sustainability

MDPI

Article

Construction of Security Pattern for Historical Districts in Cultural Landscape Based on MCR Model: A Case Study of Chaozong Street, Changsha City

Zihan Chen [1,*], Su Liu [1], Wei Liao [2] and Junxue Zhang [3]

[1] School of Architecture and Planning, Hunan University, Changsha 410082, China; liusu001@163.com
[2] Institute of Sustainable Heritage, University College London, Gower Street, London WC1E 6BT, UK; wei.liao.21@ucl.ac.uk
[3] School of Civil Engineering and Architecture, Jiangsu University of Science and Technology, Zhenjiang 212100, China; zjx2021@just.edu.cn
* Correspondence: zihanchen1228@163.com

Abstract: This study aimed to establish a comprehensive and sustainable approach to the conservation of historical districts through the "Cultural Landscape Security Pattern" (CLSP) theory. Deploying this theory can penetrate limitations posed by physical and social-emotional factors, enabling a resilient framework which can coordinate long-term heritage protection with urbanization in a more sustainable manner. Chaozong Street in Changsha City, China, was taken as the locus of study, which was initiated by quantitatively analyzing and evaluating the cultural landscape. The ArcGIS spatial analysis and the minimum cumulative resistance (MCR) model were then considered to model different levels of CLSP. It was on this basis that corresponding regulations and development strategies were then proposed. The results from the study demonstrate that implementing CLSP in historic districts can construct a protective network over the districts, which can then guide the recovery of fragmented historical built environments, as well as ensure continuity of historical consciousness and integrity. In addition, in comparison with conventional protection planning methods, this method features greater flexibility and adaptability when considering and accounting for complex spatial issues in historic districts and provides a novel approach for similar studies.

Keywords: historical districts conservation; cultural landscape security pattern; MCR; resilient protective framework; sustainable development

Citation: Chen, Z.; Liu, S.; Liao, W.; Zhang, J. Construction of Security Pattern for Historical Districts in Cultural Landscape Based on MCR Model: A Case Study of Chaozong Street, Changsha City. *Sustainability* **2023**, *15*, 10619. https://doi.org/10.3390/su151310619

Academic Editors: Zhiqing Zhao, Qinglian Wang and Bocheng Zhang

Received: 31 May 2023
Revised: 28 June 2023
Accepted: 3 July 2023
Published: 5 July 2023

1. Introduction

Historical districts carry abundant significant and precious cultural heritages (CH), which have been preserved and inherited by people throughout a city's long-term development. Those CHs form the unique sense of local space and cultural identity, and are therefore crucial in boosting the district's vitality [1]. CH is composed of physical artefacts and intangible factors. Among them, the physical artefacts of CH mainly include monuments, old buildings, historic places, and other kinds of historic relics, while intangible factors typically refer to regional/local cultures and social customs formed based on spiritual beliefs or oral traditions. The intangible factors, combined with physical artefacts, represent and identify the uniqueness of society [2]. Therefore, the existence of historical districts not only strengthens urban identity and the residents' sense of community but also showcases the distinctive local characteristics [3,4]. In more recent decades, however, the spatial patterns and cultural linkages of many historic districts in China have been disrupted due to intense urban expansion and unsuitable land use. This then poses a significant threat to the security and integrity of the cultural environment [5]. In response to these threats, scholars have advanced various theories, such as "historic urban landscape", "historic character", and "urban-rural historical and cultural settlements" [6,7]. These theories have played an indispensable role in enhancing the overall protection of cultural

heritage. Notwithstanding these efforts, there remains an inadequate understanding of spatial relationships (spatial dependence), spatial structure (spatial heterogeneity), and the interaction between spatial elements [8]. It has been challenging for scholars to competently identify key landscape elements in historic districts and then determine an appropriate protection strategy. As a result, existing methods may fail to cope with the issues led by fragmented spatial systems and rigid protective regulations [9].

In recent years, Chinese Territorial Spatial Planning (CTSP) has emphasized the application of spatial theory, techniques, and research models in various disciplines. Identifying and comprehending the interaction between the elements of the heritage environment (in terms of time and space, function, and cultural connotation) from the perspective of "space" has been increasingly attractive to researchers in the area of heritage protection [10]. Based on CTSP alongside heritage protection theories, the scholar Wang proposed a "Cultural Landscape Security Pattern" (CLSP) stemming from the "Cultural Heritage Security Pattern" (a derivative of Yu's "Security Pattern" research) [11,12]. Compared with other protection theories, the CLSP goes beyond tangible physical environments and structures and integrates all tangible factors (physical artefacts like historic buildings, structures, relics, etc.) and intangible factors (spiritual beliefs, oral traditions, lifestyle, etc.) into one comprehensive framework. The "intangible factors" mentioned here primarily refer to spiritual values, including the sense of cultural identity and the evoked memory when people respond to the perceivable historical evidence [1]. Spiritual values are intrinsic motivators for the continuation and preservation of a place's cultural-historical features [13]. Therefore, they are crucial with regard to cultural diversity and sustainability, which can mitigate the threat posed by global homogenization [14]. Furthermore, this pattern simulates the interaction between the various patterns of landscape and its underlying cultural evolution and boosts an understanding of the inherent cultural linkages and spatial structures that have been formed via cultural dissemination [15].

CLSP has the ability to provide a more holistic, precise, and resilient protective framework to deal with a district's complex and prominent spatial contradictions, causing it to be a superior method. Its advantages and potential are clear in two respects: firstly, it architects a hierarchical protection network with improved connectivity. This rehabilitates and strengthens the spatial-temporal continuity of historic district landscape elements and reduces fragmentation and isolation. Secondly, CLSP outlines core cultural landscape elements and structures, which demonstrate the "inviolable protection boundary" for restricting urban expansion. The employment of CLSP can vastly reduce the indispensable area of buffer zones, which allows greater space for socio-economic development. Therefore, CLSP plays an essential role in easing the contradiction posed by heritage conservation and urban development and the intensive human–land oppositions, thus promoting sustainability in urban development [12].

At present, research on CLSP mainly focuses on applications at the urban–rural scale, whereas relevant studies on the local scale of heritage districts remain lacking. In order to fill this gap and verify the theory's viability and efficacy, this study implemented this analytical framework to model CLSP in Chaozong District, Changsha. Firstly, the landscape elements within the district were catalogued and geocoded before generating a new ArcMap, with these elements being assigned the value of "Resistance coefficient" (R). The Resistance Coefficient here represents the level of difficulty or ease with which different landscapes evoke people's internal perception or identification of the cultural aspects within the district as they navigate through it [16]. Then, the data were processed by the Minimum Cumulative Resistance (MCR) model to calculate the Cost Distance between each cultural landscape resource within the district. In the third phase, the Cost Distance values were levelled to form CLSP. Finally, through analyzing the modelled CLSP, it was discovered that the CLSP can establish more compact buffer zones as well as more efficient local and global corridors between different cultural landscape resources. The cultural landscape resources and their surroundings are no longer isolated but form a unified and systematic whole. Due to the consideration of people's emotional response towards landscape resources, CLSP is

more likely to enhance and sustain the sense of identity and memory in the district when applied in practice. Additionally, when compared to conventional protection planning methods, which categorize different regions as either "core protection zone, construction control zone, or style coordination zone", the well-structured spatial framework of CLSP can spare more flexible areas for urban development. With regard to all these findings, it is believed that the CLSP demonstrates superior potential for achieving the long-term sustainable development goals of historical district conservation and urbanization.

2. Research Area and Data

2.1. Overview of Research Area

The research site considered was the Chaozong district in Changsha, China, a famous cultural-historical community. It is favored for its geography (located in the core central urban area), and the continued stream of people visiting and settling has greatly propelled its local retail, hospitality, and accommodation industries (Figure 1). Until the 1980s, Chaozong was also the only way to access the Xiangjiang Wharf, where various freights were shipped and stored, which resulted in the establishment of warehouse facilities and freight transfer stations. In the 1990s, these warehouses were demolished and replaced with housing to serve as accommodation for staff and workers.

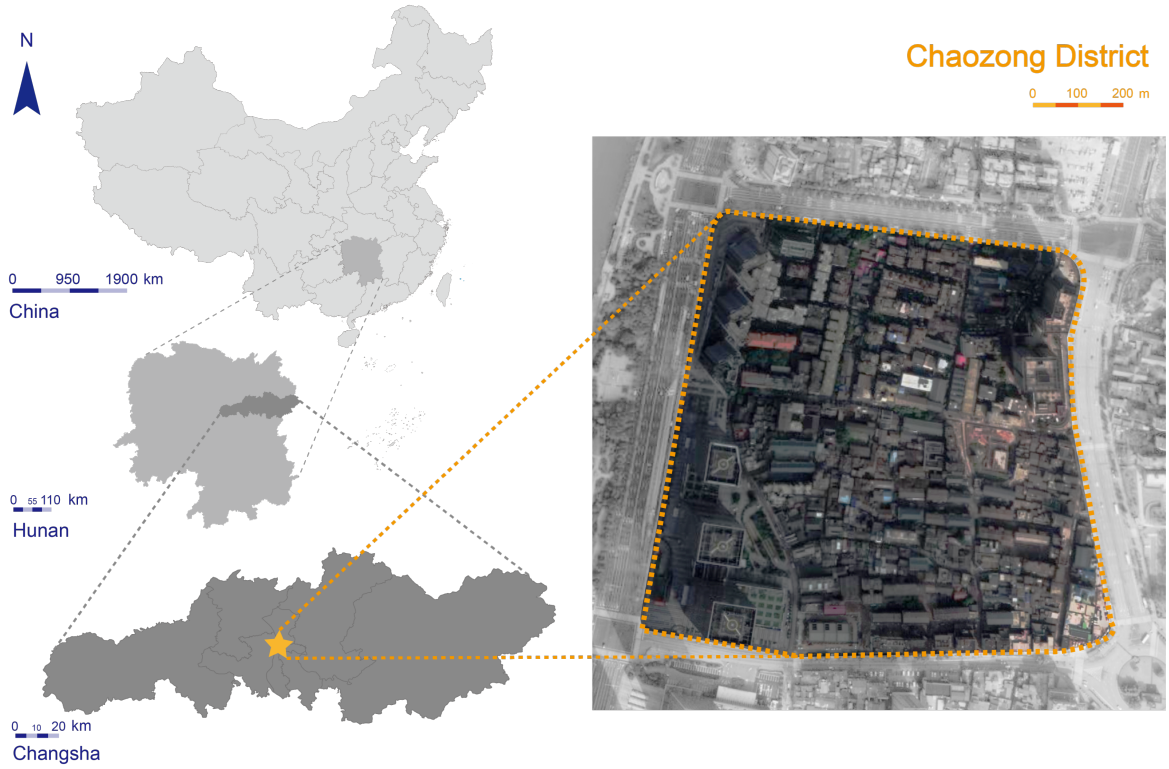

Figure 1. Location of research district.

Chaozong captures the vicissitudes of Changsha, presenting both the city's historical and cultural distinctive atmosphere, unique characteristics, and spirit of place. The district retains traditional streets alongside early 1900s historical architecture, during which building techniques and humanized spatial scale implementation differ from homogenized modern cities. A large number of heritage sites have been retained, such as the city walls built through different dynasties (including the Song, Yuan, and Ming dynasties) and the Shiwu School and Jiu Ruli Mansion, which were constructed in the first half of the 21st century. According to official literature, there are currently various immovable cultural relics still present, including three immovable, two provincial-level, and 10 municipal-level cultural relics in the district. The district's functions are varied and diversified, including

residential areas, cultural inheritance/preservation areas, a memorial to the Anti-Japanese War, as well as entertainment and leisure facilities. Despite the passage of time and changes, this district still preserves a wealth of historical buildings and cultural landscapes. However, as a result of rising urbanization, Chaozong's protection and development have been identified as urgent issues requiring resolution. Thus, the exploration and establishment of effective methods and pathways for preservation are of vital importance in order to enable a sustainable framework that balances urban development against heritage protection.

2.2. Data Collection and Processing

The data for this study were predominantly collected from five sources:

- The current land-use and land cover map (textual and vector files), provided by the municipal Natural Resources Planning Department of Changsha City;
- *Protection Plan for Cultural-Historic of Chaozong District* , provided by the Architectural Design Institute Changsha;
- The current cultural-heritage distribution, along with relevant plans (in CAD or textual formats), provided by the local Cultural Bureau;
- Relevant literature;
- Digital Elevation Model (in thirty-meter spatial resolution), collected from the Geospatial Data Cloud (http://www.gscloud.cn/ (accessed on 12 March 2023));
- Road data extracted from the Open Street Map (OSM).

In addition, the conversion, processing, and integration of vector data were accomplished by using ArcGIS (version 10.4) in order to establish a geographic information spatial database in accordance with the heritage's geological locations.

3. Research Theories and Methods

3.1. The Evolution of "Cultural Landscape Security Pattern"

The concept of 'security' considers the capability of maintaining stability within an expected maximum tolerance range and the reliability of preventing unpredicted damage [17]. 'Pattern' then refers to the internal structure of the system in the context of ecological landscape studies and it is presented as the spatial distribution and configuration of ecological or geographical factors [18].

In combining the two concepts, in 1995, Yu introduced the notion of "security pattern" (SP) in their ecological landscape research [10]. This unveiled the innate order and mechanism of the landscape system, which underpinned the maintenance and control of the ecological process [19]. Yu also identified the existence of specific positions of greater strategic importance than others in affecting certain processes. The MCR model developed by Knaapen can be used to analyze the latent spatial distribution of ecological processes, which identifies landscape ecological SPs and provides corresponding guidance and design to maintain ecological courses [20]. Subsequently, with the assistance of cutting-edge technologies such as neural network CA models [21], the MCR model has been applied to strengthen national ecological security [22–25], rational land use expansion [26,27], land use evaluation [28], and tourism development [29–32].

The concept of CLSP extends the principles and methods of SP by considering heritage conservation theory [12]. Indeed, the SP is a comprehensive pattern composed of multiple single patterns, including the ecological security pattern, the biological protection security pattern, the cultural heritage security pattern, and the recreation security pattern [26]. In 2017, Wang introduced the CLSP, a network system composed of key nodes, settings, and connections which carry historic, cultural, scientific, and aesthetic values. These factors are decisive in protecting and inheriting the cultural significance of landscapes [12]. Since 2020, scholars such as Guan and Wang have applied the CLSP theory to their empirical research relating to the protection plans of indigenous cultural landscapes and traditional villages [16,33]. Implementing CLSP in historical districts has helped identify the districts' heritage spatial patterns, such as their distribution characteristics, combination typologies, and spatial structures of historical elements. However, the research undertaken with this

theory is considered somewhat limited and it is therefore key that further exploration into the theory be carried out if it is to be justified in its applicability to spaces of different scales.

3.2. Elements and Structure of CLSP

Cultural landscapes are formed and evolve via anthropogenic activities in the natural environment, and they are updated and reinforced through the diffusion and transmission of culture [34,35]. This social process resembles the natural movement, migration, and evolution of biological species in the context of ecology [19,36]. By comparing the five elements of a typical ecological SP (the source, buffer zone, and link between sources, radiation pathways, and strategic points) to the cultural landscape [37], Yu asserts that the physical ingredients, constituting the historic environment alongside the channels connecting them, are fundamental to the Cultural Heritage Security Pattern (CHSP) [38]. Wang thus developed the CHSP through the lense of "cultural landscape" in conjunction with Forman's "patch-corridor-matrix" model and refined the SP [39]. Wang abstracted the constituent elements of the site and devised an SP model consisting of "nodes, backgrounds, and links" [12]. These are further explained as follows.

- Nodes: Nodes refer to heritage locations or areas that carry strategic significance, as is the case for "sources" in ecological security patterns [20]. These nodes play a critical role in the continuity and evolution of culture over time and the dissemination and substantiation of cultural information.
- Background: In both ecological and cultural landscape SPs, the background performs as a buffer zone to maintain the stability and safety of the "source", whereas, for ecological SP, the "source" typically refers to its surroundings, which are low in resistance to promoting species diffusion [19]. For CLSP, the sources considered are the nearby spaces of heritage sites [7]. They include both the material and immaterial cultural factors that carry culture and social consciousness [40,41].
- Link: In landscape ecology, any two landscapes that have a continuous corridor are considered to be connected [42]. Cultural heritage landscapes are characterized by interconnections, where various heritage sites are linked, though the strength of the links varies between spatial locations. The "interconnections" resemble the "corridors" of ecological SP, presented as channels that facilitate the cultural diffusion, dissemination, and perception of cultural landscapes. The channels can be embodied as tangible elements, such as roads or water systems, or intangible elements, such as social, cultural, emotional, and information spaces that center on connections [43].

3.3. The Construction Methods and Pathways

3.3.1. Construction Methods

In this study, a quantitative analysis was conducted by using ArcGIS as the primary tool to investigate the features of "nodes, backgrounds, and links" in CLSP. The key research methods include visualization of the nodes, spatial relationship analysis, and MCR simulation.

The visualization of nodes involves modelling and displaying the spatial data of heritage sources as maps for different analytical purposes. The spatial relationship investigation incorporates spatial overlapping and buffer zone analysis to reveal spatial relationships, distribution patterns, and characteristics of cultural landscape elements.

The MCR model is used to construct resistant planes by which the modelled corridors are generated dependently. Scholars have developed various algorithms to identify heritage corridors, including the MCR [44], Gravity Model [45], and Comprehensive Evaluation Indicators System [46]. When compared with conventional conceptual and mathematical models, the MCR model is more advantageous since it better simulates the nodes' inhibitory effects on spatial movement processes and can more effectively describe the interaction between spatial patterns and cultural dissemination. Thus, the MCR model was chosen to extrapolate the minimum resistant planes-the corridors-between "sources" in the districts in order to assess the corridor's spatial accessibility.

The formula for the Minimum Cumulative Resistance model is as follows:

$$MCR = f_{min} \sum_{j=n}^{i=m} (D_{ij} \times R_i). \quad (1)$$

MCR is the value of the minimum cumulative resistance. D_{ij} denotes the Euclidean distance from the node (source) j to the landscape i. R_i is the resistance coefficient, which is specific to the typology of landscape i. $\sum_{j=n}^{i=m}$ describes the cumulative resistance through all units between j and i [22,33]. f_{min} is a black-box function that calculates the least-cumulative resistance from any source to all of the points within the district, which also identifies the positive relationship between the MCR value and the distance or the R concerning different types of spots i.

3.3.2. Research Framework

Based on summarizing and reviewing the aforementioned studies [12,30,39], a research framework was established to construct and analyze CLSP in the Chaozong district via the following steps (Figure 2).

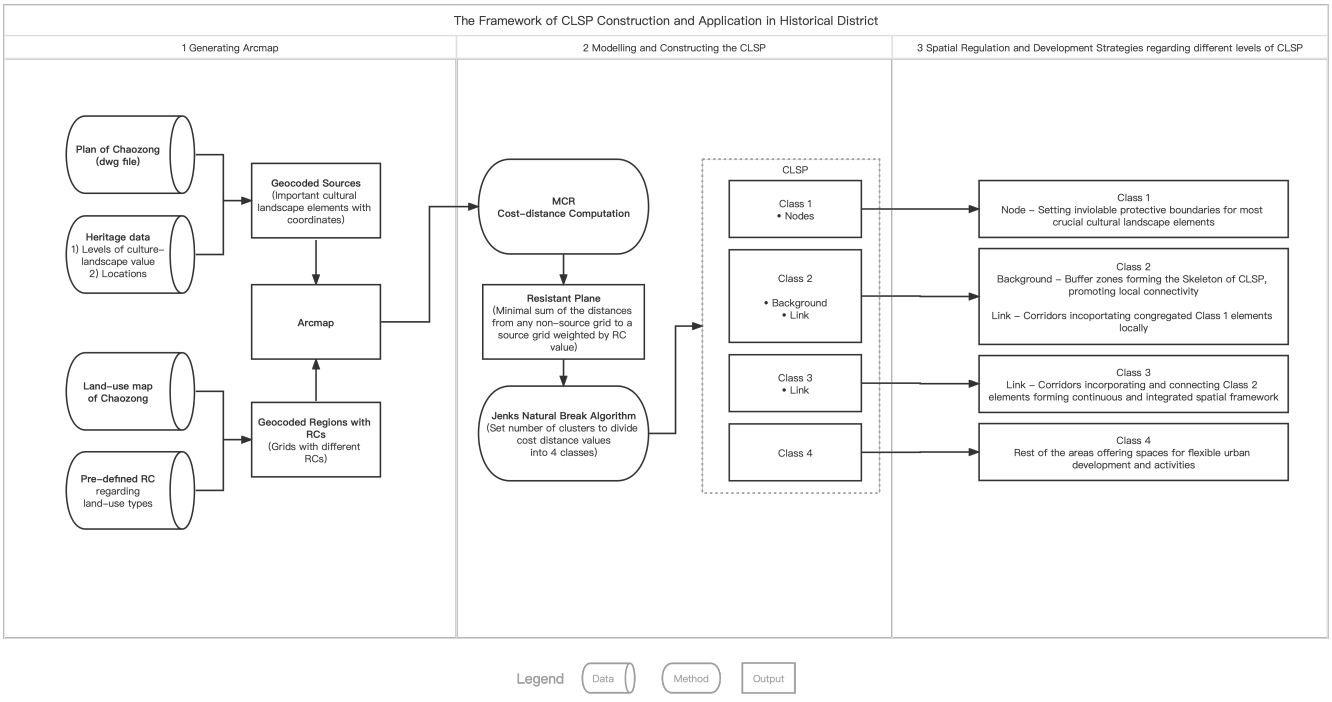

Figure 2. The framework of CLSP construction and application in the historical district.

- Identify "sources (or nodes)" (key heritage sites), which refer to heritage elements that play a critical role in shaping the historic environment and its inherent culture [47]. Usually, these heritage sources can be identified through related heritage literature, official statistics, and field studies. Then, these heritage sources were demonstrated spatially in ArcGIS and ranked and assigned values as per their different levels of importance for the primary estimation of the key spots in the SP;
- Define the resistance planes and heritage corridors—the "resistance plane" was used to determine the explicit corridors (such as roads and water systems) or implicit vital corridors which sustain local culture and historical consciousness;
- Architect CLSP for the district—promoted by the results of the abovementioned analysis and assessment, CLSP was then generated for the district. The different levels of SP can then be referenced in setting up spatial regulations for heritage protection.

4. Case Study

This study used MCR to simulate a person's perception of cultural landscape elements in Chaozong when travelling through its different paths and spaces. The linear zones resulting from the shortest distances between each "source" were projected as the potential cultural heritage experience corridor within the district. As to those areas with greater MCR values, the different levels of CLSP were marked ascendingly, suggesting tourists' increasingly restricted experience or perception towards its cultural heritage and value [48].

4.1. Identifying Cultural Landscape "Sources"

The cultural landscape consists of natural and cultural features, such as natural waterways, ancient trees, historic buildings, traditional residences, and inscriptions [49]. Through survey data, this research has discovered that Chaozong retains a variety of cultural heritage landscapes. These include a municipal-level heritage site, fourteen immovable cultural relics, twelve historic buildings, one ancient well, four monuments of historical significance, and forty-one ancient trees. Based on a value and importance analysis, experts have ranked the features into first, second, and third-level cultural landscape resources (Table 1). In addition, in accordance with land-use status and field research, the spatial positions of each cultural landscape source have been examined in detail (Figure 3).

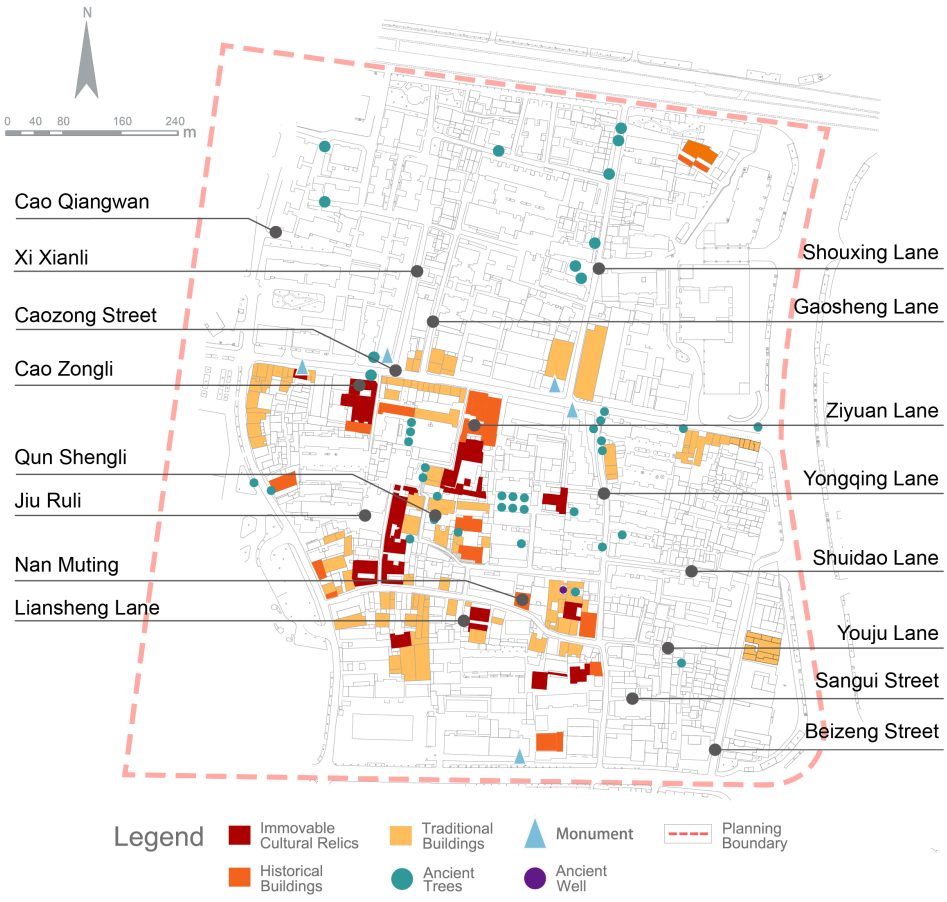

Figure 3. Spatial distribution of cultural landscape sources in Chaozong district.

Table 1. Sources of vital cultural landscape heritage in Chaozong Street.

Levels of Cultural Landscape Value	Heritage Typology	Resources	Amount
First Level	Major cultural and historical site	Jinjiu historical site	1
	Immovable cultural relics	Christian church, Former Residence of Chen Yunzhang, Changsha Warehouse Site, Air Defense Facility Site of Chaozong, hotels and theatres during the Republican-era, Residential House (No. 4, 33, 52, 54 and 85 Liansheng Street), Mansions (No. 2, 4 and 6 Jiuru Li), granite pavement of Chaozong	14
Second Level	Historical buildings	No. 70 and 118 Fuqing Street; No. 2, 18,35 and 60 Liansheng Street; No. 12 Qunsheng Street; No. 18 Nanmu Hall; No.2 Chaozong Li; No.13 Ziyuan Lane; No.4 Peiyuan Bridge; No.352 Zhongshan West Road	12
Third Level	Others	Former site of a publishing house, the monument of Qu Hongxi's former residence, ancient wells, traditional-feature buildings, ancient trees	-

As shown in Figure 3, the sources of Chaozong are primarily located in the southwest of the district. The three types of landscape resources (heritage sites, immovable cultural relics, and historic buildings) are generally evenly distributed, save for those concentrated in areas such as Chaozongli and Liansheng Street. Traditional features of buildings are dominantly situated around the above-mentioned sources in a focused and continuous pattern. In addition, the four historical monument sites are concentrated on both sides of Chaozong, and preserved ancient trees are aligned along Shouxing Street, Yongqing Lane, Ziyuan Lane, and Nanmu Hall. The field surveys have determined that the cultural landscape sources of Chaozong are currently in isolated and fragmented states. However, the relatively continuous traditional vernacular buildings around them promote connection and cultural perception continuity between sources to some extent.

4.2. Determining the Resistance Surface for Experiencing Cultural Landscapes

Resistant planes describe the limitations for individuals when perceiving the historical and cultural consciousness of sources (heritage sites) when travelling through the routes. The term indicates the spatial process of cultural dissemination. The different levels of MCR values refer to the ranked spatial connectivity between sources.

Typically, a person's perception of historical-cultural consciousness is influenced by spatial factors such as land cover type, topography (elevation and slope) [50], and linear distance (water, roads, commercial areas, residential areas) [51]. Heritage sites account for the largest focus of people's cultural perception, which naturally identifies the 'sources' most prominent value and function. Natural elements such as rivers, green spaces, recreation, and open spaces then follow as the next key to heritage sites. Despite being less culturally relevant, natural components help form a sense of continuity and completeness in cultural perception and the environment. In contrast, the presence of city roads, parking lots, and wastelands typically instils negative feelings which limit an enjoyable experience.

This study began by selecting the proper factors which underpin perceptive resistance, before then determining their associated resistance coefficients (R in Equation (1)) by reference to pre-defined R values as determined by experts [16,33] (Table 2). Then, simulations were executed in ArcGIS to obtain MCR values for sources within the district, in order to spatially model the resistant planes. The factors considered in this research were categorized into two classes (Figure 4).

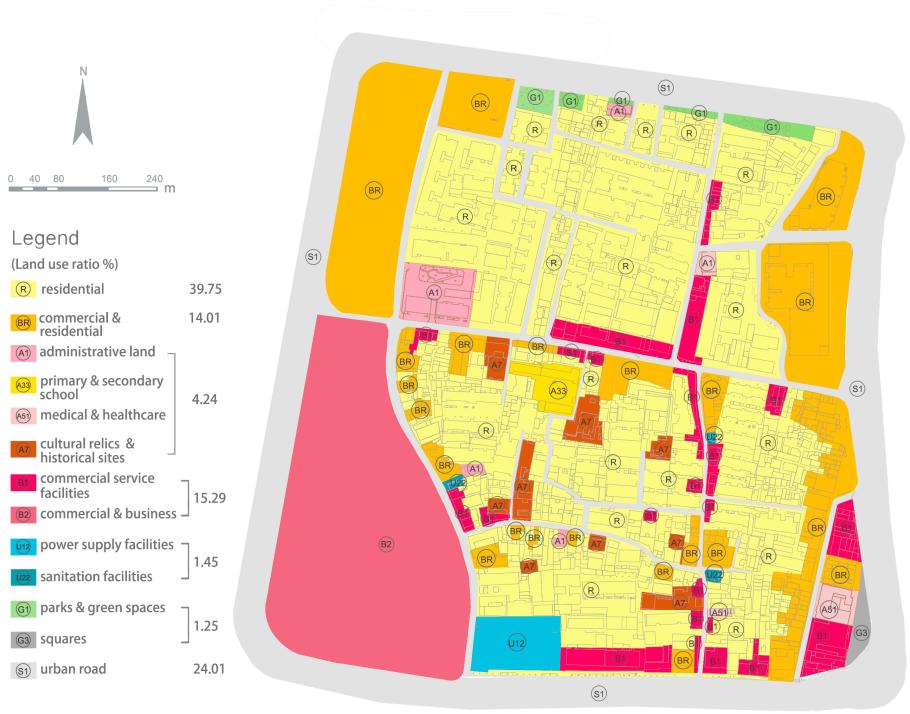

Figure 4. Current land-use status in Chaozong.

Table 2. Cultural landscape resistance factor and resistance coefficient.

Land-Use Type	Resistance Factor	Resistant Coefficient (0–300)	Raster Value
Roads and traffic facilities	Street, traditional granite material road	10	1
	Urban road	200	2
Green space, watering and squares	Parks and green spaces	10	3
	Ancient trees with cultural significance	0	4
	Squares	50	5
	Ancient well	0	6
Construction Land	Residential	50	7
	Commercial-residential	100	8
	Administrative office land	150	9
	Primary and secondary school	50	10
	Medical and healthcare land	150	11
	Cultural relics and historical sites	0	12
	Commercial service facilities	150	13
	Commercial and business	300	14
	Electricity facilities	200	15
	Sanitation facilities	200	16

4.3. Constructing the CLSP Framework

After establishing the resistant-plane model, the thresholds used to separate the levels of CLSP were selected by employing the "Jenk's Natural Breaks" method. In contrast to current existing research, which commonly rates SP as low, medium, and high levels [15,19,22], this research implemented a four-level rule. However, the first and last levels (Class 1 and

Class 4 CLSP) in this framework are similar to the "high" and "low" levels defined by other research, which are comprised of the most and least crucial landscape elements, respectively. What marks the significant difference are the middle levels. As in this research, the medium level is defined as two parts-Class 2 and Class 3-in order to optimize the connectivity for Class 1 at local and global scales. The connectivity is demonstrated by the modelled corridors, which ought to be refurbished and maintained to enhance the overall historical consciousness, implying an indispensable budget. Considering the fact that the "sources" are apparently concentrated in the southwest of Chaozong district, the (local) corridors in this region are much shorter than those (global) trying to incorporate far apart Class 1 elements. In practice, it could be wise if different renewal and maintenance standards could be implemented concerning the lengths of corridors, thus maximizing cost-effectiveness. Additionally, for some extremely isolated elements, the two levels can act as buffer zones subject to fine-grained regulations. The redefined four classes of CLSP take economic efficiency into account, thereby improving the practicability of the results. In this work, the new classes were generated by re-classification in ArcGIS to attain four levels of CLSP, which constitute 13.1%, 17.7%, 23.3%, and 45.9%, ranging from the most cultural-diffusive sources with the least MCR values, to cultural-perceptive barriers, respectively (Figure 5).

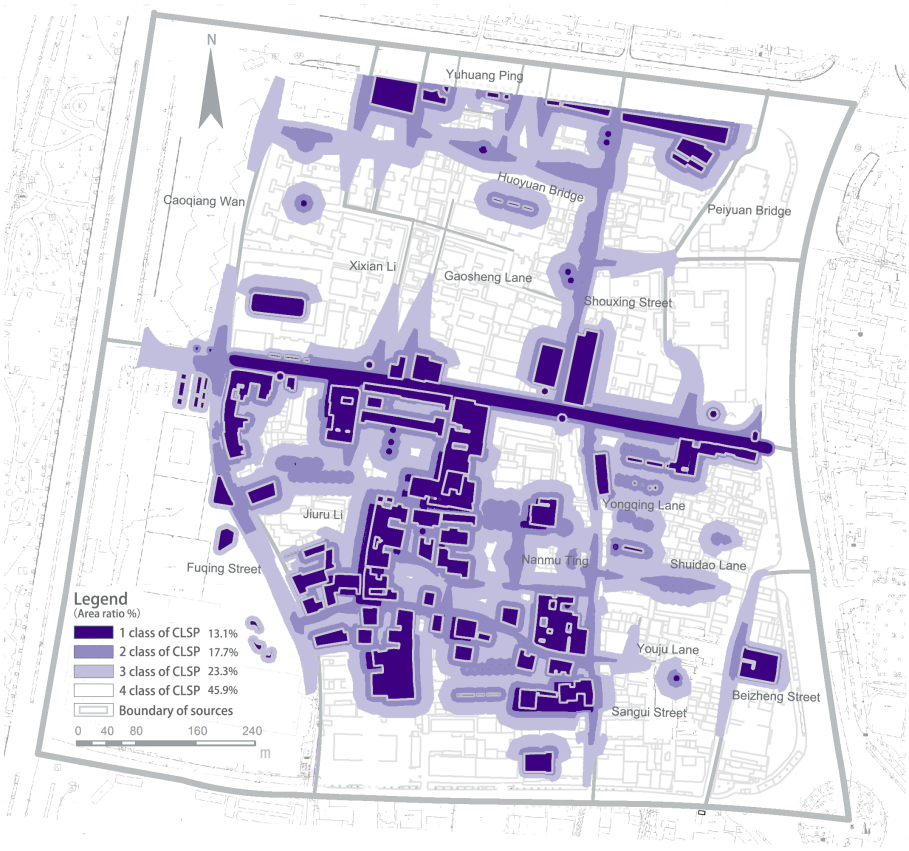

Figure 5. CLSP of Chaozong district.

5. Results Analysis and Discussion

5.1. A Well-Structured Spatial Conservation Pattern

Upon analysis of Figure 5, Class 1 CLSP typically overlaps with sources, which perform as crucial spatial nodes for sustaining the safe and stable development of historical culture. In terms of spatial distribution, the compositions of this CLSP are mainly clustered in the southwestern part of the district, while those in other areas are relatively dispersed. The spatial characteristics outline the core zone of the entire historical district in which there are abundant cultural landscape elements congregated. The agglomeration provides a strong cultural atmosphere and immersive experience for visitors. Nevertheless, the

opposite situation can be witnessed in the scattered and fragmented elements, as the lack of connectivity hinders cultural-historical and spatial consistency. Class 1 CLSP enjoys the top protective priority due to the fact that any damage or demolishment imposed on them will lead to depreciated cultural value and reduced continuity of cultural-historical perception. In addition, this situation may weaken the robustness of the spatial structure, resulting in the nodes' gradually eroded cultural attributes and functions [19]. Hence, the Class 1 CLSP should be treated as the "inviolable protection boundaries" in the contexts of either urban renewal or development. In other words, strict protection measures should be implemented to safeguard the authenticity and integrity of the cultural-historical significance of these precious elements. The corresponding protection strategies should adhere to the principle of minimal intervention. The rule requires (a) timely and cautious preservation and restoration executed by well-trained professionals, (b) respect for the original materials, structures, and traditional craftsmanship in order to avoid the diminished or loss of cultural identity, and (c) advancing preventive measures to mitigate the negative impacts and damages caused by natural factors (acid rain and weathering), economic activities (demolition, reconstruction, and excessive commercialization), and nuisance (vandalism, graffiti, and theft).

The Class 2 security pattern enhances the local spatial connectivity and forms the primary skeleton of CLSP, especially in the southwest area. Specifically, it provides adjacent nodes with buffer zones that accentuate the overall historical consciousness amongst the districts. As shown in Figure 6, clear spatial corridors have been formed in certain areas. These enhance the cultural interconnections, such as Shouxing Street, Liansheng Street, Sangui Street, and Chaozong Lane. However, obstructions have been discovered in some areas, such as Peiyuan Bridge, Beizheng Street, and Caoqiang Wan, where spatial corridors could not be formed. This may be owing to two underlying reasons. First of all, the few nodes lack the ability to achieve cultural dissemination. Secondly, neighboring areas are mostly 'high-resistance' lands (commercial or commercial-residential lands), and these modern high-rise buildings are wholly inconsistent with the traditional style of Chaozong. As a basic protective strategy for Class 2, improving the spatial quality can be achieved through renovation and enhancement. For example, by appropriately refurbishing or renovating the streets, building facades, lighting systems, green space, signage systems, etc., can be intensified to consolidate its cultural identity and spatial connectivity, which underpin historical perceptual consistency. Additionally, appropriate historical and cultural amenities are permitted in the Class 2 spaces, such as exhibition halls, art galleries, and cultural creative shops. Apart from strengthening the cultural signature and preserving the communal memory of the community, these amenities will attract more tourists.

Class 3 further strengthens connectivity at a global level. It forms an integrated and continuous spatial framework which incorporates and connects Class 2. For example, the severed areas in Class 2 (Figure 6) have been bridged by Class 3 ClSP, such as Fuqing Street, Huoyuan Bridge, Shuidao Lane, and Yongqing Lane. Additionally, with it being less prone to visual resistance, Class 3 can promote the formation of social-emotional corridors in areas with excessive visual obstructions, uniting distant and isolated cultural landscape clusters. Examples of this are Fuqing Street and Beizheng Street. Conversely, in areas such as Caoqiang Wan, Xixian Li, and Gaosheng Lane, continuous spatial corridors are unable to be constructed successfully due to the poor accessibility and permeability of such spaces, which include wastelands and walls. Such obstructions can, however, be cured by land reuse restructure. By optimizing the layout of elements, the connectivity between all historical buildings may be largely enhanced. Aside from the spatial elements, a cost-effective method of curation is to set fine-designed signage and lighting systems which can cultivate the holistic cultural atmospheres, such as historical ambience spaces, traditional outdoor theatres, markets, and bookstores.

The fourth class contains little cultural landscape elements and dominantly serves as the basic environment and contextual background of the district's cultural attributes. Socio-economic activities centred on urbanization are permitted here to meet the urgent needs of modern life for residents and tourists. However, it should be noted that these activities

ought to be in accordance with the actual situation and characteristics of Chaozong, of which the compelling benefits are verified.

Figure 6. A well-structured spatial conservation pattern.

5.2. A Resilient and Flexible Spatial Development Framework

The current orthodox approach (Figure 7) divides the historical area into three regions subject to different levels of protection: the "core protection zone", the "construction control zone", and the "landscape coordination zone". This approach is beneficial for preserving architectural heritage since it delineates the boundaries of conservation zones as per their hierarchy of importance. However, this method has certain limitations. Firstly, its protection range can be over-generalized, resulting in inflexibility in meeting the functional and structural requirements of rapidly developing cities. Secondly, it tends to excessively emphasize historical buildings and overlooks the cultural landscape's role in maintaining and cultivating historical consciousness.

In contrast, establishing a CLSP in Chaozong can provide a more flexible and efficient spatial framework to achieve the interaction and coordination of multiple interests and objectives [47]. CLSP comprehensively accounts for the cultural, historical, and social background, and protects the cultural landscape as a whole. It provides more developable spaces for social, economic, and cultural activities (Figure 8), which enhances the district's social-cultural vitality and economic potentiality to achieve sustainability.

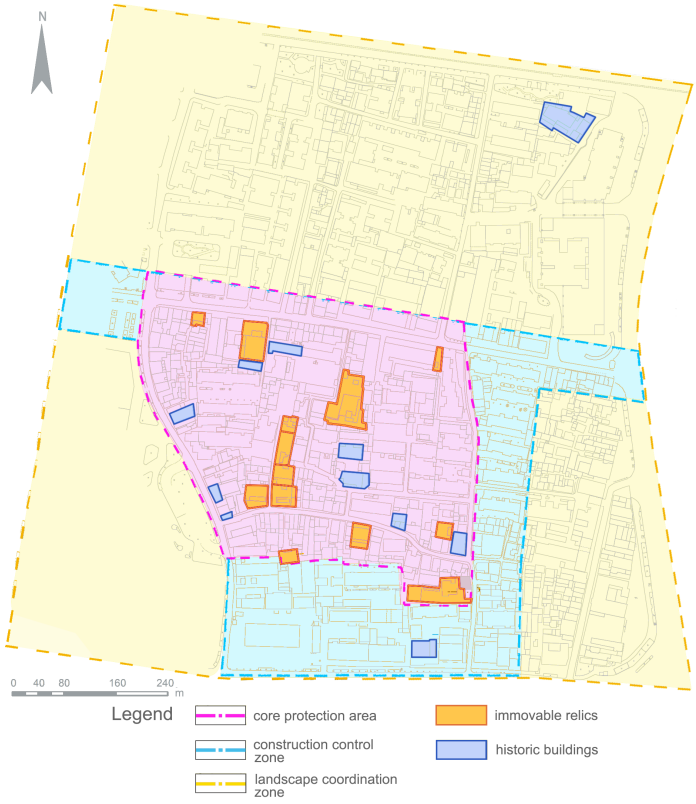

Figure 7. Current orthodox protection plan by using the conventional approach.

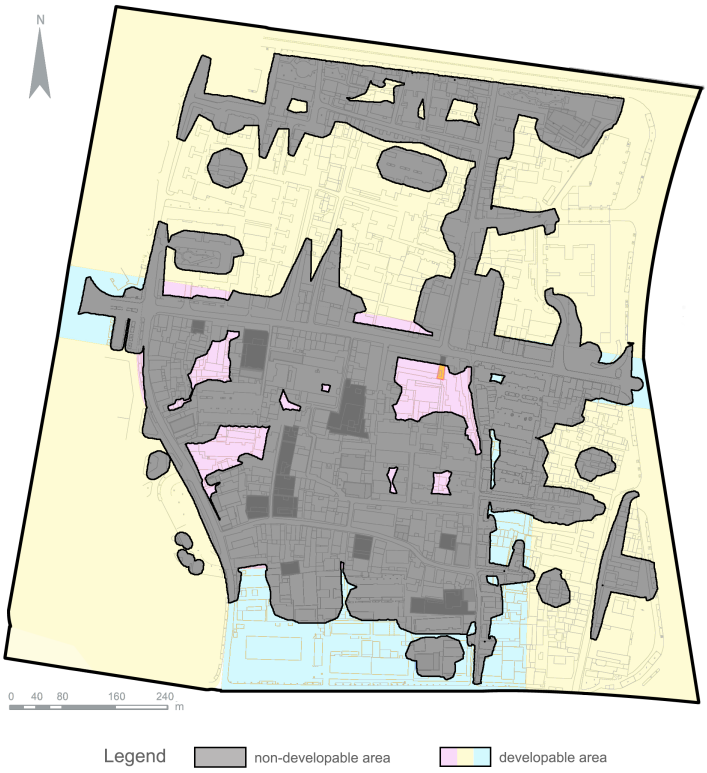

Figure 8. A more resilient and flexible spatial development framework for sustainable development compared to the current protection plan.

5.3. Limitations and Future Research Directions

5.3.1. Limitations

After carefully reflecting on the CLSP for Chaozong, there remain unresolved issues that require further study, as follows.

- There is an absence of consideration of the effects posed by urbanization activities and land use typologies outside of Chaozong. Further, the detailed spatial heterogeneity within lands in identical usages has not been considered when constructing the resistant planes;
- There are no equitable criteria for determining CLSP-specific indices (e.g., resistance factors and resistance coefficients) due to the associated theories being in their infancy. Consequently, the data considered have been extracted from similar studies, expert opinions, and investigations. Thus, subjectivity and bias of data are possibly present;
- Being restricted by the available data, only land-use typologies have been chosen to model the resistant planes without incorporating other factors.

Although the rationale of the research framework still requires substantiation, this study provides a novel path for conserving historical districts.

5.3.2. Future Research Directions

Regarding the above limitations, future research can shed light on the following aspects to enhance the reliability and robustness of the methodology.

Firstly, the scope of the research region should be expanded to examine the interlinkages between internal-district elements and external ones. For instance, the resistance level at the district's border would be significantly lower if there is an adjacent green land instead of a waste processing facility. By involving additional external regions, more comprehensive and precise insights can be gained regarding the development strategy of historical neighbourhoods at a macro level.

Secondly, a more objective quantification approach should be adopted to define the factors and their associated parameters underpinning landscape resistance. For instance, structured in-situ surveys can be conducted to gather people's subjective evaluations of different landscape elements. By employing supervised learning techniques, such as Multiple Linear Regression, the weights of these explanatory variables can be statistically interpreted, largely increasing the results' objectivity. Additionally, unstructured data such as crowd-sourced data, including people's reviews of spots within the district, can be processed by NLP topic modelling techniques. The modelled topics alongside their quantities and determined sentiments can be converted to determinants of resistance with different levels of weight.

Lastly, the dimensions that influence landscape resistance can be expanded by utilizing urban big data and other theories. For example, the check-in data provided by telecom companies can imply people's spatial preference for gatherings, enabling the evaluation of appropriate weights to resistance factors in different spatial locations. Additionally, other theories such as spatial syntax can provide richer information about the intrinsic spatial properties, such as integration and choice, which would further develop the comprehensive understanding of landscape resistance.

6. Conclusions

This study considered and addressed the increasing conflict between heritage conservation and urban development through CLSP to achieve a sustainability goal. Compared with other heritage protection theories and approaches, the CLSP has the ability to go beyond tangible physical environments, taking all tangible factors (physical artefacts such as monuments, historic buildings, relics, etc.) and intangible factors (spiritual beliefs, oral traditions, lifestyle, etc.) into an integrated and comprehensive consideration. In the historical district, the tangible and intangible cultural landscape factors interact with and influence each other. Among them, tangible factors are the visible physical evidence of historical and

cultural aspects within the district and serve as the physical carriers of intangible factors. The historical and cultural values, as well as the spiritual values within the intangible factors, cultivate people's cultural sense of identity, belonging, and collective memory of the district, thereby promoting their attention to the protection of tangible factors. It is evident that, only through comprehensive coordination and the integrated protection of the tangible and intangible factors in historical districts, can sustainable development be truly achieved.

In this study, CLSP theory was implemented through ArcGIS for MCR modelling to manifest a potential spatial structure and value hierarchy in Chaozong. The resulting protective spatial network system consists of four levels of CLSP. The nodes (Class 1 CLSP) are "sources" of the cultural landscape and are crucial for immortalizing the street's history, whilst the corridors (Class 2, 3, and 4 CLSP) between each "source" can enhance local and global connectivity. It is through these levelled spaces that the integrity and continuity of the cultural development process can be ensured.

The historic district features both physical and spiritual elements. When organized by CLSP, the spatial connections between different cultural landscapes at various scales can be bridged and strengthened. Additionally, the CLSP approach allows a greater amount of space for modern urban activities. It helps balance the contradictions between development restrictions (for heritage conservation) and the destruction of historic architecture (for economic development). By implementing CLSP, the human–land opposition embodied in the contradiction between heritage conservation and urban development can be better mitigated in a sustainable way.

Author Contributions: Conceptualization, Z.C.; methodology, Z.C. and W.L.; software, Z.C.; validation, Z.C. and W.L.; formal analysis, Z.C.; investigation, Z.C.; resources, S.L. and J.Z.; data curation, Z.C.; writing—original draft preparation, Z.C.; writing—review and editing, Z.C. and W.L.; visualization, Z.C.; supervision, Z.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data available in a publicly accessible repository. The spatial data presented in this study are openly available in [http://www.gscloud.cn/ (accessed on 12 March 2023), http://guihuayun.com/ (accessed on 5 March 2023), https://www.openstreetmap.org/#map=16/28.2047/112.9708 (accessed on 5 March 2023)].

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SP	Security Pattern
CLSP	Cultural Landscape Security Pattern
MCR	Minimum Cumulative Resistance
CTSP	Chinese Territorial Spatial Planning

References

1. Heath, T.; Oc, T.; Tiesdell, S. *Revitalising Historic Urban Quarters*; Routledge: London, UK, 1996. [CrossRef]
2. Willis, K.G. Chapter 7—The Use of Stated Preference Methods to Value Cultural Heritage. In *Handbook of the Economics of Art and Culture*; Ginsburgh, V.A., Throsby, D., Eds.; Elsevier: Amsterdam, The Netherlands, 2014; Volume 2, pp. 145–181. [CrossRef]
3. Boussaa, D. Urban Regeneration and the Search for Identity in Historic Cities. *Sustainability* **2018**, *10*, 48 . [CrossRef]
4. Li, M.; Liu, J.; Lin, Y.; Xiao, L.; Zhou, J. Revitalizing historic districts: Identifying built environment predictors for street vibrancy based on urban sensor data. *Cities* **2021**, *117*, 103305. [CrossRef]
5. Lan, W. Discussion on the Integrated Value and Multi-level Value Elements of Historic Urban Area. *China Anc. City* **2021**, *35*, 11–16.

6. Whitehand, J.W.R.; Gu, K. Conserving Urban Landscape Heritage: A Geographical Approach. *Procedia-Soc. Behav. Sci.* **2010**, *2*, 6948–6953. [CrossRef]
7. Zhang, S.; Xue, L. On Japan's "Law for the Conservation and Enhancement of Historic Environment and Cultural Setting in the Historic City" and Its Reference to China. *Urban Plan. Forum* **2010**, *6*, 102–108.
8. Li, D.K.; Mei, C.L.; Wang, N. Tests for spatial dependence and heterogeneity in spatially autoregressive varying coefficient models with application to Boston house price analysis. *Reg. Sci. Urban Econ.* **2019**, *79*, 103470. [CrossRef]
9. Zhu, L.; Wang, Z.; Liu, Y. Exploration on Pattern Construction of Historic and Cultural Space in Dongshan Town of Suzhou under the Territorial Spatial Planning Context. *Chin. Overseas Archit.* **2022**, *8*, 22–27. [CrossRef]
10. Li, Y.; Xiao, L.; Ye, Y.; Xu, W.; Law, A. Understanding tourist space at a historic site through space syntax analysis: The case of Gulangyu, China. *Tour. Manag.* **2016**, *52*, 30–43. [CrossRef]
11. Yu, K. Security Patterns in Landscape Planning with A Case in South China. Ph.D. Thesis, Harvard University, Cambridge, MA, USA, 1995; ISBN: 9798641929927.
12. Wang, F.; Jiang, C.; Wei, R. Cultural Landscape Security Pattern: Concept and Structure. *Geogr. Res.* **2017**, *36*, 1834–1842. [CrossRef]
13. Lenzerini, F. Intangible Cultural Heritage: The Living Culture of Peoples. *Eur. J. Int. Law* **2011**, *22*, 101–120. [CrossRef]
14. Wong, L. *Globalization and Intangible Cultural Heritage: International Conference*, Tokyo, Japan, 26–27 August 2004; UN: Tokyo, Japan, 2005.
15. Van Oers, R. The Concept of Historic Urban Landscape (HUL) and its Relation to Cultural Landscape. *Chin. Landsc. Archit.* **2012**, *28*, 16–18. [CrossRef]
16. Guan, Z.; Chen, S. Study on the Safety Pattern of Local Cultural Landscape and the Construction of Heritage Corridor–Taking in Yongtai, Fujian as an Example. *Chin. Landsc. Archit.* **2020**, *36*, 96–100.
17. Kahan, J.H.; Allen, A.C.; George, J.K. An Operational Framework for Resilience. *J. Homel. Secur. Emerg. Manag.* **2009**, *6*. [CrossRef]
18. Heyman, T.; Yskout, K.; Scandariato, R.; Joosen, W. An Analysis of the Security Patterns Landscape. In Proceedings of the Third International Workshop on Software Engineering for Secure Systems (SESS'07: ICSE Workshops 2007), Washington, DC, USA, 20–26 May 2007; p. 3. [CrossRef]
19. Yu, K. Security patterns and surface model in landscape ecological planning. *Landsc. Urban Plan.* **1996**, *36*, 1–17. [CrossRef]
20. Yu, K. Landscape ecological security patterns in biological conservatio. *Acta Ecol. Sin.* **1999**, *19*, 8–15.
21. Wang, X.; Li, J.; Zheng, T.; Diao, S.; Zhang, X.; Tian, Y. Constructing Landscape Ecological Security Patterns of an Ancient Capital Based on Cellular Automata Theory. *Urban Sci.* **2022**, *6*, 29. [CrossRef]
22. Yu, K.J.; Qiao, Q.; Li, D.H.; Yuan, H.; Wang, S.S. Ecological land use in three towns of eastern Beijing: A case study based on landscape security pattern analysis. *J. Appl. Ecol.* **2009**, *20*, 1932–1939.
23. Wen, B.; Liu, Y.; Xia, M. Layout optimization of rural residential land based on theory of landscape security pattern. *Trans. Chin. Soc. Agric. Eng.* **2014**, *30*, 181–191.
24. Zhang, Y.; Yu, B.; Ashraf, M.A. Ecological security pattern for the landscape of mesoscale and microscale land: A case study of the Harbin City center. *J. Environ. Eng. Landsc. Manag.* **2015**, *23*, 192–201. [CrossRef]
25. Li, Q.; Zhou, Y.; Yi, S. An integrated approach to constructing ecological security patterns and identifying ecological restoration and protection areas: A case study of Jingmen, China. *Ecol. Indic.* **2022**, *137*, 108723. [CrossRef]
26. Wei, L.; Zhou, L.; Sun, D.; Yuan, B.; Hu, F. Evaluating the impact of urban expansion on the habitat quality and constructing ecological security patterns: A case study of Jiziwan in the Yellow River Basin, China. *Ecol. Indic.* **2022**, *145*, 109544. [CrossRef]
27. Su, Y.; Chen, X.; Liao, J.; Zhang, H.; Wang, C.; Ye, Y.; Wang, Y. Modeling the optimal ecological security pattern for guiding the urban constructed land expansions. *Urban For. Urban Green.* **2016**, *19*, 35–46. [CrossRef]
28. Liu, X.; Shu, J.; Zhang, L. Research on applying minimal cumulative resistance model in urban land ecological suitability assessment: As an example of Xiamen City. *Acta Ecol. Sin.* **2010**, *30*, 421–428.
29. Wei, S.; Pan, J.; Liu, X. Landscape ecological safety assessment and landscape pattern optimization in arid inland river basin: Take Ganzhou District as an example. *Hum. Ecol. Risk Assess. Int. J.* **2020**, *26*, 782–806. [CrossRef]
30. You, W.; He, D.; Hong, W.; Wu, L.; Ji, Z.; You, H.; Tan, Y.; Zheng, X. Identification for Tourism Disturbance Sensitive Areas and Their Protection Based on Landscape Security Pattern in World Mixed Heritage Site Wuyishan Scenery District. *Mt. Res.* **2014**, *32*, 195–204. [CrossRef]
31. Li, H.; Yi, N.; Yao, W.; Wang, S.; Li, Z.; Yang, S. Shangri-La County ecological land use planning based on landscape security pattern. *Acta Ecol. Sin.* **2011**, *31*, 5928–5936.
32. Zhang, L.; Liao, Y.; Yang, C.; Ran, D. Land Evaluation for Human Activity in Shoucheng Nature Reserve Based on Theory of Landscape Safety Pattern. *Bull. Soil Water Conserv.* **2019**, *39*, 217–222. [CrossRef]
33. Wang, Y.; Liao, Z. Research on traditional village form of Jiarong Tibetan based on landscape security pattern: A case study of Zhibo village in Barkam City. *Acta Ecol. Sin.* **2021**, *41*, 1209–1220. [CrossRef]
34. Lavrenova, O. Genesis of Culture in Space. Conception of Cultural Landscape in Context of Cultural and Philosophic Research. In *Spaces and Meanings: Semantics of the Cultural Landscape*; Lavrenova, O., Ed.; Numanities-Arts and Humanities in Progress; Springer International Publishing: Cham, Switzerland, 2019; pp. 11–52. [CrossRef]

35. Stephenson, J. The Cultural Values Model: An integrated approach to values in landscapes. *Landsc. Urban Plan.* **2008**, *84*, 127–139. [CrossRef]
36. Taylor, K. Cultural Landscapes and Asia: Reconciling International and Southeast Asian Regional Values. *Landsc. Res.* **2009**, *34*, 7–31. [CrossRef]
37. Mark, B.; McMahon, E. *Green Infrastructure: Linking Landscape and Communities*; Island Press: Washington, DC, USA, 2006.
38. Yu, K. Ecological security pattern and spatial development pattern optimization of national territory. In *Landscape Architecture Frontiers*; Higher Education Press Limited Company: Beijing, China, 2016; Volume 4.
39. Forman, R.T.T. *Land Mosaics: The Ecology of Landscapes and Regions*; Cambridge University Press: Cambridge, UK, 1995.
40. Wang, F.; Prominski, M. *Urbanization and Locality: Strengthening Identity and Sustainability by Site-Specific Planning and Design*; Springer: Berlin/Heidelberg, Germany, 2015 .
41. Wang, F.; Lv, Z.; Zhang, B.; Zhang, S.; Dong, W.; Liu, P.; Huang, Z.; Wu, B.; Lu, S.; Xu, F.; et al. Memory and homesickness in transition: Evolution mechanism and spatial logic of urban and rural memory. *Geogr. Res.* **2017**, *36*, 3–25. [CrossRef]
42. Green, D.G.; Klomp, N.I.; Rimmington, G.; Sadedin, S. *Complexity in Landscape Ecology*; Springer: Dordrecht, The Netherlands, 2006.
43. Sun, J.; Zhou, S.; Wang, N.; Zhu, H.; Zhou, D.; Zhen, F.; Liu, X.; Yang, J.; Chen, J.; Yang, X. Mobility in geographical research: Time, space and society. *Geogr. Res.* **2016**, *35*, 1801–1818. [CrossRef]
44. Yang, K.; Cao, Y.; Feng, Z.; Geng, B.; Feng, Y.; Wang, S. Research progress of ecological security pattern construction based on minimum cumulative resistance model. *J. Ecol. Rural. Environ.* **2021**, *37*, 555–565. [CrossRef]
45. Li, S.; Zhao, Y.; Xiao, W.; Yue, W.; Wu, T. Optimizing ecological security pattern in the coal resource-based city: A case study in Shuozhou City, China. *Ecol. Indic.* **2021**, *130*, 108026. [CrossRef]
46. Huang, Q.; Peng, B.; Elahi, E.; Wan, A. Evolution and Driving Mechanism of Ecological Security Pattern: A Case Study of Yangtze River Urban Agglomeration. *Integr. Environ. Assess. Manag.* **2021**, *17*, 573–583. [CrossRef]
47. Yu, K.J.; Li, W.; Li, D.; Li, C.; Huang, G.; Liu, H. Suitability analysis of heritage corridor in rapidly urbanizing region: A case study of Taizhou City. *Geogr. Res.* **2005**, *24*, 69–76.
48. Wang, S.; Ou, M. Zoning for regulation of construction land based on landscape security pattern. *Acta Ecol. Sin.* **2013**, *33*, 4425–4435. [CrossRef]
49. Taylor, K.; Altenburg, K. Cultural Landscapes in Asia-Pacific: Potential for Filling World Heritage Gaps. *Int. J. Herit. Stud.* **2006**, *12*, 267–282. [CrossRef]
50. Peng, W.; Zhou, J. Development of Land Resources in Transitional Zones Based on Ecological Security Pattern: A Case Study in China. *Nat. Resour. Res.* **2019**, *28*, 43–60. [CrossRef]
51. Dai, L.; Liu, Y.; Luo, X. Integrating the MCR and DOI models to construct an ecological security network for the urban agglomeration around Poyang Lake, China. *Sci. Total. Environ.* **2021**, *754*, 141868. [CrossRef]