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Alterations of Historic Rural Landscape Based on the Multifunctional Approach: The Case of Coastal Fishing Villages in the Yangtze River Basin

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Abstract: The historic landscape is an important component of a village, and the alteration of villages is a necessary process of development. To analyze characteristics of historic rural landscape alterations and the reasons behind them, this study utilized a landscape multifunctional approach and a comprehensive methodology comprising space syntax and field investigations. This study divides the historic rural landscape into two types, ecology-led and production-led patterns, which validate the relationship among ecology, social properties, and cultural connotation in space, offering a new perspective on the alteration of historic rural landscapes. Our findings indicate the interaction among ecology, production, and lives, both diachronically and synchronically, and suggest that it is possible to maintain ecological harmony, functional transformation, and the inheritance of cultural connotation through improving historic rural landscapes.

Keywords: fishing villages; historic rural landscape; landscape multifunctionality; space syntax

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1. Introduction

During urbanization, various social spaces have been changed, driven by modern needs. This has caused several clashes between development and traditional memory, diverse subjective participation, and demands from the local people. The historic landscape contains the regional identity and cultural connotation, which can be traced from the conception of the cultural landscape. In 2005, the historic landscape was clearly defined in the Vienna Memorandum on "World Heritage and Contemporary Architecture-Managing the Historic Urban Landscape" [1], which integrated current surroundings, sustainable development, and integrity of landscape in a certain space. It not only emphasized the historical development of landscape but also its influence on modern lives and the coordination with current surroundings. However, current research on historic landscapes mainly focuses on urban areas. The management of the rural landscape by international institutions had been promoted since 2017 [2]. The rural landscape is defined as terrestrial and aquatic areas co-produced by human–nature interactions. Current research on rural landscapes mainly focuses on their connotation [3], values [4], current utilization [5], and future development [6]. The rural landscape has always been regarded as a type of heritage, with synchronism and diachronism, while most of the related research has often neglected the integration of its history with current developments.

Landscape multifunctionality theory has mainly focused on the interactions among nature, society, and people, divided into two aspects: land usage [7] and institutions [8]; ecological systems [9] and landscape value [10]. However, such research is based on the land classification system and emphasizes its certain function rather than its integrity and connections between its spatial alterations and mechanisms.

Thus, this article utilized the landscape multifunctionality theory, selected two typical coastal fishing villages in the Yangtze River Basin to analyze the alterations in their historic landscape and altered mechanism, and proposed relevant advice for future development. This article dominantly answered four questions: How does landscape multifunctionality theory connect with space syntax to analyze alterations of the historic rural landscape from different scales? What are the features of a historic rural landscape? What are driving forces for the alterations of historic rural landscapes based on landscape multifunctionality theory? What advice can be proposed based on landscape multifunctionality theory?

2. Landscape Multifunctionality Theory

Landscape multifunctionality theory originated from the study of the multifunctionality of agriculture by the European Commission in the late 20th Century [11]. The promotion of the Millennium Ecosystem Assessment (MA) accelerated its study in 2005 [12]. In general, landscape multifunctionality means ecological function, production function, and living function [13]. The ecological function relates to the space that can provide ecological products and services to maintain the regional ecotope. Production function means people can engage in production activities and perform a specific function in a certain area. The living function relates to the place where people spend their daily lives and undertake featured activities [14]. Current research on landscape multifunctionality dominantly focuses on three aspects: identification and classification of spatial functions [15]; alterations of the spatial configurations and driving elements [16]; multiscale evaluation and advice on future development [13].

Relevant research on rural landscape multifunctionality has dominantly focused on spatiotemporal altered characteristics of multifunctional rural areas [17] and their interaction [18], effectiveness [19], and evaluations [20], including qualitative descriptions and quantitative indicators regarding the geology [21], ecology [22], agriculture [23], economics [24], and so forth.

Quantitative research on the connotation of rural landscape multifunctionality is dominantly about indicator analysis, which lacks visual and direct analysis, a connection with the alterations of spatial configuration, and comprehensive understanding of the historical contexts of the landscape.

Principles concerning rural landscape heritage also regard the rural landscape as a multifunctional resource that is influenced by people. Regarding the historic rural landscape, "Historic" emphasizes the historic significance of the objects, including their diachronic and synchronic features. "Rural" limits the spatial definition. "Landscape" is the study object. To some extent, the historic rural landscape is the extension and compensation of the "cultural landscape" to rural areas, including tangible elements and intangible elements [25]. Thus, the historic rural landscape considers a temporal influence, tangible alterations, intangible connotations, and the relationship with its surroundings spatially. With the landscape multifunctional approach, the historic rural landscape has unique characteristics under spatial and temporal influence: ecological function refers to the alterations in the ecotope and landforms in villages, which can be presented through its external spatial alterations [26]. Production function, as a result of social influence, indicates variations in the spatial functions of villages, expressed through internal spatial alterations [27]. Living function refers to the daily lives of the local people and their preserved traditions [15].

3. Methodology

3.1. Study Area

This study selected two coastal fishing villages in the Yangtze River Basin, Jinshanzui village and Tianao village, and analyzed their altered landscapes. As fishing villages, their production approaches were closely connected to their spatial configuration and ecology. Governments in China have various administration modes for land use and planning, including the top-down mode, the bottom-up mode, or the mixed mode. Thus,

these fishing villages have experienced various spatial alterations and formed various landscape features. Although several scholars have studied the coast using landscape multifunctionality [28], they focused on urban areas in the Yangtze River Basin rather than villages. The research on fishing villages has predominantly focused on spatial alterations of fishing villages with sociological and geographical methods [29], current spatial utilization and functions [30], conflicts among various actors including fishermen, visitors, and the government [31], revitalization of these villages [17], or assessment of their revitalization with indicators [32]. It has lacked visualized analysis and alternative mechanisms.

Coastal fishing villages in the Yangtze River Basin are typical villages presenting interactions between the environment, society, and people, which can be divided into two types: offshore and island types. Jinshanzui village is located in Jinshan town of Shanghai. It is an offshore type and the earliest fishing village in Shanghai. It is also the only preserved fishing village in Shanghai. It is confronted with the sea and surrounded by highways. Its location limits its boundaries (Figure 1). It has a population of 2000, and over 1200 of them are inhabitants [33]. The village covers an area of 3.5 km^2, and its coastline is over 6 km in length [33]. The village was formed in the 1960s, and its development reached its peak in the 1990s. There were over 800 fishermen and 45 fishing boats at that time [33]. The village has receded at the beginning of the 21st century, and there are currently 18 fishing boats and 100 fishermen. It has begun to transform since 2010 [34].

Figure 1. Jinshanzui village (resource: Baidu Maps).

Tianao village is located in Shengsi town of Zhoushan (Figure 2). It is an island fishing village and was the first fishing village to develop tourism in China. The village covers an area of 2.43 km^2: plowland covers an area of 0.19 km^2, and the remaining area is forestry [35]. In the 1960s, there was a population of 2994 in Tianao village, and 504 were fisherman. After 2000, there were 4054 inhabitants, and 908 of them were fisherman. Currently, there is a population of 640 in Tianao village, and 151 are fisherman [36].

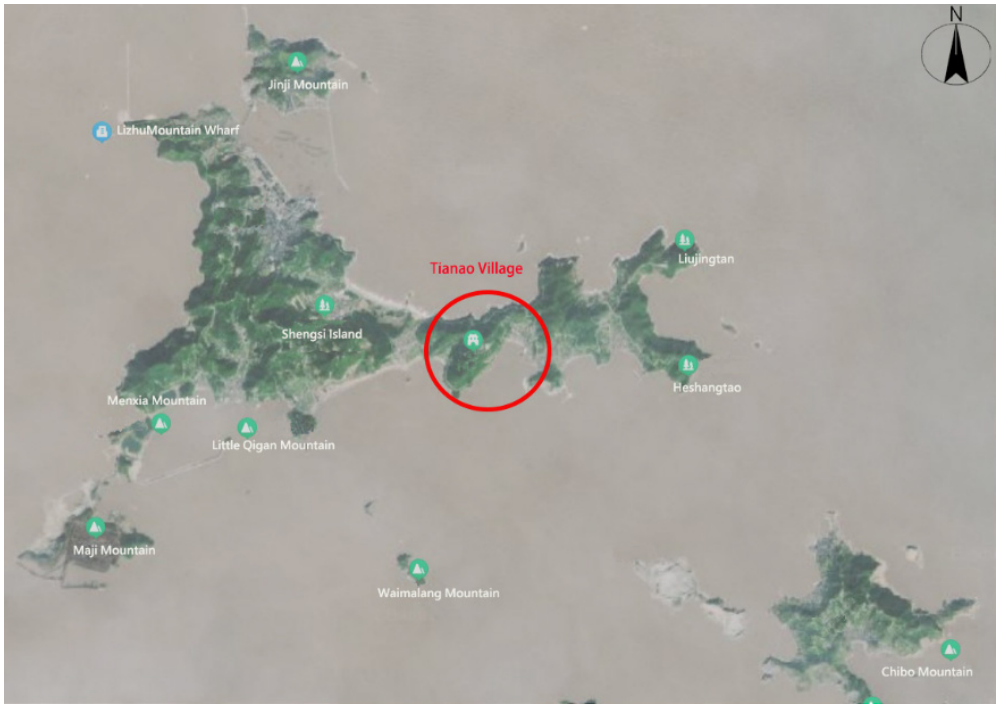

Figure 2. Tianao village (resource: Baidu Maps).

Both villages developed a fishery industry in the 1960s, were transformed at the beginning of the 21st century and sought recent redevelopment due to the recession of the fishery industry. However, due to various governance and environments, their historic landscape had various characteristics. After the ten-year fishing ban implemented on the Yangtze River, fishery and tourism have been depleted in Tianao village. Jinshanzui village has not banned fishery and has developed into a multifunctional fishing village due to government support and various subjective participations. Thus, this study selected these fishing villages to analyze their landscapes.

3.2. Space Syntax

The ecological and production functions were analyzed with space syntax. Space syntax is a science-based and human-focused approach that explores relationships between space and its relevant social and cultural phenomena through the quantitative expression of physical habitat structures, including buildings, settlements, and landscapes [37].

Space syntax can simulate the possible effects of spatial designs on the people who occupy or move around the sites using conceptual models: visibility graph analysis (VGA), isovists, and axial maps. An isovist is a static description of the area observed at each point in space and tends to analyze the internal space of buildings [38]. VGA was developed based on isovists and provides a dynamic description [39]. Visibility graph analysis demonstrates the spatial configuration by describing the mutual visibility relationship of points in space. The axial model is suitable for social places with significant human influence, while the fishing villages are ecologically oriented [40]. Thus, this study selected the VGA model to analyze and demonstrate the validation of the spatial formation and its social properties.

Integration, control value, intelligence, and mean depth to the landmark are frequently applied indicators in space syntax analysis. Their units are step, which calculates the number of spaces required to pass before reaching another space from a certain point [41]. Integration indicates the topological accessibility of a certain space at different scales, which can be divided into global integration and local integration. Global integration is the integration values at an infinite radius, used to represent a picture of the integration pattern at the largest scale, and local integration means integration values at a radius of three

(root plus two topological steps from the root), used to represent a localized picture of integration [42]. The global integration tended to stimulate large-scaled crowds, while the local integration tended to stimulate small-scaled crowds [42]. The formulas are as follows [43]:

1. Calculating the total depth (TD), the sum of the number of connections between a particular nod and every other node in a certain space. N means the number of all nodes within a radius, and nx is the nodes for a given root at a given depth or level.

$$TD = (0 \times nx) + (1 \times nx) + (2 \times nx) + \cdots + (X \times nx)$$

2. Calculating the mean depth (MD), demonstrating the denotation of the average depth value of all nodes within a radius. MD is the ratio of TD and the number of n minus one.

$$MD = TD/(n - 1)$$

3. Calculating the relative asymmetry (RA), indicating the depth of the system from a particular node with the theoretically possible depth or shallowness of this system.

$$RA = 2(MD - 1)\, n - 2/(n - 2)$$

4. Calculating the real relative asymmetry (RRA). RRA not only indicates the depth of a node in a whole system but also in a suitably scales benchmark configuration [43].

$$RRA = 2\{n[\log_2(n + 2/3) - 1] + 1\}/(n - 1)\,(n - 2)$$

5. Calculating the integration.

$$\text{Integration} = RA/RRA$$

For the integration, high values are warm colors and low values are cold colors. Warm colors indicate high accessibility and visibility. Cold colors indicated low accessibility and visibility.

Intelligence is the ratio of local integration and global integration, demonstrating the stimulation of the entire spatial configuration from the partial space layouts. The coordinates of the intelligence consist of the scattered plots, trend line, and fitting degree (R^2). The abscissa of scattered plots is the global integration, and their ordinate is the local integration. Scattered plots demonstrate the discordance between the partial space and the entire space. Trend line is the minimum distance from all points to the line. The steep trend line indicates that the local integration is better than its global integration, and the space has its characteristics. R^2 means the connection between the abscissa and the coordinate of scattered plots. Its value being higher than 0.5 indicates a close connection between the partial space and the entire space [43]:

$$\text{Intelligence} = \text{Local Integration}/\text{Global Integration}$$

The control value indicates the controllability of every node, calculated by the sum of the inverse connectivity values of the immediate space [44]. High values are warm colors, and warm colors indicate high connectivity. However, cold colors indicate low connectivity.

The mean depth to the landmark is the average depth from a particular space to all other spaces, demonstrating the accessibility between the surroundings and the landmark, which was indicated by (2) above [43]. High values are warm colors and indicate inferior accessibility to the landmark. This study selected the Historical District at Jinshanzui village and Scenic Square at Tianao village as landmarks, because the two landmarks have existed since the two villages were formed. The spatial configuration of these two villages was developed to be linearly centered with these two landmarks and extended to the west inland. The landmarks witnessed the alterations of the two villages. They also play an essential role in current daily lives.

Therefore, this study utilized space syntax to explore the historic landscape of fishing villages and implemented DepthmapX software (a spatial analysis software originally developed by Alasdair Turner at the Space Syntax group in UCL) to conduct the analysis.

3.3. Socio-Historical Analysis

The socio-historical approach has long been involved in geography. However, early studies in 1.845 implied urban problems rather than proposed them directly. Engels considered the diachronic development of industrial capitalism as the influential element when he analyzed the formation of industrial cities. Although his study referred to dichroism, industrial capitalism was one of the influential elements rather than the indicators of social elements that can impact industrial cities [45]. At the beginning of the 20th century, Taylor pointed out that geological development was impacted by social elements and proposed social influential indicators. It was not until 1.960 that social elements connected with temporal elements and formed the early socio-historical approaches [46].

The socio-historical analysis, as a basic analytical method, was officially mentioned by Pinell, who utilized it in the study of cancer social history in France [47]. The author utilized a socio-historical approach to analyze the influence of social elements in the process of French cancer. Then, the socio-historical approach was utilized in literature [48], law [49], and other fields.

Sociohistorical analysis regards the space as a representation of the social structure. It explores the influences of economic [50], political, and perception elements on spatial alteration as well as their social practice in diachronism [51].

Socio-historical analysis has begun to be utilized in the landscape field since 2005. Chen [52] analyzed the diachronic alteration of landscapes in African and American national parks and explored the influence of socio-historical and socio-economic elements on landscapes at different ages. Steen-Adams [53] proposed this kind of approach and framework based on the previous research: through the diachronic alteration of the research target, the study concluded the altered regularities and implied driving forces, built an altered mechanism, and they proposed relevant advice. Based on this framework, Subin-Kozhevnikova [54] took Vinnytsia in Ukraine as an example to study urban space, in particular the formation of urban artistic space and its influencing elements.

Thus, this study, based on landscape multifunctionality theory, selects Jinshanzui village and Tianao village as examples and utilizes space syntax and the socio-historical approach to explore their spatial alteration at various ages. Then, this study identifies the altered regularities of historical landscapes, builds an altered mechanism of historical rural landscape analysis, and proposes advice for future development, from the perspectives of ecology, production, and lives (Figure 3).

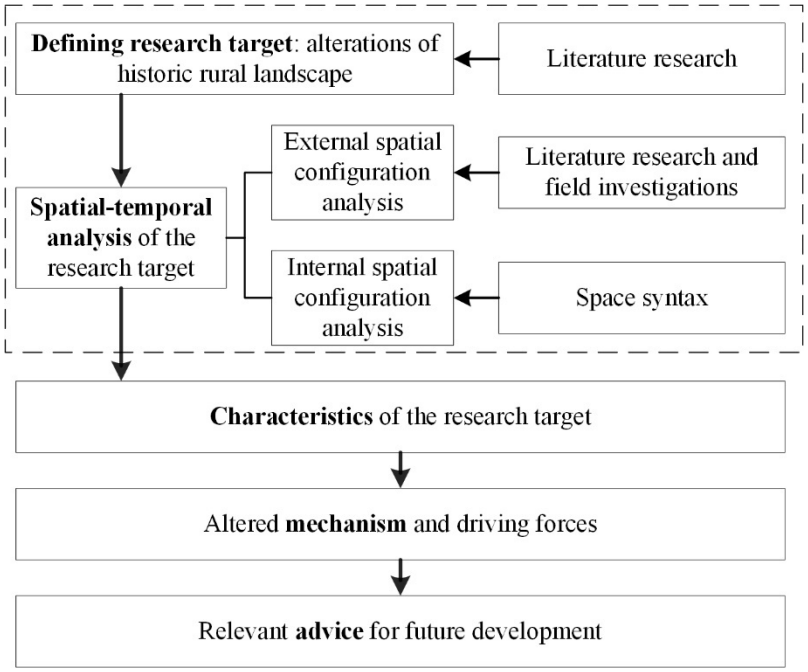

Figure 3. Research framework.

4. Results

4.1. Alterations of External Configurations at the Two Fishing Villages

Alterations of the external configuration of Jinshanzui village were presented through its coastline and entire layout. Jinshanzui village is east of Hangzhou Bay and has experienced a smooth collapse towards the land since the Tang Dynasty (618–907 A.D.). Its coastline was historically only influenced by nature, such as flow change and climate, because people did not live there nor were settlements formed at the shore [55]. Until the Qing Dynasty (1636–1912 A.D.), the coastline changed dramatically and changed into the form of "几" before the 1960s [56]. Thus, these alterations were strongly impacted by nature. People who lived there started to hunt fish. A fishing village then began to develop [33]. Villagers built habitat areas on the shore, where most fishermen worked and traded. After the 1980s, with the acceleration of the fishery at Jinshanzui village, the inhabitants hunted fish on the sea and started relevant business on the shore [33]. Thus, the coastline receded and formed the current one (Figure 4).

Jinshanzui village had been a natural place before the 1960s. After people moved there, it gradually became a fishing village. Thus, the 1960s were an essential time. As the most important industry, fishery was prospering in the 1980s. In 2000, the government relied on these better-developed fisheries to develop tourism and revitalized the space in Jinshanzui village. After 2010, its fishery and tourism receded, and the village needed to transform. Thus, the government brought in academic institutions for new planning of Jinshanzui village, and the village was revitalized [33]. These alterations influenced its historic landscape, expressed through its external spatial configuration. Thus, this study selected the alteration in the 1960s as the starting point, compared with the spatial configuration before the 1960s, and the alterations in 2000 and 2010, to analyze the alterations of the spatial configurations in Jinshanzui village.

As shown in Figure 5, the village had not been formed until the 1960s, and only the alteration of the coastline influenced the outline of this space. In the 1960s, buildings in Jinshanzui village were distributed along the coastline. Until 2000, the layout had the Historical District as the core and developed linearly. The current configuration is similar to this, though building development is accelerated and scattered in the northwest (Figure 5).

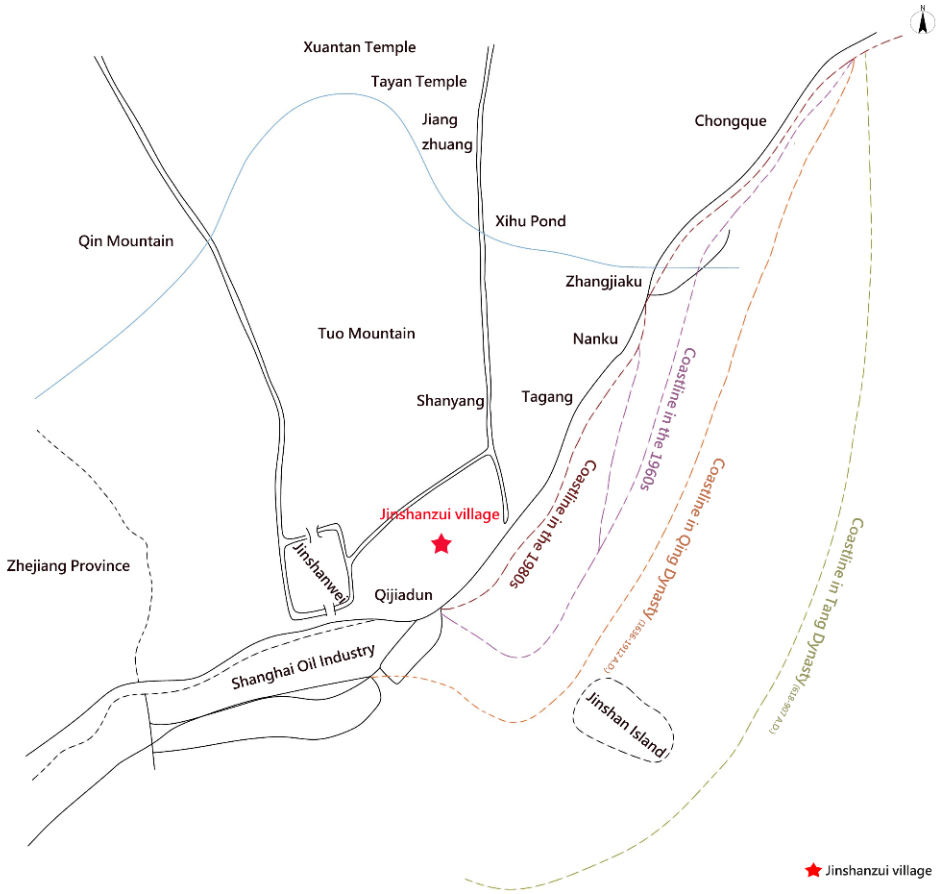

Figure 4. Alteration of the coastline at Jinshanzui village.

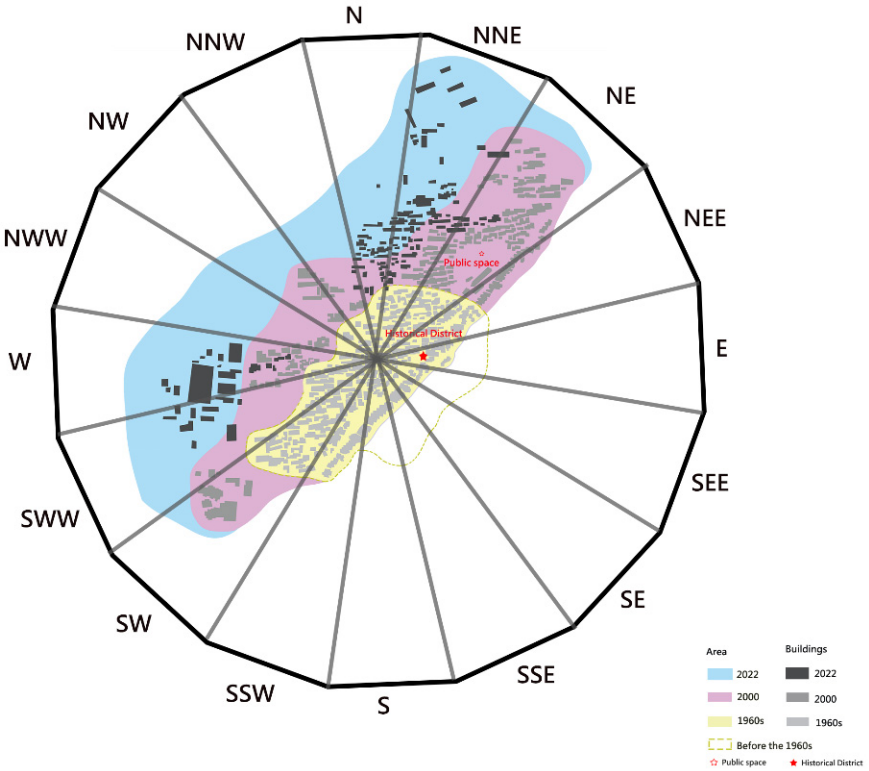

Figure 5. External configuration alteration of Jinshanzui village.

Compared with Jinshanzui village, the coastline in Tianao village has had little alteration. However, its shore space changed due to sea reclamation and human activities [35]. From Figure 5, we can see that Tianao village was similar to Jinshanzui village and that few people lived there before the 1960s. Inhabitants had migrated there gradually until the end of the 1950s. Most inhabitants lived for the fishery, because the village was near the sea and most of its area was forestry. A fishing village was formed in the 1960s, and because of its natural condition, the alteration of the external spatial configuration in Tianao village relates to its surrounding ecotope. The fishing village is dominated by forest, and the habitat area is in the southeast. The central area is mountainous, where few people live. In the 1960s, there were few villagers in Tianao village, and their buildings were concentrated in the southeast near the shore. Lingyin Temple, in the central peak, was built in 943. It has long been the center of spirituality for the locals. In 2000, owing to the sea reclamation, the habitat area was gradually moved to the shore. The temple was developed as a scenic spot, and more people tended to build houses and start businesses around it. Currently, because the shore is occupied with buildings, most new buildings are built in the northeast, inland, which has destroyed the forest. Forest and shores around the central area have shrunk (Figure 6).

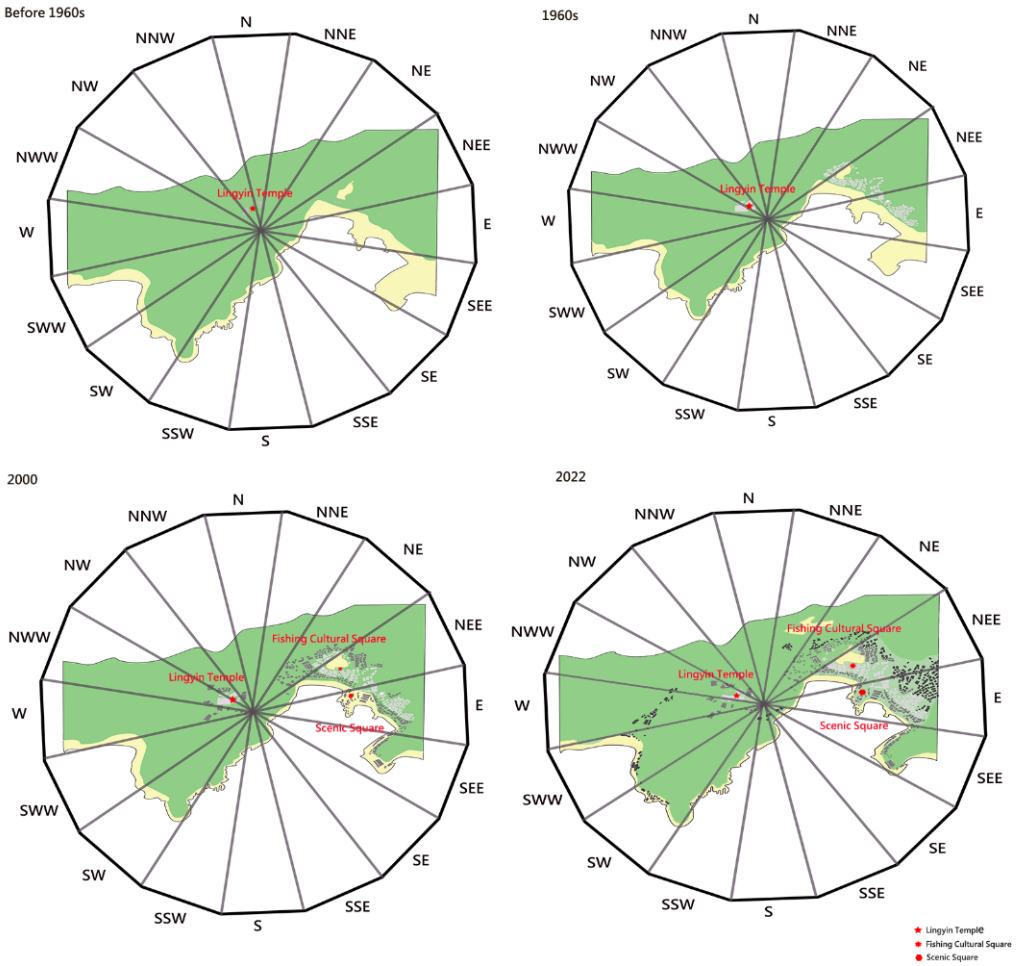

Figure 6. External configuration alterations of Tianao village.

4.2. Alterations of Internal Configurations at Two Fishing Villages

4.2.1. Jinshanzui Village

In the first phase (Figure 7 and Table 1), the global integration of Jinshanzui village was from 1.350 to 3.948, and its average was 2.553. Its local integration was from 1.629 to 6.723, and its average was 4.590. Its intelligence was 0.606. The highest integration was

observed in the south-central coastal area, and the lowest integration was located in the northeast and northwest areas. The coordination of the central and northeast areas was low and formed a small independent space, while the southern coastal area was high and tended to be open. The control value was from 0.047 to 0.2, and its average was 0.997. The highest connectivity was at the border of the village. The mean depth to the Historical District was 2.178. Its surroundings were accessible, but the accessibility of the northwest area needed to improve.

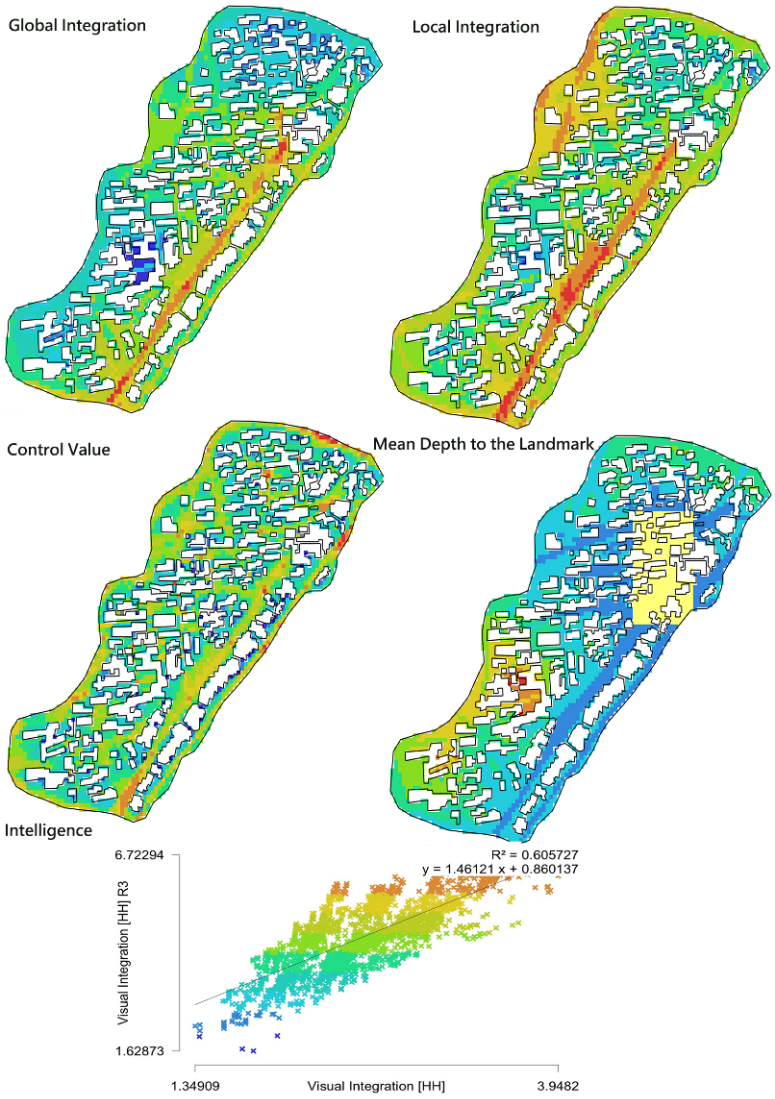

Figure 7. Spatial analysis of Jinshanzui village in the 1960s.

In the second phase (Figure 8 and Table 1), the global integration of Jinshanzui village was from 0.898 to 4.721, and its average was 2.896. The local integration was from 0.556 to 6.686, and its average was 4.552. Its intelligence was 0.818. The highest integration was observed in the north and southwest inland, and the lowest integration was in the central area. The local integration was higher than the global integration in the south area and formed an independent space. There was a small public space in the south with high integration and coordination. The control value ranged from 0.096 to 2.697, and its average was 1.008. Its connectivity was low, but the north was better connected than the south. The mean depth to the Historical District was 2.791, while the accessibility in the north and the east decreased inland.

Table 1. Statistics for variables of Jinshanzui village (unit: step).

Variables	1960s	2000	2022
Global Integration			
Average	2.553	2.896	4.982
Minimum	1.350	0.898	1.204
Maximum	3.948	4.721	7.996
Std. Dev.	0.456	0.691	1.477
Local Integration			
Average	4.590	4.552	6.200
Minimum	1.629	0.566	0.499
Maximum	6.723	6.686	10.288
Std. Dev.	0.856	1.050	1.944
Intelligence	0.606	0.818	0.947
Control Value			
Average	0.997	1.008	1.007
Minimum	0.047	0.096	0.047
Maximum	0.02	2.697	2.203
Std. Dev.	0.352	0.329	0.396
Mean Depth to the Landmark			
Average	2.178	2.791	2.963
Std. Dev.	1.352	0.964	0.962

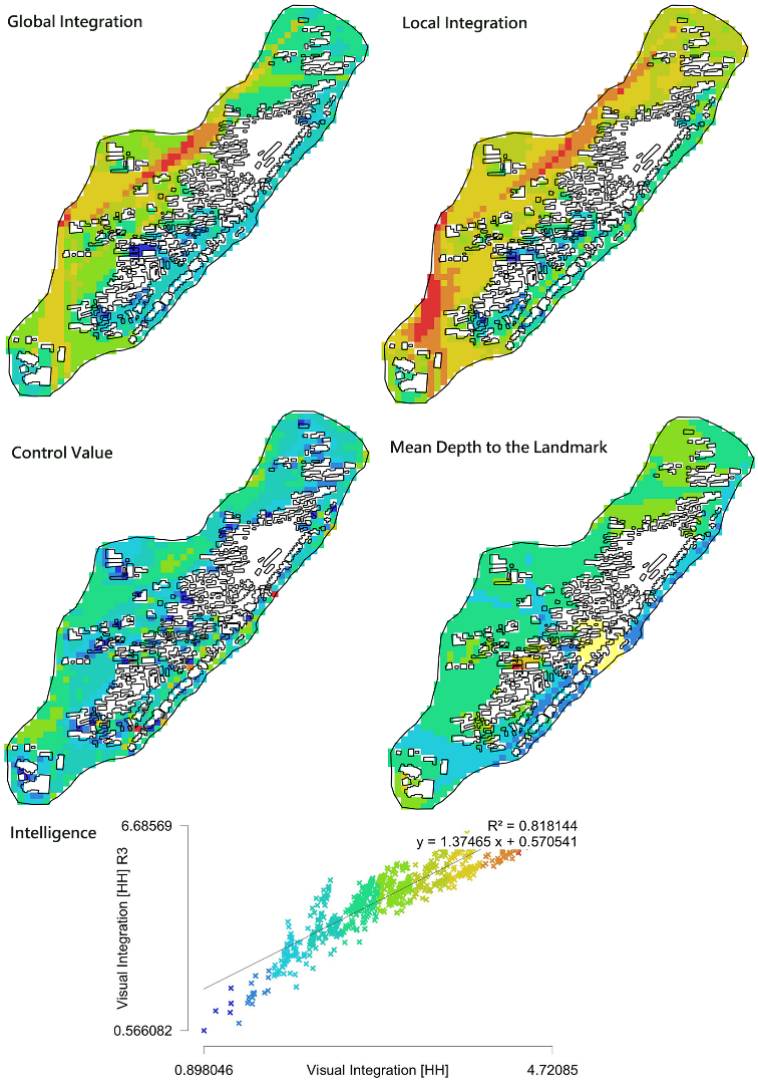

Figure 8. Spatial analysis of Jinshanzui village in 2000.

In the third phase (Figure 9 and Table 1), the global integration of Jinshanzui village was from 1.204 to 7.996, and its average was 4.982. Its local integration ranged from 0.499 to 10.288, and its average was 6.2. Its intelligence was 0.974. The highest integration was observed in the north, inland. The lowest integration was observed in the south coastal area and the central area. The local integration was lower than the global integration in the west and formed an independent space. The coordination of the Historical District and its surroundings and the newly developed area in the north was optimal. The control value was from 0.047 to 2.203, and its average was 1.007. The connectivity of the northern inland and the southern coastal areas was superior. The mean depth to the Historical District was 2.963; thus, it was accessible to its surroundings.

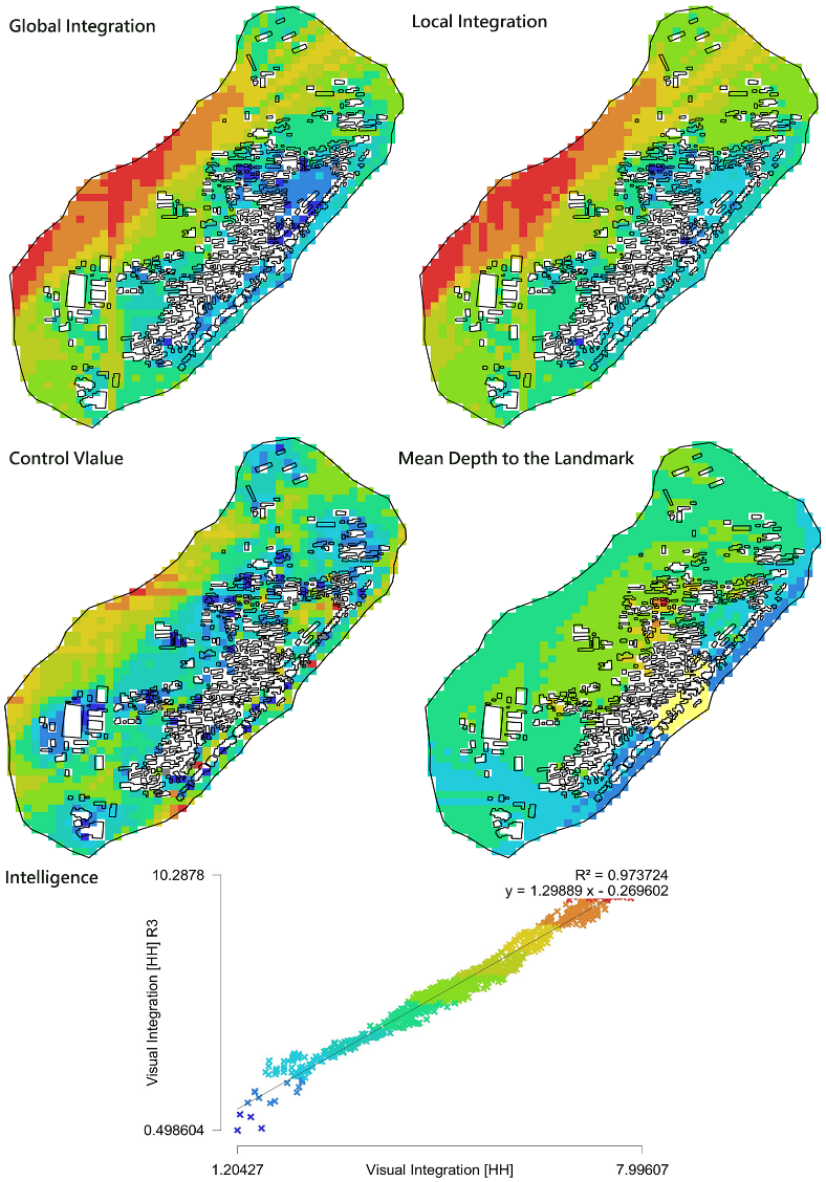

Figure 9. Spatial analysis of Jinshanzui village in 2022.

In all, the global integration of Jinshanzui village has gradually increased, which demonstrates that its accessibility and visibility are improving. The area with optimal accessibility and visibility has moved from the coastline to the central inland area. Its coordination has improved according to its intelligence. The average of its control value increased in the second phase but declined later, while its standard deviation increased gradually, demonstrating the imbalanced planning of the connectivity in the third phase. Al-

though the mean depth to the Historical District increased, its standard deviation declined, illustrating that it is currently well-planned.

4.2.2. Tianao Village

In the first phase (Figure 10 and Table 2), the global integration of Tianao village was from 3.145 to 30.661, and its average was 19.062. The local integration was from 3.724 to 30.813, and its average was 19.134. The intelligence was 1.000. The highest integration was observed in the north area, and the lowest integration was on the southeast coast. Thus, the coordination between the entire configuration and the partial space was optimal. The control value ranged from 0.008 to 1.482, and its average was 1. The highest connectivity was observed on the north coast. The mean depth to the Scenic Square was 1.488, while its accessibility was low.

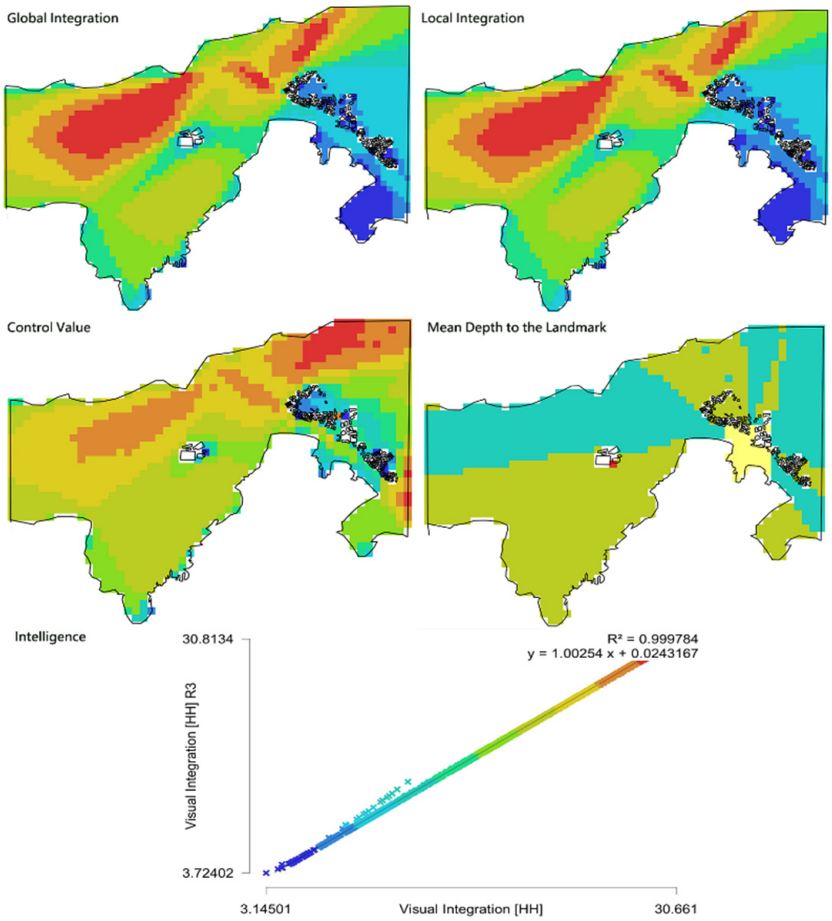

Figure 10. Spatial analysis of Tianao village in the 1960s.

In the second phase (Figure 11 and Table 2), the global integration of Tianao village ranged from 1.826 to 20.712, and its average was 11.927. The local integration was from 1.113 to 25.079, and its average was 13.920. The intelligence was 0.969. The highest integration was observed in the west coastline, and the lowest was in the southeast area. The central and the northwest areas had optimal coordination. The control value ranged from 0.019 to 2.187, and its average was 1.001. The highest connectivity was on the north coast. The mean depth to the Scenic Square was 2.532; thus, its accessibility decreased.

Table 2. Statistics for variables of Tianao village (unit: step).

Variables	1960s	2000	2022
Global Integration			
Average	19.062	11.927	4.375
Minimum	3.145	1.826	0.502
Maximum	30.661	20.712	6.391
Std. Dev.	6.760	4.229	1.273
Local Integration			
Average	19.134	13.920	9.400
Minimum	3.724	1.113	0.499
Maximum	30.813	25.079	21.001
Std. Dev.	6.778	5.223	3.252
Intelligence	1.000	0.969	0.658
Control Value			
Average	1.000	1.001	1.010
Minimum	0.008	0.019	0.024
Maximum	1483	2.187	2.783
Std. Dev.	0.224	0.264	0.290
Mean Depth to the Landmark			
Average	1.488	2.532	2.407
Std. Dev.	0.554	0.613	0.890

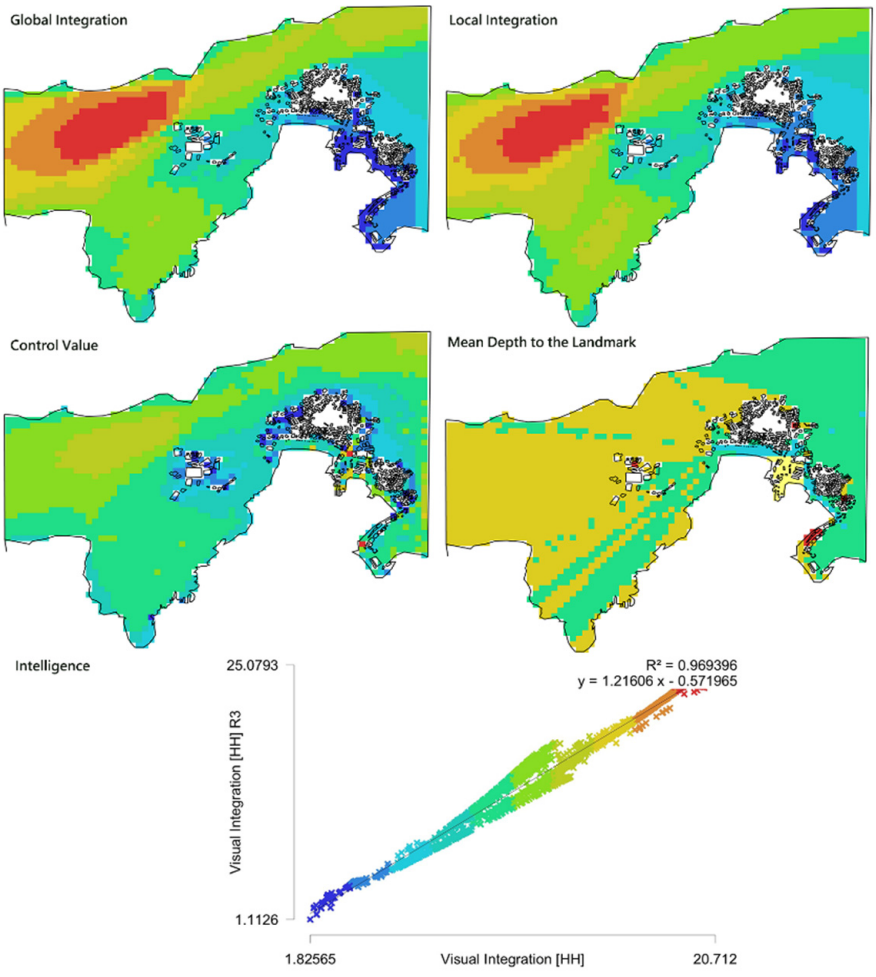

Figure 11. Spatial analysis of Tianao village in 2000.

In the third phase (Figure 12 and Table 2), the global integration was from 0.502 to 6.391, and its average was 4.375. The local integration ranged from 0.499 to 21.001, and its

average was 9.400. The intelligence was 0.658. The highest integration was observed in the western mountain and the coastal area, and the lowest was in the eastern area. The local integration on the northeast coast was higher than its global integration and it formed an independent space. The eastern area had high global integration and became an open space. The control value ranged from 0.024 to 2.783, and its average was 1.010. The connectivity in this village was inferior. The mean depth to the Scenic Square was 2.407, and high accessibility was observed in the southeast area.

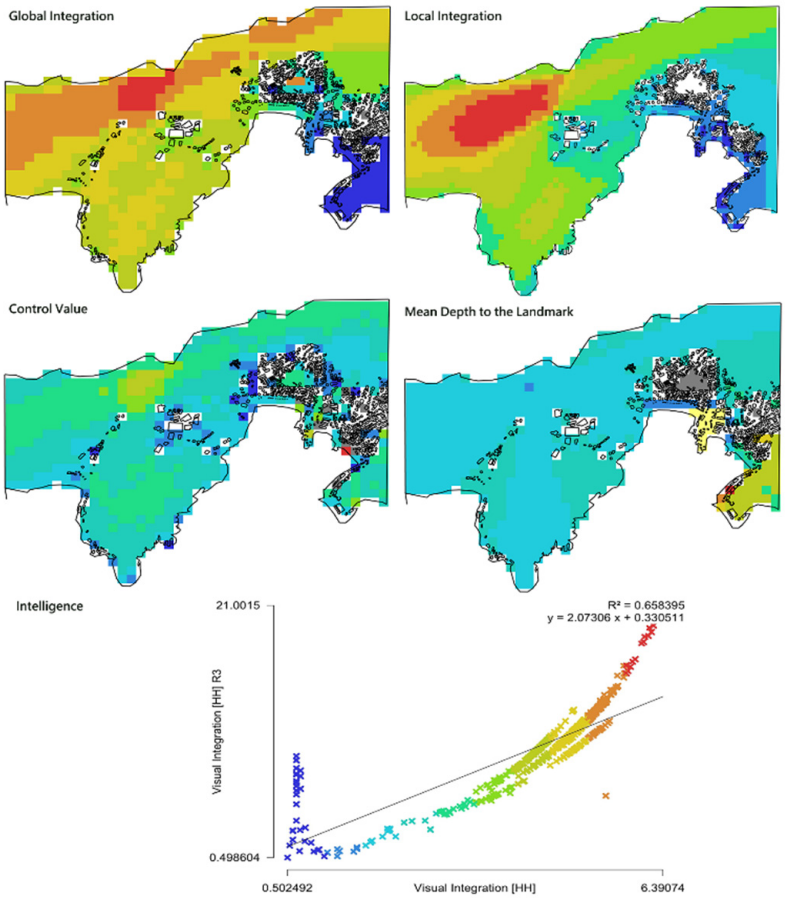

Figure 12. Spatial analysis of Tianao village in 2022.

In all, the global integration and the intelligence of Tianao village have declined gradually, demonstrating its decreased accessibility and visibility. Several independent spaces have been formed, and the connection between the entire space and the partial space has weakened. The increase in the control value and the mean depth to the Scenic Square demonstrate the improved connectivity and accessibility, in particular of the Square.

5. Discussion

5.1. Patterns of the Historic Rural Landscape

According to the analysis above, there are two patterns of a historic rural landscape: production-led patterns and ecology-led patterns. The alteration of the historic landscape in Jinshanzui village has a significant impact on its production function. Its internal spatial configuration was changed according to its functional alterations. Thus, it transformed from a tourist destination to a multifunctional village, integrating living, industry, tourism, and research. Tianao village followed an ecology-led pattern with a massive impact on its ecological function. Tianao village has developed tourism, which influenced its environment, particularly its shore and forest. However, the two villages preserved their local culture and presented it through various activities and tangible decorations.

5.1.1. Production-Led Historic Rural Landscape: Jinshanzui Village

Jinshanzui village followed the production-led pattern. Thus, the alteration of its historic landscape had little influence on its ecological function and was related to its external configuration. Its external spatial configuration was altered with its coastline, which was formed in the Qing Dynasty and was shrunk after the 1980s due to the rapid development of the fishery and buildings. Following this, its coastline has been maintained until now. However, its ecotope had a slight influence because there has been little ecological land in the village since the first phase.

However, its production function has been influenced significantly and is dominantly reflected through its spatial functions. In the 1960s, buildings in the village were mainly residential rather than commercial or public. The residential buildings were centered in the Historical District and developed in an axial pattern to the northwest and the southeast. Most residential areas are located in quiet areas with high local integration. In 2000, the spatial configuration of Jinshanzui village, centered around the Historical District, was clearer. Residential buildings increased dramatically and formed a small public space for villagers to entertain. Business started to develop in the Historical District, owing to the development of tourism. The government built the Teahouse, Battery, and Fishery Museum and revitalized an old well in the north of the district. Commercial areas also formed along the south coast. These areas had high integration and were open to the public. The residential area was located in a quiet place with high local integration. More people were attracted for a short stay due to its featured decorations.

With the recession of the fishery, the village sought transformation. The government reconstructed the northwest area of the village to kick-start the industry. This attracted scholars for research and professionals for their entrepreneurship. This strategy also improved the cultural need in the village, and many designers started studios in the area. These independent cultural spaces were formed in the industrial area, with optimal accessibility, visibility, and connectivity (Figure 13).

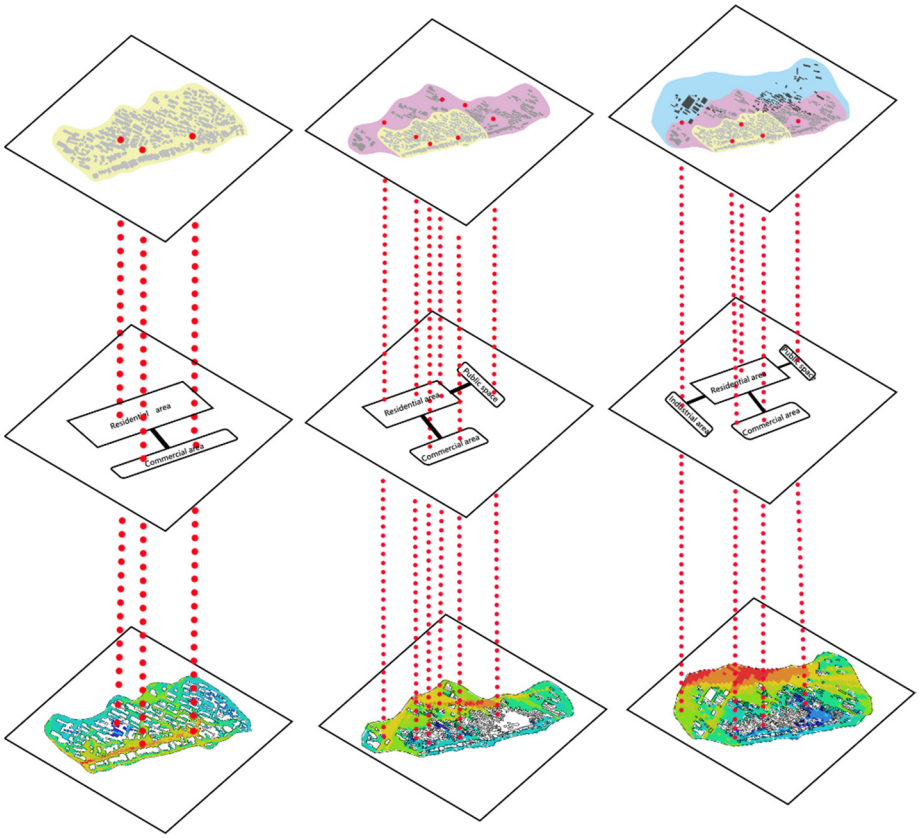

Figure 13. Alteration of Jinshanzui village.

In addition, the living function has also been impacted in Jinshanzui village. This function relates to daily lives and traditions. People's daily lives have been preserved since the 1960s, such as the worship of Mazu before and after the annual flood season. Traditional festivals reflecting the fishing culture, such as Buddhist Day and Zhonghe Day, have been, and are even still, held. After 2000, tourism started to develop. The government invited developers to hold some fishing-related cultural activities, including Fishing Cultural Day and Flower Day, to attract tourists. These activities were predominantly held in public spaces in the residential or the western public areas, with superior accessibility and visibility. A unique historic landscape with a fishing cultural connotation has been gradually formed (Figure 14).

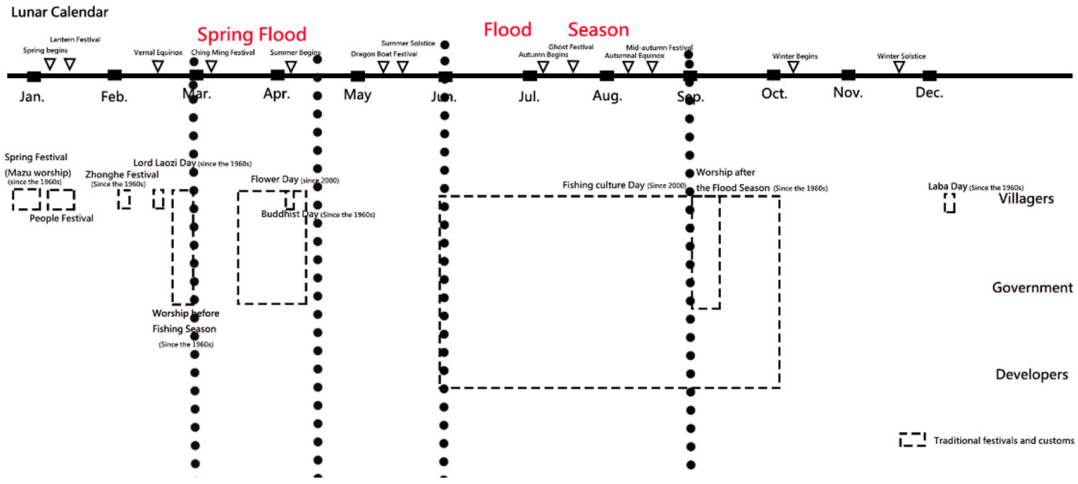

Figure 14. Lives at Jinshanzui village.

5.1.2. Ecology-Led Historic Rural Landscape: Tianao Village

Compared with Jinshanzui village, the alteration of the historic landscape in Tianao village has had a significant influence on its ecological function. This is because its villagers mainly lived for the fishery, and the function has been transforming towards tourism since the second phase. The village is located on an island surrounded by forest, with rich natural resources. However, its traffic is inconvenient; thus, the alteration of its historic landscape has had little influence on its production function. It also has significant cultural value and has been preserved since the second phase, which has a massive impact on its living function.

The ecological function in Tianao village is related to the relationship between its external spatial configurations and its ecotope. Tianao village faces the sea on the north and the south sides and is dominantly occupied by forest. The living area is located in the southeast and southwest areas. In the 1960s, there were few villagers in the village, and buildings were concentrated in the southeast at a distance from the coast. The western part of the village was dominantly forest. Lingyin Temple was at the central peak of the village. Since 2000, tourism has developed, and the population has accelerated. The living area has extended to the north coast and the northeast inland. The temple was developed as a scenic spot; thus, the number of buildings surrounding it increased and the forest declined. Currently, buildings increased, and the residential area continued to extend to the south shore and the northeast inland. The western area was developed towards the south shore. The forest in the north and the east decreased dramatically.

The production function in Tianao village was predominantly for residents, and the public space was concentrated in the southeast of the residential area, used for exchange, business, worship activities, and entertainment. These buildings were independent spaces with low global integration. In the second phase, due to the development of tourism, the population and the number of buildings in the village accelerated. The buildings were extended to the south coast and the north inland and formed various functions. The

government set the Scenic Square at the shore and the Fishing Cultural Square in the public space of the residential area, equipped with fishing boats, appliances, and statues, which reflected the daily lives of villagers and gave visitors a valuable opportunity to experience fishing culture. These places were located in open space with high integration and optimal accessibility and visibility. The old temple was revitalized as a scenic spot, which encouraged villagers to start shops and promote homestays and visitors to go sightseeing. Its integration improved as well (Figure 15).

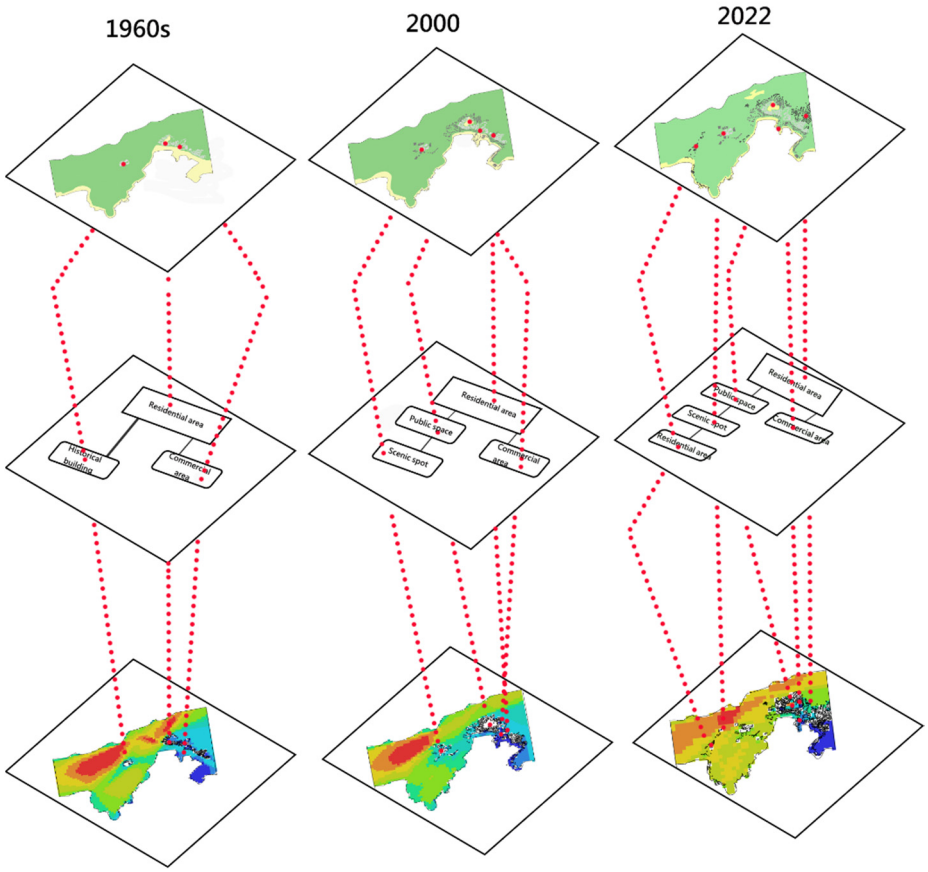

Figure 15. Alteration of Tianao village.

From the perspective of living function, villagers at Tianao village have their own daily lives and traditions, such as sea worship, ceremonies before the flood season, fairs at night, and particular worship. Since Lingyin Temple has been the spiritual place for villagers and the Avalokiteshvara is enshrined in the temple, the worship of Avalokiteshvara has long been a typical activity in Tianao village. Since 2000, due to the development of tourism, the government has cooperated with developers and the locals to hold some celebrations and fishing-cultural festivals, including Xieyang Day and sports events. These activities are often held at the Fishing Cultural Square and Scenic Square to attract more visitors (Figure 16). They form unique intangible features and have become an essential part of the historic landscape of Tianao village.

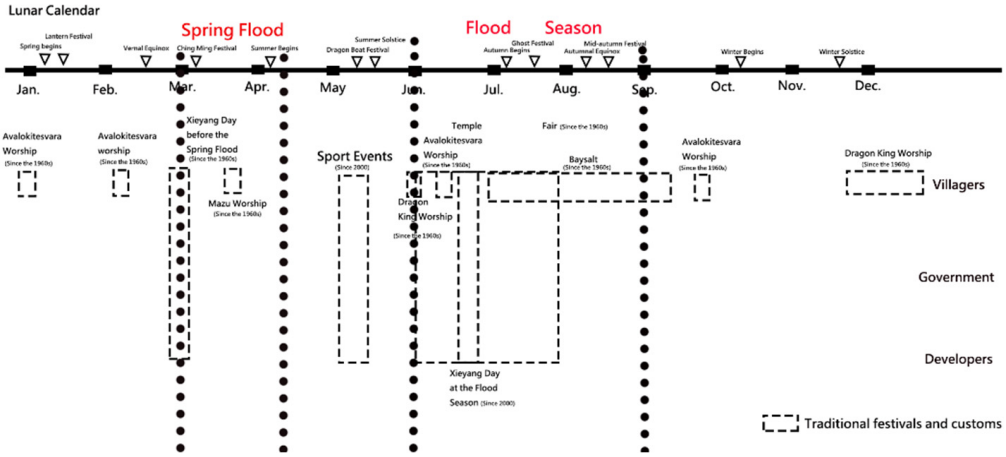

Figure 16. Lives at Tianao village.

5.2. Mechanism of the Alteration of the Rural Landscape in the Fishing Villages

5.2.1. Ecological Elements

The spatial configuration of fishing villages has been limited by geographical conditions since they were formed. Regarding Jinshanzui village, the water from the upper reaches of Hangzhou Bay brought plenty of bait for the fish and reduced the salt content of the East China Sea, making it more suitable for offshore fish to live there [56]. Consequently, almost every spring and autumn, large quantities of fish and shrimp moved to Hangzhou Bay and formed a huge fishing ground [56]. It was not until the 1960s that people came to this place and found captured fish. Thus, they settled there, and the fishing village was formed. In 2000, the population in Jinshanzui village increased, but there was not enough space along the shore for everyone to live. They expanded into the northwest and formed the current layout.

The influence of ecological elements mostly related to site selection and expansion. As opposed to in Jinshanzui village, most of the land in Tianao village is located on highland. Thus, its habitat area was selected to be in the southeast valley. In approximately 2000, the government decided to develop tourism and revitalized the highland in the center of the village into a scenic spot [35]. It promoted the establishment of its surrounding residential area. The number of residential buildings increased dramatically at that time, and they were expanded to the surroundings or the northeast, owing to the landform.

5.2.2. Production Elements

At first, villagers lived for the fishery. With the improvement of their conditions and techniques, the fishery developed. Unique fishing culture attracted many people to visit, and the government decided to develop the tourism industry. However, with the increase in visitors, pollution in the villages was severe. The development of the fishery damaged the water, and overfishing accelerated the recession of the fishery. With this, these villagers found it hard to maintain their lives and began to seek transformation. Thus, their space was developed into various patterns.

In Jinshanzui village in the 1960s, the fishermen were dominantly working at the shore. They had to wait for the ebb and capture the fish on the beach [33]. Their houses were built at the beach, facing the sea. Streets in the village were narrow with severe pollution and inferior accessibility and visibility (Figure 17). The western inland had high integration but was less developed. After the liberation in Zhoushan in the 1980s, pirates were captured. The government made mutual-aid boats and started fishing co-operatives. The fisherman could now work on the sea, and it took only 10 years for the village to realize mechanized sailing, which kick-started the pelagic fishery [33]. Their lives improved, although their living space was still narrow. Up until the 21st century, the government developed tourism and aimed to redecorate the village with fishing culture. They built

museums and developed businesses in the Historical District of the village. They also built public space in residential areas to entertain people. After 2010, the fishery recessed and old buildings needed renewal; thus, the village sought transformation. The fisherman abandoned fishing for related industries, including ocean transportation, tourism, and cultural and creative design. The government aimed to develop relevant industries and invited scholars to plan the village. These industries were set in open spaces in the northwest of the village, which also improved the village's integration. Although these social groups can provide financial support, it was inevitable that the village would be commercialized to some extent.

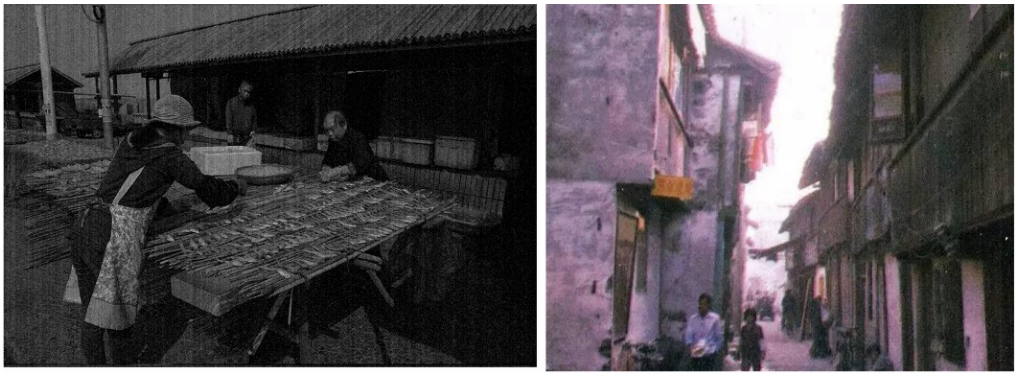

Figure 17. Jinshanzui village in the 1960s.

The function of Tianao village was predominantly related to living at first. Residents chose to live along the shore and capture fish. After 2000, visitors were attracted by the fishing culture [35], and the inhabitants found business opportunities related to this tourism. They adapted their houses or built new ones as homestays, which damaged the spatial configuration and planning of the village. The government issued a project, named the Beautiful Island Project, to improve this condition [57]. The government revitalized the village systemically, and the old temple was developed as a scenic spot and attracted people to start offering homestays. The residential shore was revitalized into a Scenic Square. The public space in the residential area was revitalized into a sightseeing square decorated with fishing culture. The street became wide and clean. The revitalization divided the village into two parts through districts. The sightseeing part received decoration related to fishing culture, and the residential area with low integration was planned as a quiet and independent place (Figure 18). However, after 2010, most buildings in the village needed to be revitalized. Design styles of homestays were similar. The tourism industry in this village thus lacks creation. The overcommercialization of the village distracts from the spatial configuration and reduces the attraction of the village. In 2020, the government issued the fishing-ban institution [58], which influenced the development of the fishery in Tianao village. The village needed transformation.

5.2.3. Living Elements

The influence of living elements on alterations of the landscape of the fishing villages was mostly related to the alteration of subjective participation. In the 1960s, the subjects of Jinshanzui village were fishermen, and they could capture the fish on the shore. Their tools and techniques were not mature; thus, they captured few fish and lived a hard life. Most of their buildings were built near the shore within a narrow district. After 2000, the government developed the tourism industry, and inhabitants participated in tourism guided by the government [59]. To develop and present the local fishing culture, most restaurants and homestays were built in the Historical District, which formed the open commercial space and residential area and attracted many visitors. After 2010, the government invited academic institutions to develop the industry [58]. These institutions started enterprises in the northwest area, and some designers started their studios in

the Historical District. This added complexity to the space in the village and enhanced its vitality.

Figure 18. Homestays at Tianao villages in 2022.

The development of Tianao village has tended to follow a top-down pattern. After 2000, inhabitants found business opportunities owing to the increase in visitors to the village, and most of them chose to start relevant businesses and homestays [59]. The planning and management of Tianao village were destroyed. Thus, the government began to rebuild these plans through the Beautiful Island Project. The government encouraged inhabitants to develop the industrial chain of the fishery. With the development of these industries, inhabitants gained a lot of benefits and attracted many outsiders who came there for homestays. Thus, the number of the homestays increased. These homestays lacked local features and damaged previous planning. After 2010, the fishing ban policy disconnected the fishery and other industries of the village. Most of buildings in the village needed to be revitalized. The number of visitors was reduced, and the tourism sector was damaged. Many young people moved to the city. Middle-aged people were forced to give up their fishery and went to the city to work and support their families [57]. A large number of elderly people continued to stay in the village, which hindered its development to some extent (Table 3).

Table 3. Alterations of subjective participation in two villages.

Villages	1960s	2000	2022
Jinshanzui village	Inhabitants	The government, visitors, and inhabitants	The government, the inhabitants, visitors, the academics, social groups
Tianao village	The government	The government and inhabitants	The government, inhabitants, and visitors

5.2.4. Mechanism of the Alteration of the Historic Landscape of the Fishing Villages

This study built the alteration mechanism according to the analysis above (Figure 17). The alteration of historic landscapes of fishing villages has been influenced by ecology, pro-

duction, and lives. The ecological elements include landform and ecotope. The production elements include the influence of the production transformation on the historical landscape. The living elements include the alterations of subjective participation and the influence of cultural connotation.

Production-led pattern: production and living elements were the main driving forces. The production transformation significantly impacted the internal spatial configuration and spatial functions. Various subjective participation and the unique fishing culture also influenced the alteration of historic landscapes of the fishing village. Ecological elements were a minor driving force. The landform had an impact on site selection and expansion of the village.

Ecology-led pattern: ecological and living elements were major driving forces. The landform and ecotope impacted site selection, expansion, and production space. The production element was a minor driving force and influenced the internal spatial configuration and spatial function. In addition, the village formed a pattern of a historic landscape influenced by living elements (Figure 19).

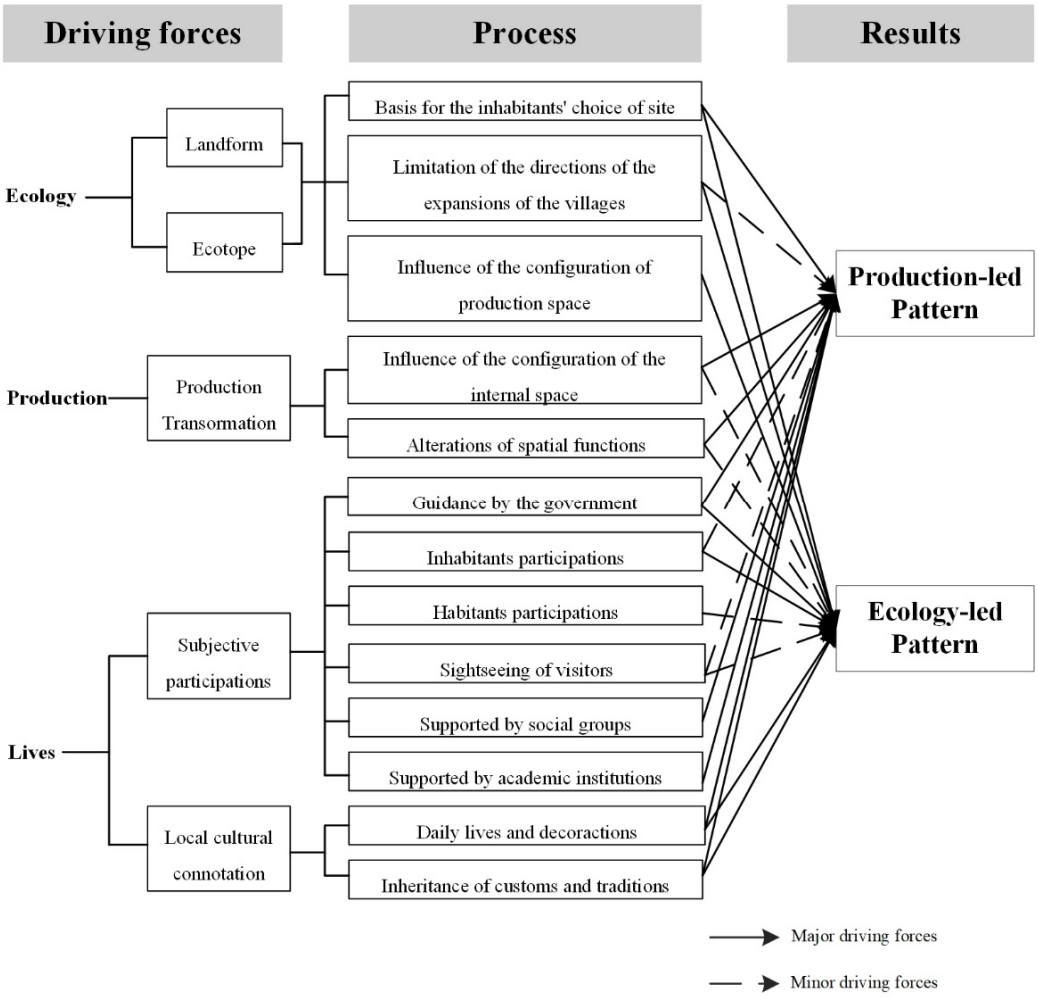

Figure 19. Mechanisms of the historic rural landscape.

5.3. Implications

To achieve better development and preservation of historic rural landscapes, some implications are presented:

1. Production-led pattern: spatial configuration and functions need to cooperate with the development of the production method. The production is altered with time and modern needs. Various production methods have different needs. For example, the

fishery needs to be close to the raw materials; thus, sites were selected along the shore. Tourism needs to attract people, and a place with optimal accessibility and visibility tends to gather people. Thus, this type of space is suitable for tourism. The newly developed industry needs certain techniques and convenient traffic. A place with high intelligence and local integration tends to be accessible, independent, and coordinated with the surroundings, which suits the newly developed industry. A place with high local integration suits a residential area. The alteration of historic rural landscapes needs various types of subjective participation. Although the government takes the dominant role, the participation of social groups, the public, and academic institutions is also significant. Cultural connotation is the basis of the alterations of historic rural landscapes. The inheritance of culture has various methods, such as inheriting rural culture through decorations and activities in public space with optimal visibility.

2. Ecology-led pattern: This relates to maintaining harmony between the natural environment and habitat areas in villages. It is important to ensure that the new landscape cannot damage the original ecology and that the ecological maintenance cannot damage the historic landscape. For ecology-led historic rural landscapes, ecological function plays an essential role in its alterations. When conserving the historic rural landscape, meeting modern needs also needs to be emphasized. The unique historical rural landscape can be displayed by decorating buildings and public spaces, such as fishing paintings on the walls of buildings and the fishing boats in the square of Tianao village. These decorations can evoke the identity of villagers and enhance their understanding of the village.

6. Conclusions

Prior work has analyzed the patterns of historic rural landscape alterations based on the landscape multifunctional theory. The outcome of this analysis validates different patterns of the historic rural landscape from the perspectives of ecology, production, and lives, both diachronically and synchronically. Production elements were major driving forces of the production-led alterations of historic rural landscapes. In the process of production transformation, the internal spatial configuration and functions were altered. The fishery and its relevant industries started on the shore, where they were near to the raw materials and had open space. The commercialization and tourism industries started in open spaces with optimal accessibility and visibility. Residential areas were located in independent spaces, which were quiet and suitable for living. Ecological elements were minor driving forces and impacted the shore and external spatial configuration. The major driving forces of the ecological pattern of historic rural landscape change were ecological elements. The surrounding environment and landform can influence site selection, external spatial configuration, and internal production function. The production elements were minor driving forces because production transformation merely influenced the habitat area. Most habitat areas were concentrated on the valley and the shore. With the development of tourism, habitat areas with high global integration were revitalized into public spaces. The village was also divided into tourist and residential areas. Moreover, the historic rural landscape was developed from a space with single production to a complex space with many production types and various results. The living element influenced the two patterns of the historic rural landscape, which can be regarded as the basic driving forces. The alterations of the two patterns of historic rural landscape were related to their cultural connotation and were formed by various subjective participations.

In all, this comprehensive analysis, as a systematic approach, helps to support the validation of the interaction among people, society, and ecology during the alteration of the historic rural landscape, analyze the physical alterations, and mark the necessity of intangible elements and subjective participation in the alteration. It also proves the altered mechanism for the alterations of historic rural landscapes, and implications are also proposed afterward, which provide a new perspective for future research. However, this article is at its primary stage. Future work should therefore include detailing the analysis

and the application of other techniques, in order to enhance our understanding of the contexts of the historic rural landscape.

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