Exploration and research on the applicability of sustainable design for ethnic minorities — Diaojiaolou

Lijun Shi[1,*], Yue Ma[2]

[1]Yunnan College of Business Management, Kunming, China
[2]Yunnan College of Business Management, Kunming, China

Abstract. Diao Jiaolou is a typical component of minority housing culture. Strengthening the study of the hanging foot building is to inherit the culture of traditional residential architecture. By classifying and analyzing the architectural characteristics of minority housing, the characteristic elements of housing are refined for this architecture and industrialized using modern means and methods. Based on protecting the ethnic heritage, modern technology uses to leave traces of the times and organize the new rural construction in western Hunan. With the acceleration of urbanization, it is necessary to establish a mechanism for renovating traditional minority dwellings with regional characteristics and apply it to the refurbishment and development of settlement dwellings.

1 Page layout

In China's vast territory, the ratio of mountainous and flat land is 2:1. In other words, there is about twice as much land in the mountains as in the flatlands[1][2]. Frigid regions make up almost one-third of the entire total territory of China, including all northern and some central areas. China's terrain ranges from subarctic to tropical climates, and various innovative housing systems can remarkably adapt to regional and local climatic conditions [3].The vast mountainous terrain and limited land in rural areas make it difficult to systematically improve the construction and maintenance of existing traditional houses of ethnic minorities, thus failing to effectively improve the living conditions of the rural population and suppressing the final result of economic development[4]. The unspoiled countryside retains China's traditional values, regional cultural diversity, local building practices and technologies, and imperial-era social traditions. Today, however, much of China's countryside is being transformed by the social, cultural, environmental, and technological changes brought about by modernization[5].

For this reason, it is essential to consider the development of sustainable development policies, the recovery and protection of the environment, and the construction of mountain settlements according to specific local policies and cultural conditions that benefit nature and people. Therefore, this study aims to determine the sustainable development strategy of traditional rural villages by preserving and revitalizing existing local housing to face new challenges and pressures. In economic globalization, keeping the local cultural identity and permanent culture is essential to cultural stability.

In addition, rural land degradation can destroy people's unity and family atmosphere, hindering regional progress and development [6]. The main concern was to restore and improve the local habitat, respecting the original structure as much as possible while allowing adaptation to the real needs of mountain villagers[7]. Specifically, these buildings must maintain their place and comply with the world's cultural values and modern lifestyles, environmental sustainability issues, current construction conditions, and standards of sanitation, fire safety, and sanitation[8].

There are two reasons for choosing Diaojiaolou as the research object of this study. The first is the respectful branch of the Chinese Guanlan architectural style, which has inherited its traditional characteristics and technical means during construction. The Guanlan-style building indicates an integrated timber-frame system dwelling type in which the floor above the ground is divided into two spaces, the upper space is mainly used for living, and the lower area is used for raising animals [9]. Diaojiaolou is the leading rural type in Southwest my country. Including Hubei Province, Chongqing Municipality, Sichuan Province, Guizhou Province, Guangxi Province, and Hunan Province. Another reason for choosing this type of house is that only a few stilt houses are left, many of which were destroyed in the recent economic development. But in China's remote and undeveloped areas, many well-preserved houses are still conducive to research products.

* Corresponding author:shilijun889@gmail.com

2 Literature Review

Regarding the study of human habitat in the mountains, the theory is based on Liang's [10]. "Human Settlements Science" is the science of human habitats, including villages, towns, and cities, and the relationship between man and his environment, with the aim "to understand and master the objective laws of the occurrence and development of human settlements, to better construct the ideal living environment for mankind" [11]. Cities often take a large area as a place to build houses, so we constantly study the relationship between homes and people's lives from the perspective of cities. In contrast, these mountainous areas in rural areas are still remembered [3]. This is why this research will supplement the research in residential areas. Therefore, it is not only of great significance to the current rural housing planning but also to people who care about rural development. China is a multi-ethnic country with 56 different ethnic groups. In most areas where ethnic minorities gather, housing still maintains its original ethnic and cultural features. However, many traditional ethnic minority houses in mountainous areas still have many problems, such as security risks, energy waste, unreasonable design, etc. Although China has abundant folk houses, they received little attention until the 1980s.In the 1950s, Liang Sicheng took the lead in going deep into the history of Chinese architecture and got a glimpse of traditional Chinese wooden structure monumental buildings.Ronald G Knapp, a leading researcher of Chinese vernacular architecture for English-speaking audiences, relates the physical properties of different built forms and spatial divisions to the background culture, family attachment, and economic status of the home[12]. However, his research is still based on a historical, static approach to understanding dwellings in Chinese cultural history, focusing mainly on the Han people, the main ethnic group in China. According to the conclusions of most scholars, stilt houses are valuable examples of sustainable housing because they are suitable for humid and rainy hot summers, severe winters, and steep mountainous geography. However, these scholars usually only outline the physical structure and cultural value of the houses, lacking a discussion of the sustainability of these houses today. Only a few researchers have proposed ways to improve the existing stilted buildings to better suit the modern lifestyle of the occupants. Hong Kuang investigated the stilted houses of the Miao family in Luojiazhai, Anzi County, Chongqing City, compared the thermal performance of the stilted houses and modern houses on the spot and put forward suggestions for improving the spatial layout of the existing houses. Temperature and humidity measurements and questionnaires in summer and winter. However, most of her housing surveys are relatively simple, the number of sampled houses is small, and the suggestions for spatial layout are not enough to improve the overall performance of existing houses. Socioeconomic transformation has also changed the overall settlement structure, land use, culture, local culture and housing forms of villages.

Beginning in 2020, the Chinese government launched a national survey of potential safety hazards in rural self-built houses. There are more than 200 million rural self-built houses in more than 500,000 administrative villages across the country. In September of the same year, the "People's Political Consultative Conference" pointed out that farmers The direct cause of many safety problems in self-built houses is mainly that farmers' families are limited by their financial capacity, coupled with luck, to save money, they do not have high requirements for the quality of houses, lower quality standards, and even take the initiative to "cut corners". Therefore, protecting existing buildings instead of building new ones can promote cultivated land conservation, and it is necessary to research the advantages and disadvantages of existing houses on stilted roads to develop strategies to deal with the challenges and threats in the process of urban development and modernization[13]. This study investigates the house structure of stilted houses in a dynamic and changing context, providing theoretical and practical solutions to maintain the house sustainably while retaining its original style and cultural value, to achieve a livable living environment adapted to modernization.

In the past few decades, research on sustainable housing has continued worldwide in response to environmental risks, forming a fad. China focuses on four main objectives of sustainable housing:

Creating a healthy, livable, and comfortable environment

Promoting comprehensive sustainable development

Promoting public participation in maintenance and awareness

This study's definition of sustainable housing emphasizes the balance between these four domains, especially in promoting public participation in maintenance and awareness.

2.1 'Vernacular Architecture' and 'Social Practice Theory'

Ronald Brunskill emphasized that regional representation and regional characteristics are the key features of vernacular architectural transformation [14] [15]. Indigenous design methods are also considered to be respected, from the joint efforts of generations and the best economic and environmental solutions for the place and time. The localized design method comes from the collaborative efforts of several generations, and the best ecological solution suitable for the local area is cost-effective and has been recognized by the residents. Recently, dwellings have been studied as models for environmental sustainability in terms of their bioclimatic properties, thermal comfort, use of materials and natural resources, productivity, and building physics. Oliver says that in all life activities, creating acceptable living conditions for its residents is the most important, especially in the current climate. Furthermore, Meier and Rowe believe that compared with high-tech buildings for sustainable housing, self-built rural houses are the most flexible building type, which can adapt to the local

climate environment and bring good benefits for improving sustainable buildings. Example. As this study posits, social practice theory can be understood as part of larger social structures, built environments, and cultural meanings, rather than focusing solely on the lives of individuals. Views from the social sciences and anthropology are used to explore the dynamic aspects of social practice and their transformative concealment, thereby broadly providing a theoretical framework for sustainable societies, including the five systems of nature, crowd, society, residence, and support, to achieve a comfortable living environment.

2.2 Settlement characteristics of Diaojiaolou

The southwest region belongs to the subtropical monsoonal humid climate, abundant precipitation, low light and heat, high humidity, and fierce animals and insects There are many snakes, so building directly on the ground is not good for health, but also for safety reasons, plus the mountainous areas There are many mountains and little arable land, which is not conducive to the construction of houses and also to solve the problem of grain storage and livestock breeding. The problem, people build houses in the mountains, and a few feet above the ground, so that the house is relatively dry, and living is also safer. The ancestors chose to live upstairs for people and downstairs for livestock, for the consideration of the full and reasonable use of living space. In this way, they formed the spatial pattern of "the upper part of the house is used for self-preservation, and the lower part of the house is used for chickens and boars". In this way, people and animals live in peace and Home momentum is also thriving, so "nesting" also gradually to the transformation of the dry-pen building. Over time, the dry-pen architecture of the "bamboo building" of the Dai people and the "palm building" of the Lahu people have been developed over time, but the hanging foot building is only one of the evolved forms of dry bar architecture. The hanging foot tower is only one of the evolving forms of dry-rail architecture.

Traditional Diao Jiaolou settlements are scattered in the valleys of Chinese mountain villages. Due to their location and underdeveloped transportation systems, the original characteristics of traditional village settlements, architecture and agricultural lifestyle were largely untouched by modern culture and development until the 1990s, resulting in hammock buildings built against the mountains in the form of single buildings (Figure 1); in Diao Jiaolou buildings built around rivers, mostly in the form of landscaped facades of Joint Row Diao Jiaolou (Figure 2); there are also some Diao Jiaolou buildings The complex and diverse functions of these buildings form the spatial form of the semi-enclosed or quadrangular courtyard. Analyzed as a whole, the buildings are stable in shape and diverse in appearance, and are composed of one or more geometric bodies, giving a light and Geometric composition of Diao Jiaolou (Figure 3). Each part of the building adopts a flexible and free combination, with staggered layers (Figure 4) and retreating layers (Figure 5); the building volume is large, but because the space occupied by the bottom is small, it appears light; the space of each layer of the building uses the upper and lower square to support the upper hollow part, and makes it above the river, thus creating a unique landscape visually. The floor plan of the building is irregularly arranged according to local conditions. For example, to adapt to the needs of the foundation, the building of the hanging foot tower uses such means as receding layers and dislocation to create a variety of changes in the vertical direction of the upper and lower layers and different sizes, and also creates "blurring" in the horizontal interface. These changing spatial and interface forms are not designed under artificial "order", but rather a free and simple form that changes with nature. In addition, the "hanging feet" of the hanging foot tower, the curve of the roof ridge, and the upward curving of the ridge wings add lightness and dynamism to the building monolith.

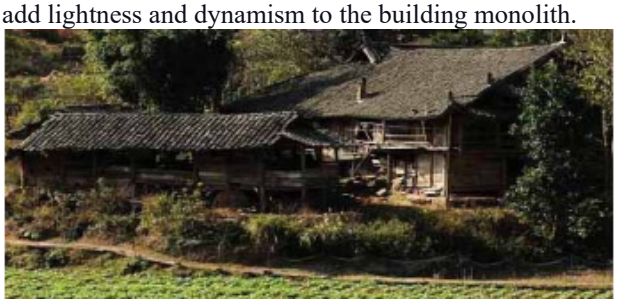

Figure 1. Single Diao Jiaolou building

Figure 2. Joint Row Diao Jiaolou

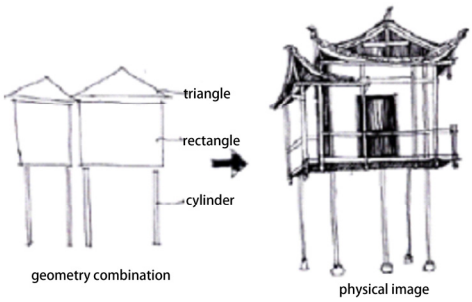

Figure 3. Geometric composition of Diao Jiaolou

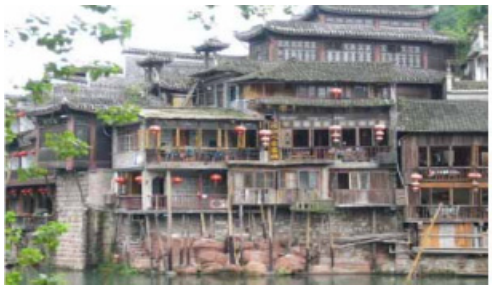

Figure 4. Staggered Layers

Figure 5. Retreating Layers

The wall material of the hanging house is mainly brick, usually a combination of wood and stone, and is made of a combination of a pierced wooden structure and an earthen brick wall. The lower part of the outer wall is made of stone or triple clay as the foundation, while the upper part is made of clay bricks. The appearance of the house is simple and elegant, and it has good heat insulation and heat preservation. Stone resources are widely distributed in the mountains of western Hunan, and the area is a karst landscape, so the stone is one of the main materials for building houses in western Hunan because it is strong and easy to collect. For example, in Lahao Yingpanzhai, Phoenix County, all the houses are built on rocky hillsides. When building a house, the rocky hillside is first flattened, and then the remaining stone pieces are fully utilized in the roof, walls, floors, and other details of the building. In this way, visually, the whole village's stone buildings give a fresh and beautiful feeling.

The dwellings in the southwest region adopt a pierced wooden structure, using a pierced square to connect the columns longitudinally in series, which are directly undertaken by the ground and gourd columns, forming the main Wooden structure partial and integral (Figure 6). For example, the eaves of western Hunan dwellings mainly rely on the load-bearing Yang, which has developed in various forms over a long period, gradually developing into a double pick from the early single pick, and gradually becoming mature. The appearance of the Diaojiaolou building and the deliberate emphasis on the eaves and corridors of the Bulkhead wood structure details (Figure 7) together constitute the unique character of the Tujia houses.

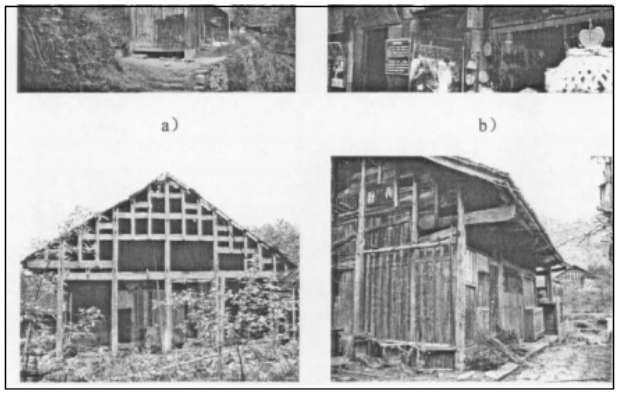

Figure 6. Wooden structure partial and integral

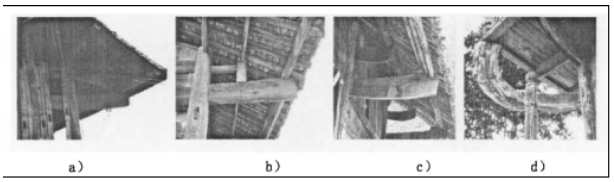

Figure 7. Bulkhead wood structure details

3 Methodology

The research will use a mix of quantitative and qualitative methods, literature reviews, and case studies. For the fieldwork in China, semi-structured interviews, direct observation, and participant observations will be used to establish an accurate and reliable understanding of the existing ethnic minority housing designs from a sustainability perspective. Direct observation of physical traces is included because they can offset the limitations of obtrusive tools such as interviews. The study will follow four phases or stages as follows. The first phase will be a literature review which will mainly inquire about the existing related research of the ethnic minority mountainous village homes and their designs and analyze the respective research methods and associated theories. The literature review phase will include information available in English and Chinese and translations where necessary, although details may vary during the translation process. The second phase will be case studies. Case studies help to develop an empirical understanding of specific real-life cases. Representative case studies in this research will represent extant conditions of ethnic minority village homes in the mountainous region of China. When studying the housing of ethnic minorities, the exploratory case study method is helpful for the in-depth and specific analysis of the phenomenon related to the background of the residents. The third phase will be data collection. There are two main sources of data collection: relatively complete image archives of ethnic minority houses in mountainous areas of China and descriptions and records based on interviews with residents. We have three main tools during the interview process: observation, video analysis, and semi-structured interviewing. The interview and design suggestions will be in the final phase. Based on the study's findings, the researcher will interview the residents of the ethnic minority houses in

mountainous Chinese villages and a few experts (scholars in China) to put forward innovative housing design advice. It also provides a relevant theoretical basis for the sustainable development of architectural design in mountainous areas of our country.

4 Conclusion

Mountain architecture is constantly changing with socioeconomic, cultural, and environmental influences. This article aims to discuss the residential design of Diaojiaolou and analyze how to improve the existing living pattern in remote mountain villages in China. During the research process, it was found that the various regional plans and policies launched in rural China are often fragmented and lack coordination. To increase people's participation in the future, including involvement in the decision-making, planning, design, and construction phases of innovative housing systems, to ensure that the strategies provided are in line with the cultural and social values that society has long valued and to ensure that people accept development, care about the built environment and ensure that Its longevity.

ACKNOWLEDGMENTS

This work was financially supported by Scientific research fund project of Yunnan College of Business Management(Project No.:2021ZD04).

References

1. Asquith, Lindsay, & Vellinga, M. (2006). Introduction. In Asquith, Lindsay, & Vellinga, M. (Eds). Vernacular Architecture in the Twenty-First Century: Theory, Education and Practice, New York: Taylor & Francis.
2. Cubillos-González, R. A., & Tiberio Cardoso, G. (2020). Clean Technology Transfer and Innovation in Social Housing Production in Brazil and Colombia. A Framework from a Systematic Review. Sustainability, 12(4), 1335.
3. Davis, P. (2010). Ecomuseums: A Sense of Place, vol. 2, New York; London: Continuum.
4. Dili, A. S., M. A. Naseer, and T. Z. Varghese. (2010). Passive Environment Control System of Kerala Vernacular Residential Architecture for a Comfortable Indoor Environment: A Qualitative and Quantitative Analyses. 42(6), 917–27. doi:10.1016/j.enbuild.2010.01.002.
5. Jim, E. & Susan, W. (2014). Urban Chinese Grow Produce by Proxy Via Unusual Juhuasuan Project, Alizila, July 3, 2014. http://www.alizila.com/urban-chinese-grow-produce-proxy- unusual-juhuasuan-project.
6. Liang, M. (2005). To Discuss the Development Design of Mountainous Region Residential District. Chinese & Overseas Architecture, 2005: 24-27.
7. Lu J.W. & H.S. (2000). Wang. Hillside Architecture Design, Beijing: China Architecture Industry
8. Nitzky, W. (2012). Mediating Heritage Preservation and Rural Development: Ecomuseum Development in China, Urban Anthropology 41, no. 2–4 (2012): 369–70.
9. Pan, Y. H., Wong, K. W., & Hui, C. M. (2006). Construction techniques of innovative housing systems in Chinese mainland.
10. .Pinijvarasin, "Experiences of Well-Being in Thai Vernacular Houses" (University of Melbourne, 2004), 247.
11. Rebacca C.L.H.(2003). Social Sustainability, Sustainable Development and Housing Development.‖ In Housing and Social Change: East–West Perspectives, edited by R. Forrest and J. Lee, 221–39. London: Routledge.
12. Su, B. (2011). "Rural Tourism in China," Tourism Management 32(6), 1438.
13. Sun, F. (2013). Chinese climate and vernacular dwellings. Buildings, 3(1), 143-172.
14. Wu, F., Zhang, F. & Webster, C. (2013). "Informality and the Development and Demolition of Urban Villages in the Chinese Peri-Urban Area," Urban Studies 50(10).
15. Zeng, S. (2017). Research on Housing Planning Development Design in Mountainous Area: Difference between China and Hawaii.