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Article

Study on protection and sustainable inheritance of Fujian Tubao: A case study of Fuxing Bao in Yong'an City

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Abstract: Fujian Tubao, a defensive residential structure predominantly found in central Fujian, represents a significant cultural heritage of the region. However, with the rapid urbanization underway, Fujian Tubao faces the threat of extinction, presenting severe challenges to its survival and development. Identifying a sustainable development path for Fujian Tubao is crucial for preserving regional culture. This study uses Fuxing Bao, a quintessential example of Fujian Tubao, as a case study to explore conservation methods based on adaptive reuse. Through field surveys, questionnaires, in-depth interviews, and case studies, we analyze the historical background of the building, focusing on the current physical and social environment of Fuxing Bao. Our findings indicate that the current state of preservation of Fuxing Bao can meet the requirements for adaptive reuse. By integrating results from surveys and interviews with local villagers, we propose sustainable development strategies and conservation methods. This research offers a sustainable development model for Fujian Tubao and other traditional regional dwellings. By adopting an adaptive reuse perspective, it aims to better address the conflict between modern living and traditional architectural preservation, ensuring that these architectural spaces are properly protected and continue to play a unique role in contemporary society.

Keywords: regional dwellings; conservation and utilization; Fujian Tubao; Fuxing Bao; chinses defensive architecture

1. Introduction

China's vast geographical expanse, rich history, and diverse ethnic composition have led to the emergence of a myriad of residential types, each reflecting the unique solutions that generations of people have devised to address their living needs. These traditional dwellings not only embody the wisdom of ancestors but also represent valuable traces of historical development, making them significant cultural heritage. Research in architectural history should not only preserve records of these immortal artistic structures but must also comprehensively detail the historical context and characteristics of common residential buildings. This is essential to fully understand the evolution of architectural history. Since the economic reforms and opening-up policies were implemented, China has undergone rapid socio-economic development, which has unfortunately resulted in the disappearance of many traditional residences. In urban areas, residential buildings have been demolished to accommodate commercial land use plans, while in rural areas, traditional homes are increasingly abandoned by villagers due to inadequate facilities. This situation presents a pressing cultural challenge: finding a balance between modern development and the preservation of historical architecture.

Fujian Tubao, a distinctive type of large defensive residence, is primarily located in central Fujian, with the densest concentrations found in Yong'an City, Datian County, Youxi County, and Sha County under the jurisdiction of Sanming City. Known locally as Minzhong Tubao, these structures are significant components of historical and cultural heritage. Historically, central Fujian has been a crucial transit and settlement area for the southward migration of Han Chinese and has served as a major hub for the Hakka ethnic group (Lowe, 2012). This mass migration commenced with the Yongjia Rebellion during the Western Jin Dynasty and continued through events such as the An Lushan Rebellion, Huang Chao Uprising, Jingkang Incident of the Southern Song Dynasty, various regime transitions, and invasions by Yuan soldiers (**Figure 1**). These periods of political upheaval and frequent warfare forced the Han Chinese to retreat to remote mountainous areas for safety and sustenance (Wang, 2018). Within this turbulent context, Fujian Tubao emerged as sanctuaries from conflict (Qin et al., 2022).

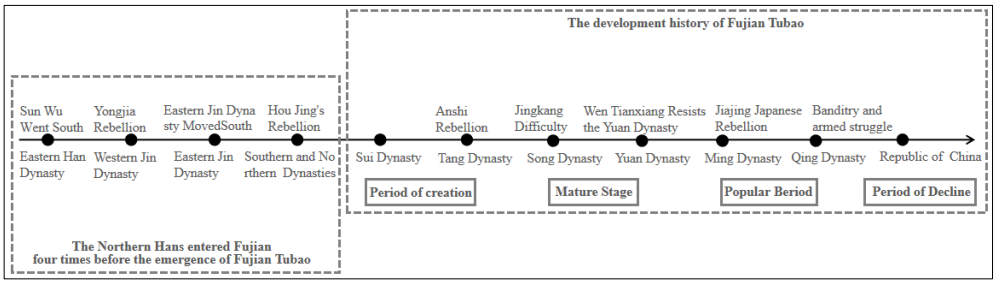

Figure 1. The development history of Fujian Tubao.

The architecture of Fujian Tubao features tall, thick outer walls that provide defense, and inner courtyards or row-style residences that serve as living spaces, clearly delineating between defensive and residential functions. Currently, like many other regional dwellings, Fujian Tubao is at risk. The challenges posed by rapid globalization and urbanization threaten the preservation of local traditional culture, leading to the rapid erosion of traditional architectural heritage. Many Tubao structures are in various states of decay, either abandoned in the mountains or deliberately demolished and rebuilt, which poses severe challenges for their sustainable conservation. This situation highlights a fundamental conflict between modernization and the preservation of historical heritage. Addressing this dilemma should be a primary focus within contemporary architectural discourse. Protecting these regional historical buildings is crucial for fostering the development of regional culture and preserving unique local characteristics.

Historical buildings, as non-renewable cultural resources in architecture, once destroyed, cannot be restored. Thus, ensuring the sustainability of cultural heritage is an essential requirement for the progression of our era. Given this context, this study focuses on a typical example of Fujian Tubao—Fuxing Bao in Yong'an City (**Figure 2**) as the main research subject. Utilizing field research methods, and guided by sustainability principles, this study combines qualitative and quantitative analyses to explore the preservation paths for Fujian Tubao. The primary aim is to extend the life and maintain the development of these structures through innovative renewal and reuse strategies. The primary research question of this article is to determine the

construction background of Fuxing Bao through the collection and organization of historical documents. This is followed by spatial mapping to delineate its spatial layout and current architectural status. Additionally, surveys and in-depth interviews with residents of Wenlong Village, where Fuxing Bao is situated, are conducted to assess existing issues and the community's willingness to use the building, aiming to identify opportunities for architectural updates.

Figure 2. Inside and outside view of Fuxing Bao in Yong'an City.

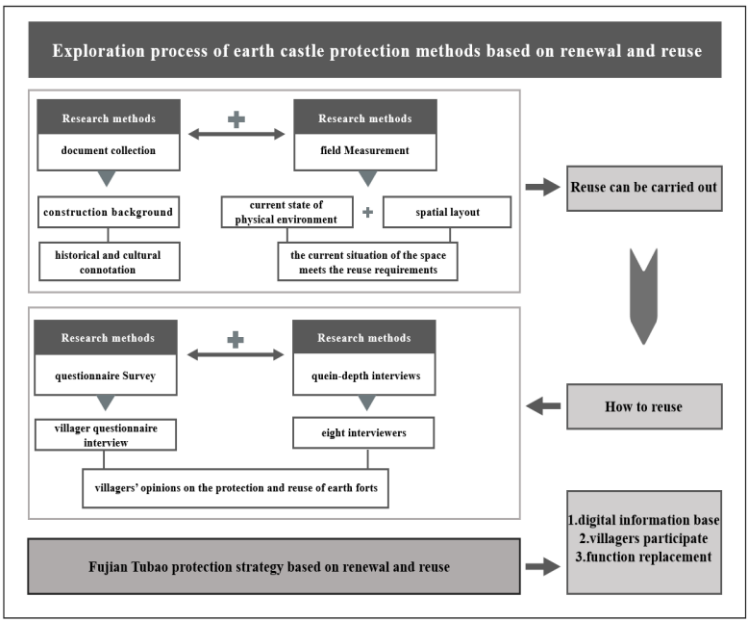

Figure 3. Flowchart for exploring the method of preservation of Fujain Tubao based on renewal and reuse.

Finally, based on the results of qualitative and quantitative research, targeted strategies for renovation and reuse are proposed (**Figure 3**). The objective is to explore the future viability and development of Fujian Tubao, aiming to effectively resolve the conflicts between modern living and traditional architectural preservation. This approach seeks to ensure appropriate protection and utilization of these structures, enabling them to serve a unique role within contemporary society.

2. Literature review

The research on the development and protection of architectural heritage has drawn significant international interest since the introduction of the 1933 Athens Charter, which established the first guidelines for the protection of ancient buildings and historical sites (Perperidou et al., 2021). The 1964 Venice Charter expanded upon these concepts by further defining historical architectural monuments, affirming their value, and advocating for their protection, restoration, and development through scientific methods (Rojas, 2015). This seminal document encapsulated Western theories and practical approaches to historical building conservation, laying the groundwork for future preservation charters. Internationally, the study of traditional dwellings gained momentum with Bernard Rudofsky, who delved deeply into the characteristics of vernacular architecture. Utilizing a wide array of images and texts, he revealed the unique charm of what he described as "the most primitive buildings"—the architecture of the common people (Carlos et al., 2022). In 1986, B.M. Feilden further contributed to this field by summarizing the emotional, historical, and utilitarian values of architectural monuments, while outlining six measures and fundamental principles for their conservation (Felton, 1986). Kenneth Powell's extensive studies on the renewal and reuse of architectural heritage challenged traditional methods by employing innovative, scientific approaches to rejuvenate these historical structures (Kindred, 2013).

Jukka Jokilehto meticulously detailed the evolution of architectural preservation theories and practices, especially in the Western context, demonstrating how these developments have shaped global cultural heritage preservation activities (Jukka Jokilehto, 2011). The 21st century has witnessed continued progress in the study of traditional dwellings, highlighted by significant outcomes at conferences organized by the International Traditional Environments Association, which have served as milestones for the global architectural community (Wang et al., 2023). The 2005 Xi'an Declaration further underscored the importance of the environments surrounding architectural heritage, advocating for the protection and management of both ancient structures and their unique contexts. Additionally, the revised 2010 New Zealand Charter emphasized the critical need for heritage preservation and restoration, advocating for minimal interventions in the preservation process to ensure the continuity of cultural heritage (Jadresin Milic, 2022).

The founding of the Chinese Architectural Society in 1929 heralded the onset of systematic research into traditional Chinese dwellings, with a primary focus on surveying, studying, and mapping ancient architectural examples, alongside collecting, organizing, and analyzing historical documents. A pivotal moment in the research of Chinese residential architecture occurred in 1941 when Liu Dunzhen

consolidated his fieldwork findings from ancient residential buildings in the southwest into "A Survey Overview of Ancient Architecture in the Southwest." (Lai, 2022). This publication effectively launched a robust era of research into traditional Chinese dwellings, notably emphasizing region-specific studies (Chen, 2010).

Zhang et al. delved into creative methodologies in regional architecture, merging cultural contexts and architectural instances from the southwest (Yan et al., 2022). Li undertook comprehensive studies of traditional dwellings in Taiwan, China informed by extensive case collection and historical document analysis (Lin, 2003). Cao et al. investigated traditional Miao dwellings in Western Hunan from multiple perspectives—orientation, topography, courtyard layouts, sloped roofs, deep eaves, sky wells, and building materials—to assess their adaptability to the local mountainous climate, subsequently pioneering research into passive energy-saving techniques for traditional dwellings (Cao, 1998).

Research on the regional dwellings of Fujian started later than in other areas, initially concentrating on the classification of dwellings. In 2000, Dai critically evaluated the prevalent methods of categorizing dwellings based on provincial administrative areas and ethnic distinctions, analyzed influencing factors for the classification of Fujian dwellings and cultural identity, and suggested a more refined and accurate classification scheme (Dai, 2000). In 1985, Yang was a pioneer in studying Fujian Tubao, analyzing these structures from socio-historical and economic perspectives, examining their causes, classifications, functions, constructions, and financing models, thereby laying groundwork for further research (Yang, 1985).

In 2009, Xue, from an architectural standpoint, identified two distinct structural features in Fulin Bao: concentric radial and axial development, proposing hypotheses for these characteristics. Through architectural mapping, Xue suggested that Fulin Bao might represent a transitional form between Fujian Tubao and Fujian Tulou (Xue, 2009). Zhou categorized Tubao as a key regional architectural type in Fujian, providing valuable insights for research into similar architectural forms and their integration into Fujian's architectural heritage (Zhou, 2019).

Both international and domestic research on traditional dwellings have made significant advancements, encompassing a range of disciplines such as architecture, history, and economics, while adopting increasingly diversified perspectives.

However, the research on Fujian's traditional residences, particularly defensive housing such as Fujian Tubao, remains insufficient. Studies primarily focus on describing the current architectural status and features from a macro perspective, lacking in-depth exploration of protective and utilization methods tailored to their specific conditions. Most case studies concentrate on well-preserved buildings that are already listed as cultural heritage sites (**Table 1**). In case studies of individual Tubao, prior research has not systematically addressed the existing conditions of architectural preservation and utilization, nor has it integrated survey and interview findings to formulate protection strategies based on authentic and objective research outcomes. There is no clear consensus on the specific processes or steps that should be followed in the conservation efforts for Tubao structures. Addressing the issues noted above, this paper aims to fill the gaps in this research area. Building on existing findings, it conducts field research on Fujian Tubao communities, collecting data to inform the study. Using renovation and reuse as entry points, it takes Fuxing Bao as a case study

to explore methods for the preservation and utilization of Fujian Tubao, providing constructive references for their sustainable development in the future.

Table 1. Catalog of case studies on Fujian Tubao.

Place	the Case Studies Involving Fujian Tubao
Yong'an City	Anzhen Bao, Fuxing Bao, Fulin Bao, Fuan Bao, Huiqing Bao, Yunsheng Lou, DunrenBao
Datian County	Anliang Bao, Fanglian Bao, Taian Bao, Pipa Bao, Tancheng Bao, Shaohui Bao
Youxi County	Maojing Bao, Jukui Bao, Ruiqing Bao, Guangyu Bao
Sha County	Shuangyuan Bao, Shuangxing Bao, Shuangji Bao
Dehua County	Daxing Bao, Houde Bao
Jiangle County	Kanhou Bao

3. Methods and object

3.1. Research object

Fuxing Bao, Yong'an City

Fuxing Bao is located at No. 78 Wenlong Village, Yanxi Subdistrict, Yong'an City, Fujian Province (**Figure 4**), approximately 4 km from the downtown area of Yong'an. Its geographic coordinates are 117°20′25.3″ East and 25°56′57.9″ North. The Fuxing Bao has a roughly rectangular floor plan that is wider north to south and narrower east to west, measuring about 43 m in width and 39 m in depth, covering an area of approximately 1677 square meters. It is a typical water-paddy-style square fortress. Constructed during the middle to late Qing Dynasty by Yu Zhuoyi and other local members of the Yu family, it served as a residential fortress. The architecture of the Fuxing Bao integrates seamlessly with its natural surroundings, combining natural and artificial barriers (utilizing the stream to the south and ditches on three sides of the Tubao). The construction techniques are exquisite, featuring openwork carvings, wood-carved windows, and decorative tiles on the walls, creating spacious and well-lit rooms with a simple and solemn ambiance. The Fuxing Bao also includes a specifically designed school, highlighting its emphasis on Confucian values (Li, 2013).

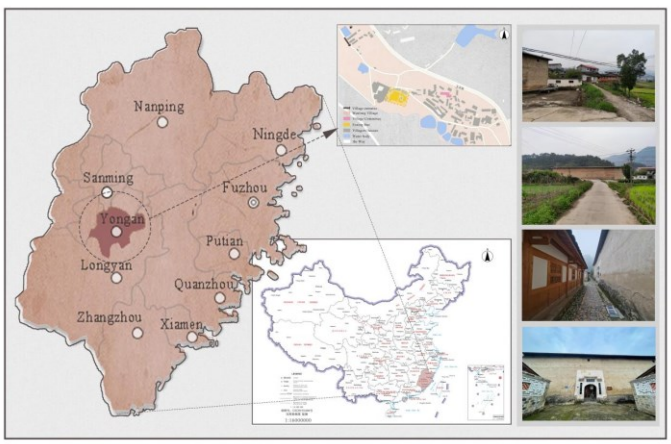

Figure 4. Research site.

From the outside to the inside, Fuxing Bao boasts a well-defined defensive system (**Figure 5**): Firstly, its location was chosen for its broad defensive view, utilizing the southern mountain, a pond in front of the gate, and surrounding muddy fields and ravines to create the first line of defense. Secondly, the main structure of the fortress is surrounded by tall outer walls featuring parapets and lookout windows, forming a second tier of a composite defensive system. Lastly, the internal defense comprises three layers: the highest floor of the Kui Xing Tower, two-story buildings oriented north-south, and interconnected room layouts that form the third line of defense against intruders entering the fortress.

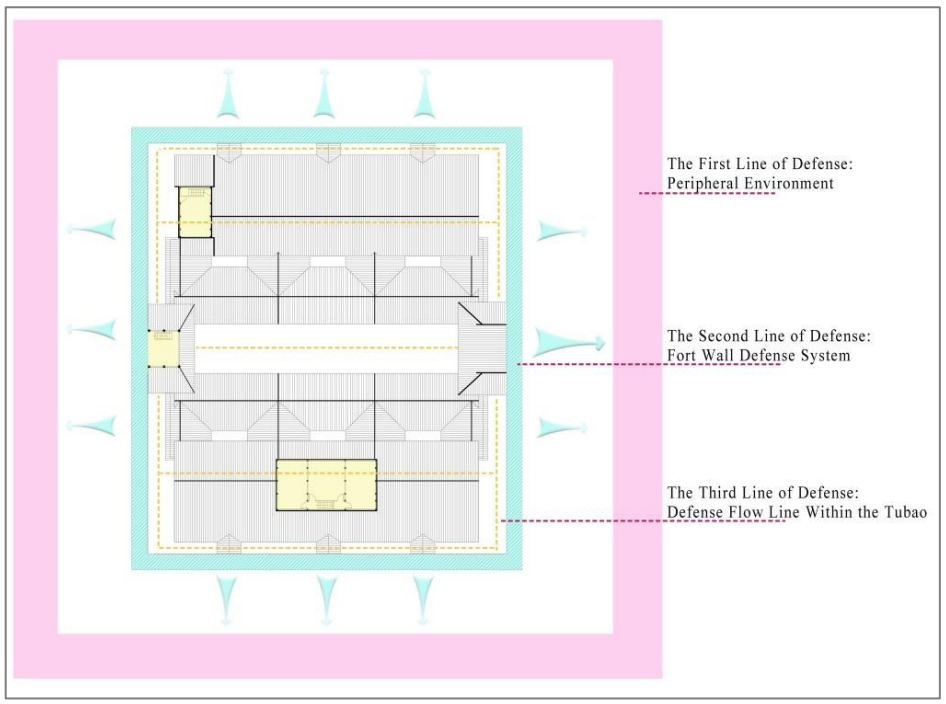

Figure 5. Schematic diagram of Fuxing Bao defense system.

During the period of the anti-Japanese war, the Fujian provincial government relocated to Yong'an City, and Fuxing Bao became the stationed site for the Taiwan branch of the Kuomintang, which was directly under the control of the Nationalist government. In recognition of its unique historical and cultural value related to the war resistance efforts, Fuxing Fortress, as part of the Yong'an anti-Japanese war sites, was listed in the seventh batch of National Key Cultural Relics Protection Units in 2013. In 2007, to protect and explore local characteristic resources, and to highlight the conservation and development of Taiwan-related cultural heritage sites at Fuxing Bao, the Yanxi Subdistrict Office of Yong'an City requisitioned the fortress and carried out its first large-scale restoration. A second round of repairs was initiated in 2011. Currently, the architectural preservation of Fuxing Bao is relatively well-maintained, yet it has not been utilized effectively and remains in a state of disuse.

3.2. Research method

The research methodology employed in this study is based on a combination of qualitative and quantitative approaches, underpinned by field surveys. This methodology includes case analysis, literature review, data analysis, and visual

analysis, with field surveys being the most critical component. The field survey method, which advocates for the long-term participation of local residents, facilitates a thorough interpretation and design of the site (Fan et al., 2023). To achieve the research objectives, a field survey lasting over 30 days was conducted in Yong'an City, Fujian Province. During this survey, the physical structures of the Tubao buildings were examined in detail. Through observations, questionnaires, interviews, spatial mapping, and data collection, the current condition and environmental context of the Fujian Tubao communities, represented by Fuxing Bao, were meticulously documented (**Figure 6**).

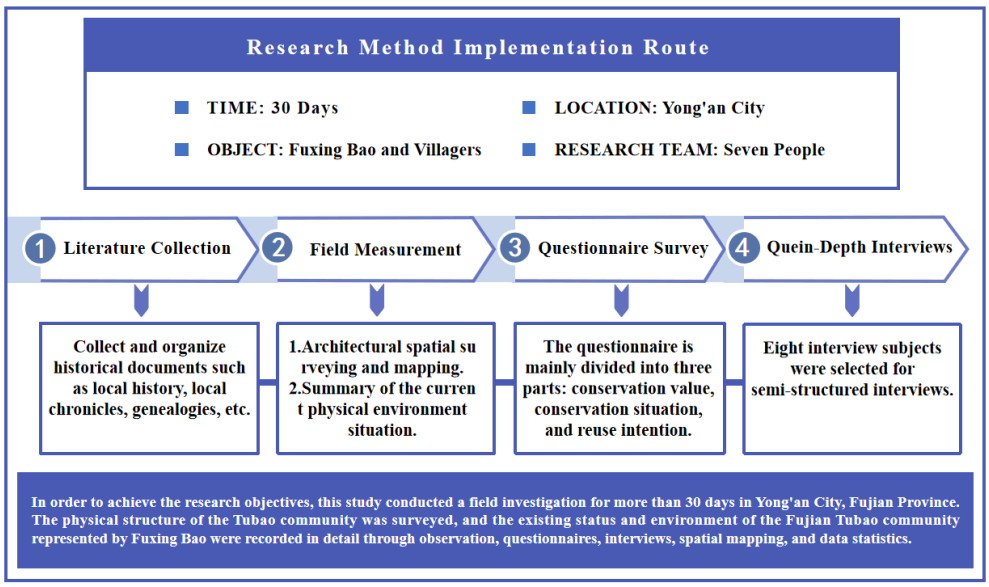

Figure 6. Methodological framework of the study.

3.2.1. Literature collection and collation

First, it is imperative to fully understand the historical context of the era. For this, we can rely on credible historical materials. Since the Ming Dynasty, there have been official and local documents that record the settlements in Fujian (Wang and Chiou, 2020). Literature research entails the analysis and organization of existing research findings and archaeological data, which allows us to summarize the historical origins and evolution of the Fujian Tubao. By starting with local historical materials, we collect and organize local histories, gazetteers, family genealogies, and other historical documents, verifying their accuracy to provide theoretical support for this study.

3.2.2. Field measurements

Through precise and authentic surveying of Fuxing Bao, our objective is to accurately capture the architectural spatial layout and the dimensions of various architectural elements. Utilizing digital systems such as 3ds Max, CAD, and BIM, we document the survey data and construct a digital model database (Zhao et al., 2023). Our research team, consisting of seven members, operates in a collaborative division of labor. Initially, we employ drone aerial photography and remote sensing systems to collect data on the external environment, analyzing the relationship between the architectural site layout and its surrounding context. Subsequently, three-dimensional

laser scanning technology is used to acquire the building's 3D information, enabling rapid generation of a volumetric model.

We rely on tools such as laser distance meters, tape measures, and sphere measures to methodically survey and map the decorative components inside the ancient structure, and comprehensively record the physical condition of Fuxing Bao. Finally, the collected data is imported into a digital platform for digital preservation. This approach not only ensures that detailed records are maintained but also facilitates future research and conservation efforts.

3.2.3. Questionnaire survey

The researchers of this study conducted a questionnaire survey among the residents of Wenlong Village, where Fuxing Bao is located, from 3 November 2022, to 2 December 2022. A total of 100 questionnaires were distributed, of which 14 were deemed invalid as the respondents had never visited Fuxing Bao. Consequently, 91 valid questionnaires were retrieved, resulting in an effectiveness rate of 86%. This survey is divided into three main sections: the conservation value of Fuxing Bao, the current state of preservation at Fuxing Bao, the status of the village functional areas, the methods of conserving Fuxing Bao, and the willingness to repurpose Fuxing Bao.

3.2.4. In-depth interviews

During the field research period, semi-structured in-depth interviews were conducted with selected participants. These interviews allowed the interviewees to express their views and feelings about certain topics directly or respond to the interviewer's questions, thereby presenting their thought processes to the interviewer. An interview outline was prepared beforehand, allowing the interviewees to provide more open-ended responses based on the interview guide. A total of 8 individuals were selected for the interviews, with the average duration of each interview being one hour. The interviewees included the secretary of Wenlong Village, the president of the Yu clan association, the administrator of Fuxing Bao, and five residents of Wenlong Village (**Table 2**). The content of this interview includes information on the architectural history and spatial layout of Fuxing Bao, its current state of preservation and conservation value, potential uses for repurposing Fuxing Bao, the necessity of developing and utilizing Fuxing Bao, and the prospects for its reuse.

Table 2. Survey interview samples.

Interview Subjects	Gender	Age	Occupation	Usual Residence
Village Secretary	Male	39	Village Secretary	Wenlong Village
Chairman of the Yu Clan	Male	67	Retirees	Wenlong Village
Fuxing Bao Administrator	Male	45	Farmer	Wenlong Village
Villager 1	Female	59	Farmer	Wenlong Village
Villager 2	Female	33	Staff	Wenlong Village
Villager 3	Male	60	Farmer	Wenlong Village
Villager 4	Female	63	Farmer	Wenlong Village
Villager 5	Male	55	Farmer	Wenlong Village

By analyzing the interview transcripts using the thematic framework method, the opinions and perspectives of the village community regarding the historical building were vividly reflected. This supplemented the data on the building's social and environmental context, providing guidance for the future preservation and rational utilization of the building. This approach enhances the rigor and scientific integrity of the research.

4. Results and discussion

4.1. Background to the construction of Fuxing Bao

According to the "Yong'an City Annals," Yong'an was first established as a county seat in the third year of the Jingtai era of the Ming Dynasty (1452). The county was re-established after a large-scale peasant uprising led by Deng Maoqi in the thirteenth year of the Zhengtong era (1448) was suppressed the following year, as the government found the area to be remote and difficult to control. Throughout the Qing Dynasty, the county was part of Yanping Prefecture and was named "Yong'an," symbolizing the aspiration for everlasting peace. Historically, the Central Plains Han people migrated to Fujian multiple times, making Yong'an a significant destination for immigrants. This influx resulted in a complex demographic structure with many large clans competing for the limited resources in the mountainous areas of central Fujian, leading to a tradition of building defensive fortresses (Lin and Wu, 2023). During the mid-Ming Dynasty, the eastern coast of Fujian was frequently invaded by wokou (Japanese pirates), and there were frequent rebellions by tenant farmers and robberies by bandits, often leading to clan disputes and armed conflicts, a state of turmoil that persisted into the Qing Dynasty. The "Yong'an City Annals" notes that from the establishment of the county (1452) until the end of the Qing Dynasty (1912), Yong'an experienced 11 significant bandit attacks on the county seat (Guan, 2018). Field research indicates that Fuxing Bao was built in the mid-to-late Qing period by Yu Zhuoyi and other members of the Yu clan as a defense against bandit attacks and was completed over three years. At that time, Jishan Township, located near Wenlong Village, was the economic hub of the area and a frequent target for bandits. Both Wenlong Village and Jishan Township, affected by the hills on either side, were situated along a strip route. To defend against attacks from the east, Fuxing Bao was strategically located at the forefront of this route to protect the villages and towns behind it.

4.2. Space layout of Fuxing Bao

Fuxing Bao is located in the paddy fields on the first terrace of Wenlong Creek in Jishan, embodying a typical paddy field fortress with a rectangular plan that is wider north-south and narrower east-west. The building is oriented west to east, with the main gate of the fortress situated at the center of the eastern wall. Fuxing Bao and its ancillary buildings are symmetrically distributed along a central east-west axis (**Figure 7**). From east to west, the sequence includes a ceremonial pond, a pond-side academy, the fortress wall, the eastern gate, the gate pavilion, a long strip-shaped patio,

north-south residential buildings, Paoma Lang, the Kuixing Lou, the western gate, and the rear courtyard.

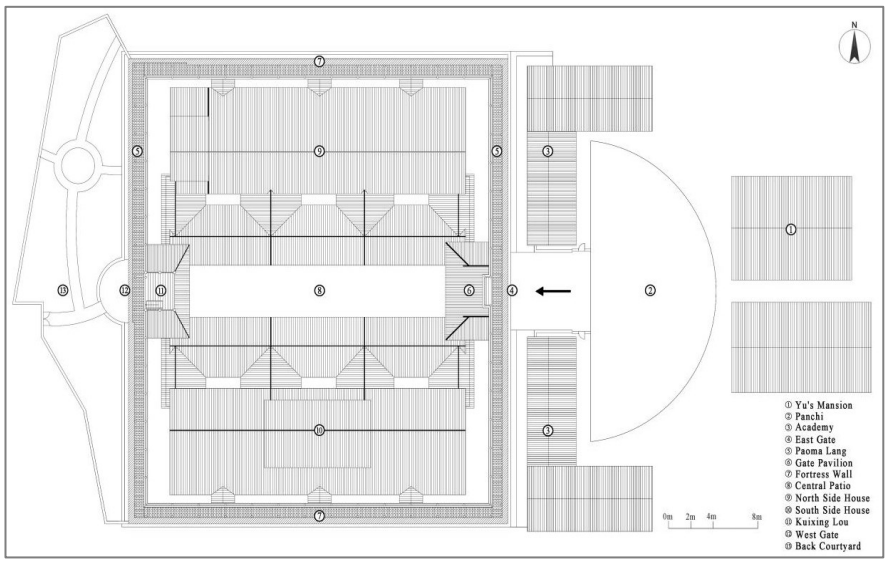

Figure 7. Architectural layout of Fuxing Bao.

4.2.1. Panchi and academy

Directly in front of Fuxing Bao lies a semicircular pond—Pan Chi, covering an area of approximately 265 square meters, with its widest point from east to west measuring about 12.8 m, and its length from north to south about 28.6 m, constructed from stacked stones. Pan Chi serves three functions here: firstly, as a barrier to obstruct frontal enemy attacks; secondly, for fire prevention and livestock rearing within the fort; and thirdly, as a manifestation of Feng Shui principles, symbolizing education and Confucianism, reflecting the owner's reverence for education and aspirations for their children's success. According to Feng Shui, "the method of Feng Shui prioritizes acquiring water, followed by sheltering from wind." (Zhang, 2018) Additionally, Feng Shui posits that "mountains govern people, water governs wealth," implying that the pond attracts wealth and fortune (Li et al., 2019). Brick structures on the north and south sides of Pan Chi are academies, symmetrically aligned with the pond's center serving as the axis. The space in front of the fort gate between these academies is paved in an H-pattern with long gray bricks.

4.2.2. Fortress wall and paoma lang

Fuxing Bao features a multi-layered defense system from the exterior to the interior, with its fortress walls forming a rectangular shape, uniformly level at their base. The fortress walls are divided into upper and lower sections; the upper section comprises rammed earth, accounting for about nine-tenths of the total height, while the lower section is built with rough stone, making up approximately one-tenth of the wall's height. The lower wall utilizes locally sourced rough stone, with gaps filled and smoothed using a mixture of clay, lime, and sand. The upper wall primarily consists of rammed earth embedded with red and yellow gravel, constructed in stages from horizontal to vertical using formwork and wedges, with staggered seams between layers. The fort walls, approximately three stories high, have an external height of

about 7.75 m (excluding the eaves), an internal height above the corridor floor of about 5.84 m, and an overall thickness of about 1.6 m, tapering from the bottom upwards. The walls below the second level are solid rammed earth with no rooms or windows. The third level has thinner walls, only 0.25 m thick, featuring five square windows on each side, 0.54 m high and 0.35 m wide, with bi-directional wooden partitions opening inward at a height of about 0.95 m from the corridor floor (**Figure 8**).

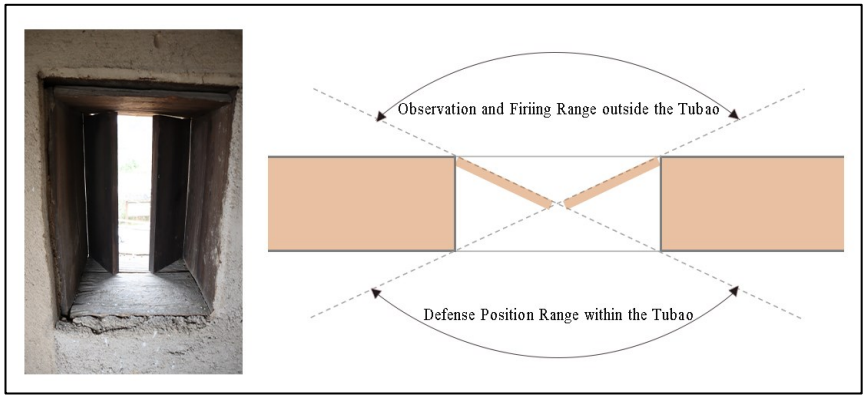

Figure 8. Lookout square window of Fuxing Bao.

The Paoma Lang encircles the fortress wall and is accessible via a wooden staircase within the Kuixing Lou. The Paoma Lang's wooden structure features a double-pitched roof and a five-purlin, four-step framework. Its columns on the outer side are closely aligned with the wall and set on the corridor floor, while on the inner side, they project about 0.38 m outward, supported by beams embedded in the top of the fortress wall, thereby expanding the corridor's width and distributing the roof framework's weight to reduce pressure on the wall below. The Paoma Lang is a typical open gallery, approximately 1.48 m wide and 2.3 m high from the corridor floor to the ridge purlin. The floor is relatively flat, paved with gray bricks in an H-pattern for protection, with a 0.25 m thick enclosing wall on the outside and a 0.9 m high wooden railing on the inside. Due to the extensive overhang of the corridor's roof, to avoid wind tunnel effects, the exterior maintenance rammed earth wall does not extend to the very top, but stops just below the joist. This design leaves up to a 0.4 m high airflow channel above the roof, preventing negative pressure from typhoons that could lift the roof.

4.2.3. Main fortress gate

From the plaza in front of the fort, two steps lead up to the main gate, which is arched and built from bricks and stones. The gate is adorned with a sculpted gray mortar pediment in a double-eave, three-story style, featuring the inscription "Fuxing Bao" in black ink within the molded frame below (Li, 2010). Couplet inscriptions on either side read "Restore Taiwan, Revitalize China." The gate opening measures approximately 1.77 m in width and 2.4 m in height, featuring a solid wooden door about 0.1 m thick, set behind a stone threshold and opening inward in both directions. In the lower-middle part of the gate, there are one round and one square opening, which can be closed and are used for surveillance and shooting (**Figure 9**). Behind the gate lies an arched passageway beneath the rammed earth walls, slightly larger than the gate itself. At about 1 m above the ground on both sides of the wall behind the

door, there are bolt holes each 0.18 m long, into which wooden bolts can be inserted directly into the wall to withstand impact. Exiting the passageway and entering the gatehouse marks the official entry into the interior of the Fuxing Bao. The gatehouse features a single-story, four-column structure with a hipped roof, an internally projected thatched roof, and leans against the eastern rammed earth walls. The floor is paved in long gray bricks arranged in an H-pattern. The gatehouse is 4.47 m high, 4.05 m wide, and 3.56 m deep, creating a spacious and bright area.

Figure 9. Main fortress gate of Fuxing Bao.

4.2.4. North-south residential buildings

The face-to-face north-south row houses are a distinctive feature unique to Fuxing Fort, unparalleled in Fujian Tubao. Corridor-style eaves galleries connect to the entrances of each row house to the north and south. The row houses span eleven bays in width and eleven columns in depth, each composed of three sets of double-hall structures. Each of the north and south row houses contains three courtyards, around which are built lower halls, upper halls, rear halls, east and west side halls, wing rooms, and corridors (Luo, 2019). The southern row houses cover an area of about 460 square meters, divided into three sets of buildings: left, center, and right. Each set extends 15.68 m deep (from column center to column center), with widths of 9.76 m, 9.86 m, and 9.85 m, respectively. The central building of the southern row houses serves as the core structure. The first floor's main room houses a hall for ancestral worship, a place for discussing major decisions within the fort. The second floor features a long desk with upturned ends, also used for offerings. The northern row houses are symmetrically arranged across a central courtyard opposite the southern row houses, with similar sizes and layouts. The northern row houses occupy an area of 455 square meters, with a depth of 15.52 m (from column center to column center). Unlike the southern structures, the northwest corner of the northern row houses features a two-story pavilion, with the rest being single-story. The north and south buildings are separated from the fort walls by passageways, and at the rear of

the row houses, there are three pavilions approximately 2 m high (from ground to ridge) and 3 m wide, linking the buildings to the fort walls.

4.2.5. Kuixing lou and west fort gate

Fuxing Bao features two gates aligned along a central axis in a pass-through hall style, a significant feng shui taboo. This is the reason for the construction of the three-story Kuixing Lou in front of the west fort gate. The Kuixing Lou has three levels, constructed of wood. The first floor is an open hall style, open on three sides and backed by the western fort wall, spanning 3.56 m wide (from column center to column center) and 2.95 m deep. The second floor features a square window in the center of the facade, measuring 1.35 m high and 0.41 m wide, with a projecting deep cornice below it to shield the lower levels from rain. The third floor is integrated with the corridor, enclosed by a 0.9 m high wooden fence. Inside, a wooden staircase provides access to the corridor.

The west fort gate serves as a side entrance to Fuxing Bao, similar in design to the main gate but with less elaborate decoration and scale. The gate is approximately 1.2 m wide and 2.24 m high (from the arch top to the ground), featuring a double inward-opening wooden door. Beyond the gate, the passageway is 3 m wide and 2.87 m high. Outside the west fort gate is a small courtyard, roughly triangular in plan, with a semicircular terrace in front of the gate. Surrounding the courtyard are walls and a gatehouse, built in a three-droplet gatehouse style with brick and stone mimicking wood. The sides feature a stepped three-tiered roof, with a bottom section featuring an inward-opening wooden door used for encirclement and retreat.

4.3. Current situation of physical environment in Fuxing Bao

4.3.1. Fortress wall

The walls of Fuxing Bao are constructed from rammed earth and, while structurally stable with no signs of collapse, have undergone weathering over the years, exhibiting cracking and spalling, particularly at the base and where the wall bends, areas not protected by eaves, making them more susceptible to rain damage. At the gate of the fort, the plaster on the walls is notably cracked and flaking, detracting from the overall aesthetic of the structure. The interior corners of the fort's walls are covered with moss, particularly on the inside of the fort walls where poor lighting conditions further facilitate the spread of moss and other bryophytes (**Table 3**).

Table 3. Table on the current status of structural damage to the building.

Construction Space	Damage Status	Illustration
Fortress Wall	There are cracking and falling off phenomena. There are cracks in the blocking and plastering at the fort gate, and the wall covering is peeling off. There is moss in the central corner of the fort wall.	

Table 3. (*Continued*).

Construction Space	Damage Status	Illustration
Floor	There are cracks, shaking and alkalization of green bricks. The gaps between bricks are large and rainwater can easily accumulate. The blue bricks are covered with moss and the road is slippery.	
Roof	There are very few cracks and falls on the tile surface.	
Wooden structure	Some wooden components are missing or damaged. Decorative dark brown dirt appears on the surface of the component. The floor slabs are somewhat decayed and the gaps between the floor slabs are large. Heavy dust accumulation on stairsand attics.	

4.3.2. Floor

The flooring in the building is comprised of three types: brick paving, cobblestone, and wooden floors. Brick paving is the most widely used flooring in Fuxing Bao, with some areas exhibiting issues such as cracked green bricks, instability, and efflorescence. The gaps between the bricks are large, leading to water accumulation. The humid climate and moist environment, conducive to plant growth, have led to the growth of moss on the green bricks of various courtyards within the Fuxing Bao, making the pathways slippery and posing safety hazards to the structural integrity of the building.

4.3.3. Roof structure and wooden structures

The building has undergone two renovations; the roof structure remains largely intact, with only minor instances of tile cracking and falling off. The existing wooden structures are generally stable, though there are some missing and damaged wooden components on the sides of the north and south buildings. Some decorative elements have discolored to a dark brown due to moisture, affecting their aesthetic appeal. The floorboards in the attics of both the north and south buildings are decayed, with significant gaps that cause movement when walked upon. The wooden staircases present similar issues, posing safety hazards and accumulating substantial dust at the stairs and attic areas.

4.3.4. Doors and windows

The door and window structures of Fuxing Bao are largely intact, with most deteriorated parts replaced. The style of the windows is relatively uniform, though two windows are missing or have fallen from the second floor of the southern row houses.

Most of the windows within the fort have been deliberately sealed and cannot be opened, except for the square watch windows on the corridors, which remain operable. The passages on both sides of the Taishi walls in the north and south row houses are completely blocked with wooden planks, and many of the wooden doors in these houses cannot be opened.

4.4. Status of the social environment in Fuxing Bao

4.4.1. Questionnaire survey results

The survey respondents were predominantly original villagers (83.72%), primarily aged between 41–60 and over 60 years old (81.37%). Most were male (67.44%), with an education level mainly at or below junior high school (65.12%). Their primary sources of income were agriculture and labor (53.49%), with most earning less than 2000 yuan per month (53.48%). The majority had lived in the village for over 20 years (83.72%). The questionnaire was divided into three sections: conservation value, current state of conservation, and willingness to repurpose (**Figure 10**).

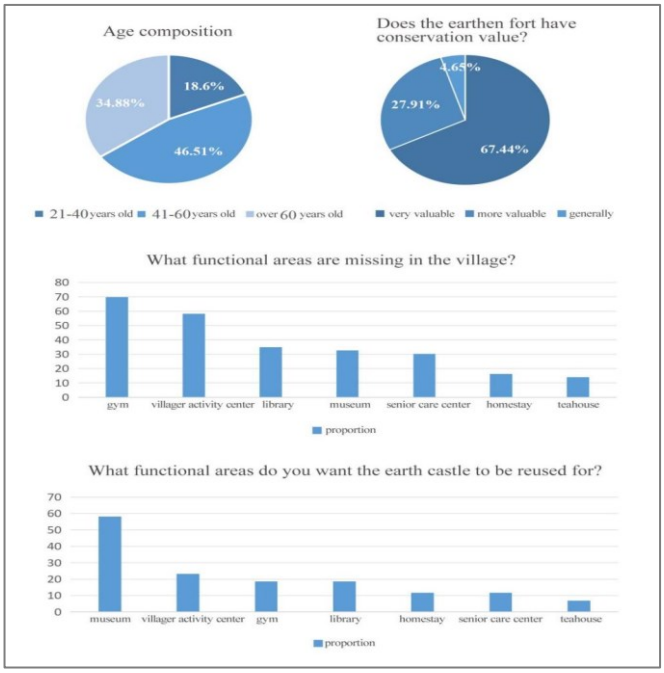

Figure 10. The pie chart of survey results.

1) Conservation Value

When asked whether Fuxing Bao has conservation value, the vast majority (95.35%) of villagers think that it has conservation value, only four (4.65%) think that it is average, and no one chooses that it has no conservation value. It can be seen that Fuxing Bao has a certain popularity and importance in the minds of local villagers, who generally agree that Fuxing Bao has a high protection value, and that the value of Fuxing Bao is mainly historical value (58.14%) and anti-war cultural value (83.72%), while some villagers (25.58%) think that it has architectural value.

2) Current state of conservation

According to the questionnaire analysis, a majority (88.37%) of villagers believe that the current conservation status of Fuxing Bao is relatively good, attributing this primarily to government efforts. While satisfaction with government-led preservation and restoration efforts is high, there is also a desire for increased government funding (60.47%), improved infrastructure, and development of cultural industries.

3) Willingness to repurpose

Regarding the repurposing of Fuxing Bao, only two individuals (2.33%) expressed opposition, while the remaining villagers (97.67%) supported its reuse and were optimistic about its prospects. The majority of the villagers (79.07%) hoped that repurposing Fuxing Bao would improve the village environment and enhance transportation convenience. When gathering opinions on what facilities were lacking in the village, most residents felt there was a shortage of fitness facilities (69.77%) and community centers (58.14%). Some also noted a lack of libraries (34.88%), museums (32.56%), and senior centers (30.23%). As for the proposed functions for repurposing Fuxing Bao, the highest demand was for it to serve as a museum (58.14%), followed by a community center (23.26%), a fitness facility (18.6%), and a library (18.6%). There was less interest in transforming it into a guesthouse (11.63%) or a teahouse (6.98%), which are more commercial in nature.

4.4.2. Analysis of the results of the in-depth interviews

During the interviews, it was revealed that, given the predominantly elderly population (over 60 years old) in the village, there is a need for a social and leisure space, which is currently lacking. Consequently, residents often gather under a large tree next to the village committee for leisurely discussions. According to the village secretary, Wenlong Village is geographically and transitively divided into north and south, with residents rarely visiting each other's areas. However, the establishment of a recreational facility within the village would be welcomed and could foster greater interaction and integration among the villagers. Regarding the current state of village transportation, four villagers reported that earlier, the village roads were wider and more conducive to vehicular traffic, unlike the present narrow conditions. In recent years, the collapse of old houses has led to the construction of new extensions without unified planning, resulting in disorganized housing arrangements that encroach on roadways. Interviewees expressed support for the repurposing of Fuxing Bao and noted that despite its restoration attracting many tour groups, the lack of convenient transportation, inadequate infrastructure, and absence of an integrated tourism industry with surrounding areas are significant challenges, gradually diminishing its appeal to tourists. When asked about the repurposing of Fuxing Bao, all interviewees agreed on the need for a community center, highlighting it as a critical and currently lacking facility needed urgently by the village. The Fuxing Bao's administrator, the head of the Yu clan, and two villagers pointed out that Fuxing Bao occupies a large area and expressed a desire to preserve its function as a clan ancestral hall, to strengthen unity and cohesion among clan members.

5. Discussion

Following more than 30 days of field research by the study team, several pressing issues have been identified in Fuxing Bao and Wenlong Village (**Figure 11**). The

primary focus for the redevelopment of Fuxing Fort involves summarizing the current challenges and proposing relevant solutions.

Figure 11. The current situation of the village.

5.1. Incomplete infrastructure construction

5.1.1. Incomplete road traffic system

The village features densely packed residential construction with narrow spacing between houses, resulting in constricted roadways and crowded transportation spaces. This layout limits travel routes and hampers daily commutes for residents. There is a lack of parking facilities within the village; external parking areas are too distant to be convenient. Residents typically park their vehicles close to their homes, occupying part of the roadway and further narrowing the streets. To address these issues, the first step involves reorganizing village plots by clearing debris and waste in the gray areas between roads, residences, and fields, demolishing illegal constructions encroaching on roads, and appropriately widening main thoroughfares to expand road usage. Reflective mirrors will be installed at narrow roads and corners to improve visibility. Furthermore, the vacant land north of Fuxing Bao will be transformed into a standardized parking lot to meet the parking needs of the villagers.

5.1.2. Lack of necessary space for public activities

The range of activities within the village is limited, with villagers primarily engaging in social interactions in streets and alleys. Due to the proliferation of digital communication, activities have become more individualized, gradually diminishing the village's vitality. The lack of communal spaces has led to a decline in both the overall vitality of the village and the quality of life for its residents. This has indirectly contributed to decreased community cohesion and exacerbated the "hollowing out" of the village (Lu, 2019). To counter these effects, it is proposed to strategically establish public activity areas within the village, equip these areas with recreational and fitness facilities, and install street lighting to accommodate evening leisure activities.

5.2. High vacancy rates and monofunctionality of space

5.2.1. Monotonous exhibition style

The exhibition methods at Fuxing Bao are outdated and simplistic, failing to incorporate modern technologies such as digital tools and interactive systems, which severely limits the historical information conveyed. The number of display panels is insufficient, and their content is outdated, failing to effectively showcase the rich historical and cultural significance of Fuxing Bao. Fuxing Bao currently lacks electrical wiring; the application of digital technologies would require power connections. Utilizing digital technology can enrich the exhibition format, making the viewing experience more engaging and interactive. Additionally, it is crucial to continually update and enrich the content of the display panels, extracting and expanding valuable historical information to prevent the displays from becoming outdated and monotonous. The exhibition content should integrate distinctive resources and leverage regional culture by organizing themed exhibitions at specific times, enhancing cultural continuity and identity.

5.2.2. Low space utilisation

Many rooms within the Fuxing Bao are vacant and the space is underutilized, with clutter accumulating in corridors and some rooms, hindering passage. This issue reflects insufficient efforts in the conservation of Fuxing Bao's cultural heritage and a simplistic approach to utilizing cultural resources. Although the main structure has been preserved and utilized, it has not been effectively integrated with local culture nor has it fully explored and utilized the unique cultural resources related to its wartime history.

To address this, a dynamic utilization approach could be adopted to adapt the space to current social conditions and living needs, revitalizing it once more (Sun, 2021). Additionally, thorough research and utilization of Fuxing Bao's cultural resources are necessary to enrich the forms and content of exhibitions, thereby improving the spatial utilization rate.

5.2.3. Single function

The defensive and residential functions of Fuxing Bao have gradually diminished with modern developments. Currently, the fort primarily serves two functions: exhibition and clan rituals. Research has indicated that the frequency of ritual activities within the fort has been decreasing over recent years, and its function as a site for such ceremonies is also fading.

Relying solely on its function as an exhibition space is insufficient to restore the vitality of Fuxing Bao. It is essential to transform the fort into a dynamic complex that meets various needs, ensuring frequent human activity, which will better utilize and preserve the structure.

6. Conclusion

This paper uses Fuxing Bao in Yong'an City as a case study to explore pathways for the renewal and sustainable reuse of Fujian Tubao and other regional residences,

aiming to restore the functional use of buildings and revitalize their spaces. Through field research in Yong'an City's Fuxing Bao and its surrounding village, this study examines the current physical and social environmental conditions of the fort. The analysis begins with an assessment of the physical state of Fuxing Bao to determine if its preservation status aligns with reuse objectives (Wang, 2023). This is followed by a survey and interviews focused on the residents of Wenlong Village to understand the social environment. Based on this analysis, existing issues are identified and solutions proposed. This article synthesizes the outcomes of literature review and field research to perform qualitative and quantitative analyses on the current architectural and social environments. Subsequently, it proposes sustainable development strategies for the reuse of Fuxing Bao and provides strategic recommendations for the conservation and utilization of Fujian Tubao.

(1) The primary step in preserving Fujian Tubao is documentation, as the number of these structures is gradually decreasing. Every day, some Tubao are lost due to poor management and erosion. However, current rescue and preservation efforts are largely limited to textual survey records and the organization of ancient texts. As a living form of cultural art deeply embedded in the community, Tubao architecture requires specialized rescue and preservation approaches. There is an urgent need for techniques that utilize digital information acquisition and processing to protect and perpetuate these buildings and their cultural practices (Qiu and Yu, 2009). Therefore, this study proposes the creation of digital models and explores the digital storage of Tubao information. By conducting field research within Tubao communities and compiling spatial survey data, a digital information database for these structures can be established (Chen et al., 2023). This electronic database would provide access to each Tubao's historical evolution, architectural layout, actual photos, interior decoration, and component dimensions, offering digital resources to aid in future preservation, restoration, and adaptive reuse efforts.

(2) The daily preservation of Fujian Tubao is inextricably linked to the involvement of the village residents. Spiritually, although the Tubao no longer serve their original defensive purposes, they remain significant as sites that preserve local memory. The villagers of the Tubao communities have a strong emotional connection to these structures, which act as a bond that maintains clan cohesion. On a material level, since villagers live in the same community as the Tubao, and are the group most frequently in contact with these structures, it is essential to engage their enthusiasm for the protection and development of the Tubao. Villagers should be the primary caretakers in the daily maintenance of these structures. Additionally, regarding the reuse of the Tubao, it is crucial to respect the villagers' wishes and aim to repurpose these buildings into functional areas that serve the community's needs.

(3) Fujian Tubao can be classified into two major categories based on their preservation status: the first includes those in poor condition, lacking professional maintenance and not listed as protected cultural relics; the second category comprises those that are architecturally intact or have undergone professional restoration. For the first category of Tubao, the structures are severely damaged, rendering the spaces unusable. The primary concern for these buildings is protection. It is recommended that the government take the lead in professional architectural repair and management to prevent them from further deterioration. Some Tubao have been restored and

reasonably protected, with their structures relatively intact, making their spaces suitable for adaptive reuse. Fuxing Bao is a representative example of this category. For such Tubao, functional reallocation can be implemented by introducing new utility areas. Without compromising their historical integrity, adaptive reuse strategies tailored to current social development needs should be adopted, repurposing these spaces for new uses (Wang et al., 2023).

The synthesis of the current architectural state and research analysis of Fuxing Bao reveals that there are certain limitations in choosing functions for its future reuse. Decisions cannot be solely based on the villagers' preferences or the layout of the village functional areas. The future renovation goals for Fuxing Bao involve a comprehensive process that incorporates multiple factors. The revitalization and utilization of architectural heritage mainly involve leveraging its original functions or proactively altering its use. The latter specifically includes the utilization of its cultural, social, commercial, and landscape functions. Through a current status survey of Fuxing Bao, it was found that the building has long been uninhabited. The houses within the fort have a cramped layout, and the close proximity of buildings results in poor ventilation and lighting compared to modern residences. These factors make it highly unlikely for villagers to move back into the fort. Additionally, Fuxing Bao is located in the heart of the village, far from the city center and commercial areas, and lacks popular attractions nearby, making it difficult to attract visitors. The building's small area also limits its potential for commercial use. Moreover, the landscape environment of Fuxing Bao is relatively monotonous and does not meet the aesthetic requirements of tourists. Utilizing it for landscape functions would require substantial human, material, and financial resources for new planning and design. This approach would deviate from the principles of authenticity, appropriateness, and sustainability in architectural heritage conservation. Therefore, this method is not suitable for the renovation and reuse of Fuxing Bao. Therefore, considering the villagers as the primary users and from the perspective of their daily life and spatial connections, we conclude that Fuxing Bao is currently best suited for cultural and social functions. This conclusion is based on an assessment of the building's preservation status, current utilization, transportation location, and landscape environment. Suitable uses include a community activity center, exhibition hall, or library.

This paper explores the renovation and utilization methods of Fujian Tubao through case studies, based on the environmental context, current architectural state, and government policy tendencies. By examining specific instances, the study aims to expand new ideas for the protection and reuse of Fujian Tubao, summarizing experiences and methods to provide rational suggestions for future conservation and renovation practices. The goal is to restore the functional value of Tubaos, enhance infrastructure development, and increase villagers' willingness to participate in protection efforts. Additionally, this research seeks to raise awareness and encourage more scholars to engage in the conservation of Tubaos, ensuring their sustainable protection while allowing them to continue serving their role in contemporary society.

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XQ; writing-original draft preparation, XQ; writing-review and editing, XQ and QZ; visualization, XQ; supervision, XQ; project administration, WY; funding acquisition, QZ. All authors have read and agreed to the published version of the manuscript.

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