International Journal of Advanced Research in Education and Society
e-ISSN: 2682-8138 | Vol. 6, No. 3, 260-275, 2024
http://myjms.mohe.gov.my/index.php/ijares

Ecological Wisdom and Spatial Form of Traditional Settlements in Southwest Fujian, China

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Received: 27 July 2024 | Accepted: 7 September 2024 | Published: 30 September 2024

DOI: https://doi.org/10.55057/ijares.2024.6.3.20

Abstract: *This study focuses on the ecological wisdom and spatial forms of traditional settlements in southwest Fujian, China, aiming to explore the practical experiences of these settlements in ecological planning and sustainable development, as well as their application value in modern society. Through analyzing the distribution status of traditional villages in Fujian Province, this research adopts a combination of document collection and field interviews to deeply investigate the geographical location, climatic characteristics, topographic and hydrological features, and human environmental characteristics of southwest Fujian. In addition, this study provides a detailed description of the architectural styles of southwest Fujian and the landscape elements of traditional villages in the region. In the discussion section, it is pointed out that there is currently a lack of deep understanding of local ecological wisdom, rapid development has led to a lack of macro spatial planning and control, and there is insufficient guidance for the development of villages. The conclusion emphasizes that in order to protect and inherit the ecological wisdom and spatial characteristics of these traditional settlements, it is necessary to strengthen the understanding and respect for local ecological culture, combine modern planning techniques, and develop more forward-looking and practical development plans. This study not only provides a new perspective and methodological support for the protection and development of traditional settlements in southwest Fujian, but also serves as a reference for the research and practice of traditional settlements in other regions.*

Keywords: Traditional Settlements, Ecological Wisdom, Spatial Forms, Southwest Fujian, Sustainable Development

1. Introduction

The history of human development is one of struggle against nature. From fear and adaptation to fearless transformation and utilization of nature, to reflection and repair, human beings have accumulated valuable survival philosophy and wisdom in the constant game and interaction with nature. The survival wisdom of the interaction and relationship between human beings and nature is essentially ecological wisdom (Zhijing, G. 2021), which has been written into cultural genes and become a group of genetic codes in the human cultural system. Ecological wisdom is the survival and living wisdom that human beings comprehend and accumulate in the long process of coevolution with nature (Kikvidze, Z. 2020).

Most of the international research on ecological intelligence is analyzed from the aspects of the theory and practice of ecological intelligence, the embodiment of ecological intelligence in the modern landscape, and the evaluation of ecological performance. The research on spatial form from the Angle of ecological wisdom is still lacking.

In China, CNKI is used as the data source and SPSS software is used to make statistics on target literature. Since the beginning of the 21st century, the number of literature has shown an exponential growth trend, especially the strategic revitalization of rural areas proposed by the state, and the number of literature has increased rapidly, involving a wide range of disciplines. By economics, management, culture, religion, landscape, architecture, geography, ecology, philosophy, aesthetics, and other multidisciplinary scholars' attention. Future research trends in this area will continue for some time. From the perspective of settlement space, these studies have analyzed settlement cases from the aspects of settlement geography, cultural history, folk custom, settlement form, settlement layout, architectural characteristics, and so on, broadening the study of traditional villages in Fujian.

2. Distribution status of traditional villages in Fujian Province

China has included 8,155 traditional villages in the national protection list, protected 539,000 historical buildings and traditional houses, and inherited and developed 4,789 intangible cultural heritage items at or above provincial level, forming the world's largest agricultural heritage protection group with the most rich content and value, the most complete protection, and living inheritance. In order to promote the protection and development of traditional villages, the Ministry of Housing and Urban-Rural Development, the Ministry of Culture and the Ministry of Finance organized the first national survey of traditional villages in 2012（Li, S.2022）. Based on the preliminary evaluation and recommendation of various places, the first batch of traditional Chinese villages were identified and publicized by the Expert Committee of traditional village protection and Development. The second, third, fourth, fifth and sixth batches were announced in 2013, 2014, 2016, 2018 and 2023. In Fujian Province, 48 were found in the first batch (2012), 25 in the second batch (2013), 55 in the third batch (2014), 104 in the fourth batch (2016), 265 in the fifth batch (2018), and 58 in the sixth batch (2023).

Table 1: Villages included in the List of Chinese Traditional Villages in Fujian Province (National traditional villages)

Region	First batch (2012)	Second batch (2013)	Batch 3 (2014)	Batch 4 (2016)	Batch 5 (2018)	Batch 6 (2023)	Total quantity
Fuzhou City	2	0	5	8	32	4	51
Sanming City	12	4	4	14	28	14	76
Quanzhou City	2	4	4	9	23	6	48
Zhangzhou City	3	3	9	10	20	4	49
Nanping City	3	3	10	18	46	6	86
Longyan City	11	5	4	13	36	5	74
Ningde City	15	6	10	32	78	14	155
Pingtan comprehensive experimental area	0	0	5	0	0	1	6
Putian City	0	0	1	0	2	4	7
Total quantity	48	25	52	104	265	58	52

In December 2014, Fujian Province issued the "Fujian Traditional Village Evaluation and Identification Measures". According to the Measures, the evaluation and identification indicators of traditional villages include three parts: the evaluation index system of traditional historical buildings and characteristic buildings of villages (score 130 points), the evaluation

index system of village location and pattern (score 100 points) and the evaluation index system of intangible cultural heritage carried by villages (score 100 points), with a total score of 330 points. For those identified as provincial traditional villages, the quantitative evaluation score should generally be above 250 points.

According to the "Fujian Province Traditional Village evaluation and identification Measures", after investigation, local declaration, expert review and publicity, 339 villages were determined to be included in the first batch of provincial traditional village list, the second batch of 234, the third batch of 189 villages, the fourth batch of 156 villages, a total of 918 villages.

Table 2: Villages included in the List of Chinese Traditional Villages in Fujian Province (Provincial traditional villages)

Region	First Batch (2015)	Batch2 (2017)	Batch3 (2020)	Batch4 (2021)	Total quantity
Fuzhou City	42	33	35	3	113
Sanming City	51	26	20	20	117
Xiamen City	3	0	2	0	5
Quanzhou City	26	26	16	22	90
Zhangzhou City	17	16	19	23	75
Nanping City	85	36	14	12	147
Longyan City	29	40	36	24	129
Ningde City	70	56	43	43	212
Pingtan comprehensive experimental area	0	0	1	2	3
Putian City	11	1	3	7	22
Total quantity	339	234	189	156	918

3. Methodology

The methods of document collection and field interview were adopted, Collection of local documents: historical maps, traditional village application, and protection planning, statistical yearbooks of governments at all levels, village genealogy, historical records, historical documents, government policy documents, oral history, and other local characters and drawings. Find out the historical context of the settlements in southwest Fujian, comb the history of the settlements in southwest Fujian, to explain the development history of the spatial form of the settlements in southwest Fujian. Mainly from the local housing construction bureau, planning bureau, library, museum, county planning, and construction bureau.To understand the local social structure and the life of the residents, interviews, and observations are extremely important. It includes understanding the origin and change of villages, organizational structure, clan relations, and religious beliefs.

4. Result

4.1 Location and climatic characteristics

Southwest Fujian is located in the southeast of China, the southwest of Fujian Province, near the Tropic of Cancer, consult and analyze the location data of Nanjing, Pinghe, Yongding, Shilla and other districts and counties, Nanjing County is located in the northwest of Zhangzhou, Jiulong River upstream. The total area of the whole territory is 1962 square kilometers, the total area of Yongding District is 2216.3 square kilometers, the total area of Pinghe County is 2328.6 square kilometers, and the total area of Xinluo District is 2685.4 square kilometers. The southwest of Fujian belongs to the subtropical oceanic monsoon

climate. The humidity is mild, the rainfall is abundant, the summer is long and not very hot, and the winter is short and not cold. Through consulting and analyzing the climatic data of Nanjing, Pinghe, Yongding, Shina and other districts and counties, the average annual temperature in the mountainous area of southwest Fujian is 20~22.5℃, the average annual precipitation is about 1800mm, the average annual evaporation is about 1500mm, the average annual sunshine duration is 1700~2 000h, and the rainfall is concentrated in summer and autumn (June ~ November). The average relative humidity is 80%, the average annual wind speed is 1.1m/s, and the average annual maximum wind speed is 13.8m/s.

Table 3: Location and climate overview of southwest Fujian(https://baike.so.com)

Region	Area (km^2)	Administrative division	Administrative division/°	Mean annual precipitation/mm
Nanjing County	1962	Eleven towns	21.4	1821.1
Pinghe County	2328.6	10 towns, 5 townships	21	1712.5
Yongding District	2216.3	10 towns, 14 townships	20.1	1663.8
Xinluo District	2685.4	7 streets, 13 towns	16-20	1500-1900

4.2 Topographic and hydrological features

Fujian Province topography itself is very complex, in the process of geomorphic development, the regional fault block as a whole uplifted, the central and western Minxi mountain belt (Xianxia Ridge, Wuyi Mountain), Minzhong mountain belt (Jiufeng - Dai Yun - Boping Mountain range) longitudinal lines, extending many branches in all directions, forming criss-cross peaks; From the perspective of terrain, the southwest of Fujian lies between the two mountain belts in the west of Fujian and the middle of Fujian and the eastern coastal area, with large relief, roughly high in the north and low in the south, and high hills, low hills and plains in the east. The middle mountain and the low mountain are the dominant landform types in this area, and their area accounts for the whole area. The mountain belt in western Fujian is the birthplace of many rivers, the largest river in southern Fujian Jiulong River and the largest river in eastern Guangdong Hanjiang River all originate here. The plain includes valley plain and intermountain basin valley plain, accounting for the whole area. Therefore, this area is known as "eight mountains, one water and one field".

The BoPing Ridge in the Central Mountains of Fujian is the most important mountain range in southwestern Fujian, with granite geology and a landscape dominated by low-to-medium mountains, with elevations ranging from 500 to 1,000 meters. The abundant rainfall in southwestern Fujian flows through complex mountain ranges and collects in valleys, forming numerous streams with complex flow patterns, which undergo multi-level convergence to form a dendritic water system; the river network is rich, and it is an important source of the Hanjiang River and Jiulong River.

4.3 Characteristics of human environment in southwest Fujian

4.3.1 History of economic development

In the mountainous area of southwest Fujian Province, economic crops such as tobacco and ramie were introduced, and fruit trees such as peach, plum, loquat, orange, pomelo and persimmon were planted. Great economic benefits have been obtained by using the bamboo forest in the mountains to make paper, make MATS and make strips. Yongding is rich in tourism resources, including red tourism, green tourism, Yongding County Xibei Tianhou Palace tour, Hakka style tourism. Fujian Tulou has been included in the 28th World Heritage candidate list. Xinluo District aims to establish an important pollution-free agricultural and animal husbandry products supply base in southern Fujian Golden Triangle and Pearl River

Delta, cultivate and develop a series of ecological pollution-free agricultural and animal husbandry products such as Meihuashan. The level of agricultural industrialization has been continuously improved, and five industries have been formed: livestock and poultry, fruits and vegetables, bamboo and wood, peanuts and tea. Known as the "Hometown of Orchids in China", the orchids have been cultivated for more than 2,000 years, and the wild orchid resources are very rich in the territory. The existing tea garden covers an area of 120,000 acre, with an annual output of 20,000 tons and an output value of RMB 1.6 billion. There are more than 20 varieties such as Tieguanyin and red cinnamon, and it is known as the "variety garden" in southern Fujian Oolong Tea area.

4.3.2 Spatial forms of traditional settlements in southwest Fujian Province

The other type is the change type. This kind of traditional village has undergone obvious changes along with population growth and the influence of new ethnic groups in the process of development. For example, the spatial form will change from ribbon to face, face to a group, and so on. This type is mainly formed by the following factors: in particular, driven by contemporary economic development, a large number of new residential houses, and the planning and construction of new rural areas have gradually changed the spatial form of traditional settlements.

4.3.2.1 Freestyle

The free-form layout is relatively flexible, most of them are located in the area of the high mountain, and the buildings show scattered growth form with the change of terrain. The density of village buildings is not high under the restriction of terrain, the general site lacks a large area of flat land, and the form of village dwellings has the characteristics of homogenization.

Figure1-1: AoYao village
（Author drawing）

Figure1-2: ShiQiao village
（Author drawing)

4.3.2.2 Banded

Generally restricted by the terrain of valleys and streams, the village form shows a ribbon-like growth state, which response well to the characteristics of the terrain. The layout of belt settlements is characterized by their development extending mainly in a single direction, resulting in an aspect ratio usually exceeding 2:1. The clusters of these settlements are often formed by linear geographical or man-made elements, such as along a major traffic artery, near the edge of a river or lake, at the foot of a mountain, or along a contour line at a particular height. Similarly, a settlement may spontaneously form around a planned street or other traffic line, with the building units closely aligned along these public Spaces, thus presenting a distinct banded outline. This pattern of development along the line, whether restricted by natural boundaries or following artificially planned paths, has significantly affected the boundary shape and spatial structure of settlements. For example, in Taxia Village of Nanjing County, meandering streams run through the village, and mountains on both sides embrace each other

to form a zonal valley, which gradually evolves into an isomorphic shape with zonal valleys and streams.

Figure2-1: NanOu village
（Author drawing)

Figure2-2: TaXia village
（Author drawing）

4.3.2.3 Facet

Planar settlements usually have a closed shape that is close to a circle, square or irregular polygon, and their morphology exhibits a low aspect ratio, generally no more than 1.5, lacking a clear direction of extension. This type of settlement is particularly common in flat terrain, because under such conditions, settlement development tends to spread naturally and the form is more balanced. Usually, such settlements are surrounded by a relatively uniform environment, and the resulting uneven development drivers are rare. The faceted form refers to the obvious core area of the village in the composition. Dense area residential distribution in general is the origin and location of the ancestral shrine village center, forming a centralized structure, the formation of this pattern, on the one hand, with the central plains han race in traditional organizational form, the population of the same clan constantly reproduce the natural form, on the one hand, there is also a security defense needs, under the walls surround close into a pattern of enclosed.

Figure3-1: HuangTian village
（Author drawing)

Figure3-2: LouXia village
（Author drawing）

4.3.2.4 Group style

The form village is divided into several relatively independent parts, showing a group space form formed by the aggregation of multiple clumps, which is a group type. There are many reasons for the formation of this layout. One is that villages, driven by the natural growth of population, continue to expand their space and develop their forms under the constraints of specific base environments, such as the separation of village roads, water systems, mountains,

and other elements. Such as some of the largest group is the birthplace of the original village, with the development of the village, some villagers living gradually moved to the village periphery is the birthplace of the river system and the special terrain, the formation of several groups, and between groups through roads, vegetation, ancestral hall space and spiritual elements such as organic link, become a relatively independent and closely connected as a whole. One is that clans with different surnames live together in the same village, but each clan keeps a certain distance from the other, forming different groups in the same area.

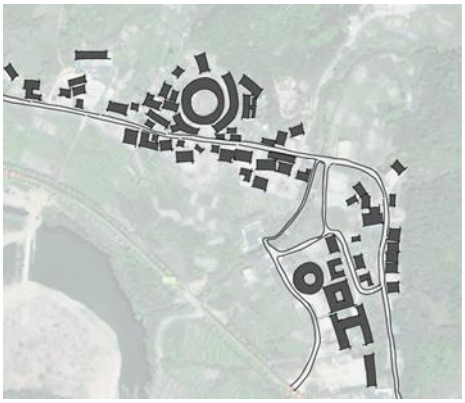

Figure 4-1: ChiZhou village
（Author drawing）

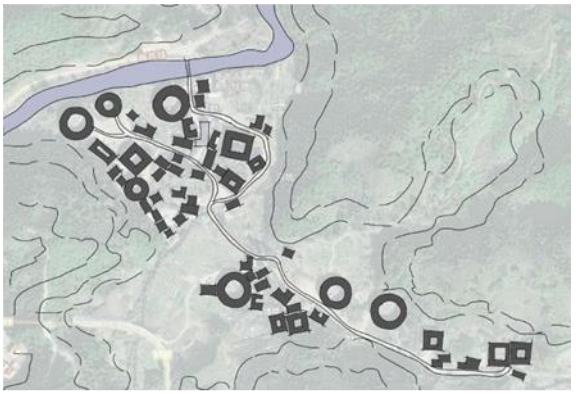

Figure 4-2: HeKeng village
（Author drawing）

4.3.3 Architecture of southwest Fujian

4.3.3.1 Traditional architecture in southwest Fujian

Architecture, as an important component of villages, holds a significant position in the landscape of traditional villages. The form of architecture is influenced jointly by the natural environment and the social and cultural environment, and it constantly evolves and changes along with the cultural and ecological environment within the region. Due to three large-scale population migrations in Fujian Province throughout history, which brought about the integration of Central Plains culture and Minyue culture, it has had a considerable influence on the local traditional architectural style, thereby affecting the landscape features and regional characteristics of traditional villages. For instance, tulou buildings were fully enclosed during the Tang and Five Dynasties periods. During the Ming and Qing dynasties, they were marked by ganglou buildings and formed semi-enclosed structures. Weilongwu houses have the style characteristics of a combination of semi-enclosure and fewer floors. It can be seen that the architectural form has changed along with social psychology, and it also indicates that the improvement of the living environment and social status of local villagers has led the architectural form to shift from defensive enclosure to natural openness. Thus, it can be known that the internal and external environmental factors of rural architecture have affected the evolution of architectural residential cultural forms. For example, Hakka residences have formed three relatively representative architectures: tulou buildings mainly for defense purposes, weilongwu houses that combine the style of Central Plains mansions and tulou buildings, and "Nine Halls and Eighteen Wells" that inherit the architecture of Central Plains mansions. The settlement life pattern of the Hakka people showcases the regional and spiritual culture of the Hakka since its development, enabling the Hakka architectural culture to be fully reflected in the human landscape.

Defensive Residential Style: Earth Buildings Earth buildings, characterized by their unique construction in narrow mountainous flatlands to accommodate the demands of communal living and defense for clan-based families, are large rammed earth Hakka residential structures.

Initially, Hakka people learned from the local indigenous residents to build thatched cottages and wooden houses as shelters. Over time, these evolved into earthen houses. Using locally sourced raw earth for walls, they employed methods of building with raw earth bricks or rammed earth techniques to construct the walls. Later on, ingredients such as glutinous rice, egg whites, and red oil were added to the earth walls to make them stronger and more durable. The Hakka's reliance on family cooperation in production stabilized and popularized this communal living pattern in earth buildings. Family gathering and defensiveness thus became the two most important functions of the earth buildings. These structures adopt a regular plan form, either circular or square, with the central axis featuring public spaces such as halls, courtyards, and ancestral halls. This architectural living form not only embodies the adherence to ancestral cultural practices but also serves the practical function of defending against external threats. Today, earth buildings have been recognized as a World Heritage Site, becoming a prime example for many tourists to understand and learn about the Hakka's traditional residential architecture culture.

Figure 5: Nanjing County Earth Building Cluster (Photographed by the Author)

Due to varying geographical conditions across different regions, there are differences in the choice of materials for residential buildings. Apart from some areas with more advanced technical craftsmanship that meticulously decorate the exterior of buildings, most regional residential architecture is constructed directly using natural materials, each with its own unique texture and finish. Residential buildings commonly employ a variety of natural materials such as unprocessed raw earth, stone, etc., which present a coarse and natural texture; there are also processed stones, adobe, wood, etc., making the buildings appear more regular with signs of human craftsmanship; additionally, bricks and tiles that have been fired artificially give the buildings a finer appearance. The proportion and method of use of these materials in individual buildings determine the texture of the building's exterior; whereas in a traditional village, a group of buildings with a similar overall style makes this style even more harmonious and unified.

4.3.3.2 Distribution status of traditional villages in southwest Fujian

Fujian earth buildings are constructed using natural materials such as raw earth, pine wood, fir wood, bamboo strips, and glutinous rice. These earth buildings, bound by blood relations, have formed unique communal spaces that are not only products of a culture centered on kinship but also serve as venues for maintaining this culture, possessing extremely high cultural, historical, and artistic values. In 2008, the "6 Groups and 4 Buildings" comprising 46 earth buildings in Fujian were inscribed on the UNESCO World Heritage List. These earth buildings are mostly located in the southwestern parts of Fujian, such as Nanjing and Yongding. Numerous earth building villages, nestled among towering mountains and connected by water systems, present a spectacular and unique landscape, fully reflecting the ancient people's wisdom in living in

harmony with nature.

The construction of Fujian earth buildings spans hundreds of years, with their forms and craftsmanship being passed down through generations, largely maintaining stability. The history of building earth buildings can be traced back to the Southern Song Dynasty, with the ancient Fenglou building in Shizhong Village, Xinluo, located at the western foothills of the Bobing Ridge Mountains (1128 AD, a square building), being one of the oldest known earth buildings（Li, M., 2021). The earth buildings in Nanjing, located at the eastern foothills of the Bobing Ridge Mountains, began during the late Yuan and early Ming dynasties, such as the Yiguang Building in Shangban Village, Shuyang Town (1356 AD), which is the first square earth building in Nanjing. Subsequently, the Liu and Zhang families in Xiaban Village, Shuyang Town, jointly constructed the circular earth building Yuchang Building (1368 AD). During the Ming and Qing dynasties, with economic prosperity, the construction of earth buildings reached its peak in the 18th century, with nearly a thousand earth buildings built in the Nanjing area, forming large residential areas solely composed of earth buildings. However, by the end of the Qing Dynasty, due to historical reasons, the construction pace of earth buildings slowed down. After the establishment of New China, there was another minor boom in the construction of earth buildings, adding two to three hundred new buildings. Today, Nanjing County has more than 1,300 earth buildings, including square, circular, and variations such as oval, arc-shaped, fan-shaped, horse hoof, five phoenixes, half-moon, curved ruler, and bagua shapes, mainly distributed in nine townships along the upper reaches of the Jiulong River's West Stream, each with its own characteristics（Huo, X.2021）. Among them, 20 earth buildings in Nanjing have been listed as World Cultural Heritage sites, accounting for about half of the total number of Fujian's World Cultural Heritage earth buildings. Earth building villages, big and small, are scattered among the mountains and ridges of southwestern Fujian. Due to their remote locations and inconvenient transportation, these villages have been less influenced by external factors. As a result, many traditional architectural styles, site selections, and layouts of earth buildings have been relatively well preserved, and traditional folk customs have also been continued.

Spatial form of building structure




Figure 6: Overview of Nanjing Tulou in southwest Fujian Province (Photo by the author

At present, China has published six batches of traditional village lists, and a total of 8,155 villages have been included in the scope of protection. A total of 118 villages in the core area of southwest Fujian are listed in the authoritative directories such as the Directory of Chinese Traditional Villages, the Directory of Traditional Villages in Fujian Province, and the Famous Villages of Chinese History and Culture. Among them, there are 24 traditional Chinese villages, 84 traditional villages in Fujian Province, 10 famous villages of Chinese history and culture, and 3 famous villages of provincial history and culture. In the list of Chinese traditional villages, Yongding District of Longyan City has the largest number of traditional villages, with 9; Next came Nanjing County, Zhangzhou City, with 7, Pinghe County, Zhangzhou City, 4, and Xinluo District, Longyan City, 3. In the list of traditional villages in Fujian Province, Yongding District of Longyan City has the largest number of traditional villages, with 34; Nanjing County, Zhangzhou City, followed with 31; There are 10 in Xinluo District of Longyan City and 9 in Pinghe County of Zhangzhou City. There are 4 famous historical and cultural villages in Nanjing County, Zhangzhou City, followed by Yongding District, Longyan City, with 3. 2 in Xinluo District, Longyan City, 1 in Pinghe County, Zhangzhou City.In 2010, the Fujian government established the Yongding Earth Building Scenic Area and Nanjing Earth Building Scenic Area. The development of earth building tourism has brought certain economic benefits to traditional earth building villages. Clarifying the long-term historical relationship between earth buildings and their surrounding natural environment, and establishing a regional cultural landscape system and its protection mechanism for traditional villages, is an urgent task.

4.3.4 Landscape elements of traditional villages in southwest Fujian

A traditional village comprises various components. From the perspective of spatial interface, the facade includes terrain, vegetation, and buildings; the ground interface includes water surfaces, road paving, and terrain; the top interface is reflected in skylines, building patios, and enclosed spaces by buildings. The formation of a village originates from several residential building clusters, followed by the establishment of roads and traffic. As the village continuously develops and expands, elements beyond residential and transportation functions gradually emerge within the village, including ancestral temples based on beliefs and blood relations, as well as farmlands, wells, and academies closely related to production and daily life. Villagers thrive and multiply in this place, and more prosperous ones even have shops and official roads, becoming increasingly flourishing, eventually evolving into large commercial ports and towns. The landscape elements contained in the traditional villages of southwest Fujian are diverse. In response to the regional environment and characteristics of southwest Fujian, they are mainly divided into agricultural production patches, village house clusters, and hydrological landscape patches.

4.3.4.1 Farmland landscape patches

The agricultural patches in the villages of southwest Fujian are more concentrated on the gentler slopes and open areas around the villages, forming a patchwork landscape with ancient houses. According to different locations, they are divided into mountain farmland and river valley farmland. The farming patterns mainly include terrace farming, large-scale farming, and small-scale farming. Large-scale farming generally takes place in river valley farmland, where each household plants different crops according to their needs, allocating them to different sections. Small-scale farming is also mostly distributed in river valley farmland, interspersed with large-scale farming, creating fields of varying sizes. The variety of crops is rich, surrounded by dense forests that blend with the farmland elements, maintaining a high level of biodiversity within a small area. At the same time, water from the mountains is channeled along the contour lines to the ponds below for collection and storage through the water collection lines. Some villages have terraced fields, which are distributed according to contour lines with smaller field areas, mostly planted with local tea trees in Fujian, forming a terraced landscape of tea culture.

The agricultural patches are planted according to the terrain, forming a "naturally derived" layout without a clear center, presenting an overall appearance of a casual and natural arrangement. This reflects the principle followed by the villages in southwest Fujian of "integrating with the terrain and conforming to nature," creating a harmonious agricultural landscape where humans and nature coexist. These natural forms, including streams that irrigate crops during dry spells, meet the irrigation needs of the farmland. They represent a complementary relationship among various natural elements (Nakagawa, T. 1985). The selection of crops suitable for local cultivation and appropriate seasonal planting ensures the recycling of nutrients to maintain soil fertility in these organic farmlands. By respecting nature and avoiding destructive practices such as cutting mountains or diverting water to create fields artificially, this approach contributes to the protection of the ecological environment, including the mountains and water systems, of the She ethnic minority villages.

4.3.4.2 residential settlement patches

The majority of traditional villages in southwest Fujian have well-preserved architectural forms, with houses built along roads and villages nestled against mountains. They exhibit integrity, authenticity, and continuity, reflecting the ancient ecological wisdom of "tailoring to the principles of heaven and earth, and complementing the suitability of heaven and earth." From the initial site selection, principles such as prohibition, suitability, and restriction of construction were fully considered, with reasonable avoidance of geologically active areas. The long-term habitation and living up to the present day are all manifestations of the ecological wisdom of our ancestors in disaster avoidance and adaptation.

The ancient residential walls and retaining slopes, along with the streets on both sides and village paths, are all constructed using rubble stones. This distinctive architectural landscape of the village stems from our ancestors' reverence for nature. The descendants cleared land along the streams and, after finishing their labor in the mountains, would gather stones to repair the stream banks, which is an expression of respect for water. Through centuries of modifications and the ecological wisdom of our ancestors, this evolved from early bluestone stream banks to bluestone walls, bluestone houses, and bluestone pavements. This low-cost, low-tech construction system has created a unique characteristic of the villages in southwest Fujian, while also reflecting eco-friendly ecological wisdom. Furthermore, water is one of the elements closely integrated with residential buildings. Our ancestors utilized the inertia of water flow to allow silt to accumulate where the riverbed was impacted, thereby expanding the

area of homesteads.

4.3.4.3 Hydrological landscape patches

Traditional landscape Feng Shui theory holds that "in the methods of Feng Shui, obtaining water is paramount," and "an auspicious site cannot be without water." Ponds can "gather water to nourish Qi"; from an ecological practice perspective, ponds serve functions such as flood discharge and irrigation, slowing flow velocity, and water storage utilization. Water systems act as conduits connecting villages with their landscape matrices. Digging ponds for water storage is an ecological practice in village water system transformation. The water system forms a landscape pattern with mountains and fields within the village, stimulating various ecological factors within this pattern. Water is the primary factor in the formation of farmland. Our ancestors, by integrating the ecological laws and hydrological distribution of upstream villages, established primitive water ecological models through practices such as guiding water for irrigation according to the terrain, rice field fish farming, digging ponds for water storage, natural infiltration through stone-paved ground, open ditch drainage for diversion, and purification and utilization of water during discharge and infiltration processes. These practices encompass several key elements of sponge city construction, forming an ecosystem that conforms to nature, utilizes natural resources, and maintains the water ecology. This represents the crystallization of the water ecological wisdom of the people in southwest Fujian.

5. Discussion

Traditional settlements are the basic "cells" for human beings to gather and survive due to the need for reproduction, and also the basic form of urban development. They not only inherit the extensive and profound history and culture of the Chinese nation, but also a perfect model of harmonious coexistence between man and nature (Ma, K (2020). In the vast territory of the Chinese nation, there are many traditional structures with strong regional characteristics. It is the carrier of China's long history and culture, and is the living fossil of folk architectural art, as for its modern architecture, has very important reference significance, The rapid development of the contemporary social economy has exerted a certain influence on the development and evolution of traditional settlements, while some problems have been derived.

5.1 Lack of deep understanding of local ecological wisdom

Under the background of historical change and contemporary urbanization and commodity economy, traditional culture is gradually declining and disappearing, and the settlement presents many architectural forms incompatible with the traditional style, facing the dilemma of how to inherit, renew and continue. Specifically, there are two major dilemmas (Pan, Y. 2020).

First, the local characteristics of rural areas are gradually disappearing, and the characteristics of urbanization are obvious. With the extensive development of the revitalization of rural human settlements in China, a large number of villages have copied the construction of cities. Although the basic living conditions of rural human settlements have been rapidly and efficiently improved, the local characteristics of rural areas have gradually disappeared, and the display of characteristic culture is monotonous and cannot be displayed favorably. As far as the contemporary concept of rural development is concerned, it cannot find its own characteristics of rural development. The marks of traditional residential houses are only replaced by the "simple and unified" architectural symbols of modern residential houses. The surface is applied to the building materials and forms, and there is even no trace. The appearance of a large number of "simple" and "unified" reinforced concrete new rural buildings

makes traditional residential houses lose their original regional cultural connotation and traditional architectural construction concept, which violates the development of modern science and traditional natural concepts. There are many ancient dwellings in the village, which are of average construction quality. There are many new buildings in the surrounding area, the materials, and style of which are not in harmony with the style of the whole village.

Second, the rural ecological environment is "de-rural" and "de-ecological". Rural dwellings are dotted in the rural space, and rural production Spaces such as farmland, roads, and ditches are planar or linear. Their spatial forms have an important impact on the overall style of the countryside. With the development of rural science and technology, the new agricultural production mode has changed. Although the new production materials greatly improve the production efficiency of agricultural products, most villagers do not recycle them, which damages the soil's ecological environment and further impacts the local rural field style.

5.2 Rapid development has led to a lack of macro spatial planning and control

In the process of urbanization, China's urbanization rate exceeded 60% in 2019 (Lin, L., Du, C.2023). In this process, urban expansion and economic development were rapid, and a large number of rural labor forces flooded into the city, which made it difficult to maintain the original way of production and life, and the number of natural villages was sharply reduced. In the process of rapid urbanization development, some settlements lack territorial space planning. The existing rural construction planning permission system has a strong principle, weak implementation, and great differences between different regions. The scope of application of Rural planning is unclear, and the compilation content is copied from the content of urban planning, which lacks pertinence (Han, F., Guo, X.2021). The stability of the spatial form of settlements is destroyed, the relationship between man and land is tense, and the regional characteristics of settlements are gradually disappearing.

The traditional settlements in southwest Fujian have the interface pattern of the village, water, forest, field, and pool. Southwest Fujian part of traditional settlements in rural development over a long period, some changes have been made to the space form one kind of type is not variant, the village is the basic to keep the original landscape features, living in the settlement volume, density and village boundary contour line will be a change, the formation of this type about the following factors: 1. Boundaries of geographic space (e.g. rivers, elevation differences, etc.); 2. The distribution of social organizations (such as branches of clans or groups with different surnames in the same village) keeps the original space and social order after population reproduction. The disordered development of some settlements in southwest Fujian has destroyed the relationship between villages and water.

5.3 A lack of guidance for the development

China's traditional development model has largely been achieved at the expense of ecology, resources, and the environment. During a period in 2000, the ecological pressure of rural human settlements in China increased year by year, and the rural environment showed a trend of comprehensive degradation (Li, L.,2020). The ecological changes in rural human settlements are mainly caused by three factors: resource utilization, production activities, and lifestyle （ Wang, M. 2016).

In terms of resource utilization, there are problems in the utilization of rural land, water, straw, and other resources. Urbanization leads to the crowding out of high-quality cultivated land resources, low per capita utilization of water resources, and serious pollution. The irrigation utilization coefficient of rural agriculture in China is only 0.3-0.4 (Li, Z., Huang.2022). Most

crop straws are directly burned, which produces a large number of gaseous pollutants and particulate matter, which is easy to cause large-scale air pollution. In terms of production activities, to improve land yield, fertilizers and pesticides were overused. Data from the first national survey of pollution sources showed that nitrogen, phosphorus, and chemical oxygen demand emitted by agricultural production were far more major pollutants than those from industrial and domestic sources (Sun, Y. 2020). Some heavily polluting factories were transferred to the countryside, and industrial wastes and garbage were directly discharged into the countryside. In terms of daily life, domestic garbage, domestic sewage, and dry toilet fecal water continue to increase and the problem of improper discharge is serious (Xu, Y.2022).

Against this background, China has put forward the rural revitalization strategy. Ecologically livable is the key to the rural revitalization strategy, which provides the basic living environment to support rural revitalization. As the carrier of the aggregation of "farmers, land and villages"(Wang, M. 2016), the construction of an ecologically livable environment in rural areas cannot be developed in isolation, but must be integrated comprehensively with the other four rural revitalization projects: "industrial prosperity, rural customs and civilization, effective governance and rich life".

The establishment of the policy of ecological livable construction is closely related to the changes in The Time's background of rural development in China. The era of "China's urban and rural areas", and the country's revitalization of targets under the guise of ecologically livable construction is not in the era of "rural China" rural reconstruction, is not simple for rural urbanization, but using the opportunities, the interaction between urban and rural areas in the country living environment of substrate material space, take the initiative to protect rural ecological security, and actively cultivate the rural property, Comprehensively improve the quality of life in rural areas, to stimulate the endogenous development vitality of rural living environment.

China's rural settlements still face challenges. The main problems and causes are as follows: First, the ecological environment background deterioration, the current lack of strict regulatory measures for the rural environment, and rural point and non-point source pollution are still very serious. Second, rural cultural inheritance is fractured, and village features and characteristics are reduced. Third, the site selection lacks disaster assessment, and the level of building shock absorption is low.

Ecological livability should practice the ecological concept of protection first and natural restoration. According to the overall requirements of coordinated development of production, life, and ecology (Strategic Plan for Rural Revitalization (2018-2022) , a rural spatial planning system with consistent planning and guidance should be established from the three spatial levels of county, town, and village. Secondly, it fits the characteristics of rural human settlements and shows the characteristics of regional culture. Based on the different resource endowments and location conditions of rural areas, differentiated development countermeasures should be formulated according to local conditions. Finally, perfect the scientific demonstration of site selection and construct a comprehensive disaster prevention system. The site selection of new village settlements should take topographic and structural factors into consideration, and avoid the sites unsuitable for construction. Therefore this research should put forward the guidance of building an ecologically livable beautiful countryside for the spatial planning of ecologically livable rural areas, and formulates a contemporary ecological wisdom model related to sustainable development.

6. Conclusions

This study is dedicated to exploring the ecological wisdom and spatial forms embodied in traditional settlements in southwest Fujian, China. By analyzing the current distribution of traditional villages in Fujian Province and combining document collection with field interviews, we have thoroughly examined the geographical location, climatic characteristics, topographic and hydrological features, human environmental characteristics, architectural styles, and landscape elements of traditional villages in southwest Fujian. The research reveals that these traditional settlements possess profound experiences in ecological planning and sustainable development, which can offer valuable insights for the development of modern settlements. However, the current understanding of local ecological wisdom is superficial, and the rapid development has led to a lack of macro spatial planning and control, as well as insufficient guidance for village development. Therefore, it is necessary to strengthen systematic research on local ecological culture, enhance macro spatial planning and control, and provide targeted development guidance to protect and inherit the ecological wisdom and spatial characteristics of traditional settlements.

The study of ecological wisdom and spatial forms of traditional settlements in southwest Fujian is of significant value for understanding the ecological planning and sustainable development of traditional settlements in China. In light of this, it is essential to attach importance to the protection and development of traditional settlements, enhance the understanding and respect for local ecological culture, and combine modern planning techniques to formulate forward-looking and practical development plans. Additionally, increasing investment in the protection and development of traditional settlements is crucial to ensure that these precious cultural heritages are properly protected and rationally utilized in modern society.

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