analysis to understand villagers' satisfaction with the participatory design workshop, support for the participatory design model, willingness to participate in self-governance organizations and funding support.

Regarding the evaluation and results of the participatory design workshop, 40% of the villagers were very satisfied, 44% were quite satisfied, 10% were basically dissatisfied, 4% were not satisfied at all, and 2% were not sure (Fig. 9). The reasons for the villagers' dissatisfaction may be as follows: a) not transforming their desired public facilities; b) disagreeing with the design scheme; c) dissatisfied with the effect after construction; d) disagreeing with the selection of construction materials; e) insufficient participation of the villagers. Overall it seems that the villagers of Hongmiao Village have a high satisfaction rate of 84% for this participatory rural environment design workshop.

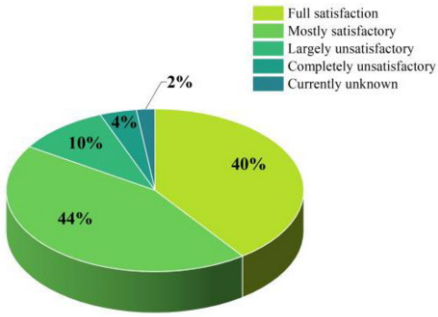

Figure 9. Overall satisfaction after the design and renovation of HongMiao Village.

The survey data on the support rate of the participatory design mode (Fig .10) shows that 82% of the people support the participatory design mode compared with the traditional design mode, which is an increase of 70% compared with the number of people before the renovation. The participatory design model provides villagers with the opportunity to participate in the decision-making and design process, establishes a trusting relationship through a transparent mechanism, promotes the villagers' sense of

subjectivity and responsibility, better meets the villagers' interests and the sustainable development of the village, and ultimately strengthens the villagers' sense of identity and satisfaction with the participatory design model.

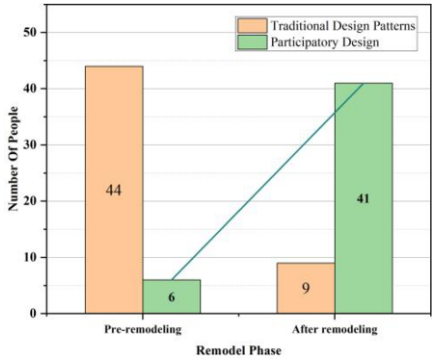

Figure 10. Support rate of participatory design in Hongmiao Village.

According to the results of our survey, 40% of the villagers indicated that they had no intention to join self-governing organizations, while 60% of the villagers indicated that they were willing to join self-governing organizations in the village, specified the organizations they were interested in and indicated that they would actively participate in the relevant activities. The details are as follows: 46% are willing to join the Hongmiao Village Environmental Protection Association, 30% are willing to join the Hongmiao Village Care Association, and the remaining 24% are willing to join the Recreation Association (Fig .11). Among the villagers who are not willing to join autonomous organizations, the reasons may be as follows: a) there is no organization of their interest; b) lack of participation cost; c) personal interests cannot be realized; and d) they do not actively participate in the activities of this workshop. The implementation of the participatory rural habitat design workshop has to some extent stimulated the villagers' enthusiasm and willingness to participate in community development, which is conducive to the subsequent maintenance of the community environment.

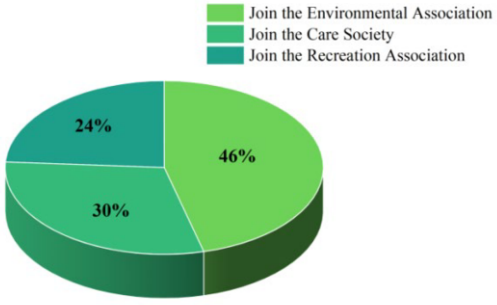

Figure 11. The situation of Hongmiao village villagers joining self-organization.

A before-and-after comparison of the data on the support rate for villagers' contribution in Hongmiao Village found that the number of residents who agreed to

contribute rose from 18% to 80% (Fig .12). Among them, the acceptance level of villagers aged 20-60 years old is generally higher, and the acceptance level of villagers aged 60-80 years old is lower, and the reason for this may be due to the influence of the objective factors of economic conditions and life needs. Older villagers pay more attention to the stability and security of their lives and take a conservative attitude toward the funds and energy invested in transforming their villages. In contrast, younger villagers are more motivated and willing to improve their lives and are more open to new ideas and approaches.

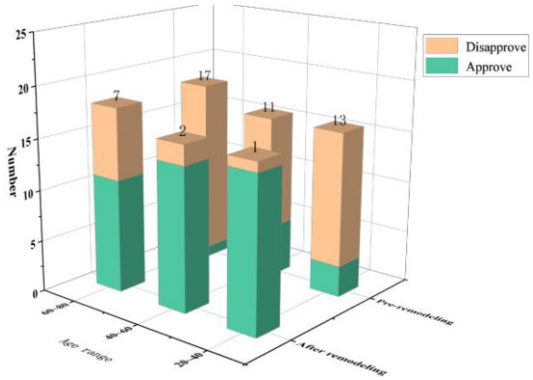

Figure 12. Comparison of the support rate of villagers in Hongmiao Village to contribute capital.

5. Conclusions and outlook

Starting from the real needs of local villages, this paper combs through the status quo of the human habitat environment, traditional design patterns, spatial morphology features, and characteristic folk culture of Hongmiao Village. Through the cultural propaganda of participatory design, carrying out various activities of self-government organizations, and improving the habitat environment in front of and behind the villagers' houses, we have practiced three aspects of participatory design to enhance the village habitat environment and improve the village governance system, and the digital and visualization methods have improved our work efficiency. In addition, in the practice of this project, we have drawn the following conclusions:

- The work process of the workshop in participatory rural environment design runs through the whole transformation process, which directly affects the promotion of the project and the cooperation of the villagers. In this transformation process, the villagers' satisfaction with the workshop is 84%, so we suggest that in the real transformation process, we should visit and investigate the target villages according to their economic development, geographic environment, population distribution, and local customs, and set up targeted transformation strategies and transformation contents.
- After the participatory design renovation, the support for its renovation approach increased by 70% relative to the pre-renovation approach, which may be attributed to the fact that this practice relies on an open design process and

a democratic design strategy, indicating that the participatory design approach itself has wider applicability and plasticity relative to the traditional design approach and that it has a greater potential to be applied in the future development of rural areas. However, due to regional differences, the participatory design approach needs more exploration and practice to improve the theoretical system.

- For the situation of funded transformation of participatory design, the willingness to fund before and after transformation reached 80%, with a growth rate of 62%, which to a certain extent proves that the transformation cost of participatory design is in line with the villagers' average income level and the expected range of expenditures, and based on this, it achieves the effect of unanticipated transformation. For regions with backward economic development, the control of conversion costs should probably be regarded as a more important challenge.
- This study infiltrates participatory design into the life of the local community in many aspects and dimensions, contributing to the transformation of the local habitat. Of course, this project demonstrates through practice that for the sustainable development and transformation of the village, architects and participants must continuously coordinate the opinions of interest stakeholders such as the government and villagers and the management of fund allocation, which is a great challenge.

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