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North–South Disparities and Influencing Factors in the Distribution of Vietnam's Tangible Cultural Heritage Sites

Min ZHAO
Yunnan University
Sisi ZHANG
South China University of Technology
Yanling WUHUANG
Yunnan University
Siyi JIANG
Yunnan University
Peng LI
leap@ynu.edu.cn

Yunnan University
Yuelu CHENG
Yunnan University

Article

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Abstract

The distribution pattern of cultural heritage sites not only reflects the trajectory of civilizational evolution but also provides an important scientific basis of heritage conservation. Using 4,245 tangible cultural heritage sites in Vietnam—including world-level, special national-level, and national-level—as the study sample, kernel density analysis and GeoDetector were employed to examine their distribution characteristics and influencing factors. The results show that: (1) Heritage sites are highly concentrated in the Red River Delta, particularly in Hanoi and its surrounding provinces. The six geographical regions can be grouped into three tiers, with the Red River Delta forming the first tier and the Central Highlands belonging to the third tier. A pronounced interprovincial polarization pattern is observed: Hanoi far exceeds all other provinces in both the number and density of heritage sites and constitutes the only significant hot spot centered on the city. (2) In terms of temporal distribution, high-level heritage sites exhibit a bimodal pattern, while their spatial distribution exhibits marked north–south disparities. The largest proportion of heritage sites dates to the Feudal Period, followed by the Period of North and South Vietnam. Architectural and artistic monuments sites, mixed monuments sites dating to the Feudal Period are highly concentrated in Hanoi and its surrounding areas, with only limited distribution in the central and southern region of Vietnam. (3) Socioeconomic factors are identified as the core driving force shaping the distribution of heritage sites, whereas natural factors act only as basic constraints; more fundamentally, the broader political and cultural landscape constitutes the deeper underlying mechanism. This study provides a scientific basis for the coordinated formulation and implementation of heritage conservation across Vietnam.

1 Introduction

The preservation and sustainable use of cultural heritage have long attracted substantial international attention[1]. Following the Industrial Revolution, institutional systems for heritage conservation were gradually established in countries such as France, the United Kingdom, and Japan. In 1933, the Athens Charter for the Restoration of Historic Monuments marked a major milestone by formally articulating, for the first time at the international level, principles for the conservation and restoration of historic buildings. The establishment of the United Nations Educational, Scientific and Cultural Organization (UNESCO) in 1945 placed cultural heritage protection on the global agenda. In 1972, the adoption of the Convention Concerning the Protection of the World Cultural and Natural Heritage (hereafter the Convention) formally introduced the concept of “World Heritage” and marked the establishment of a global framework for cultural heritage protection[2]. Subsequently, the adoption of the Convention for the Safeguarding of the Intangible Cultural Heritage in 2003 further extended the scope of global heritage protection to intangible heritage. Meanwhile, cultural heritage protection has been widely incorporated into national development strategies, and multilevel protection systems have been developed through legislation, planning, and technological means. Such efforts are intended to support the transmission and continued development of cultural heritage in the course of modernization.

As one of the important cradles of Southeast Asian civilization, Vietnam initiated its cultural heritage preservation efforts after the Second World War[3]. In 1945, Ho Chi Minh signed Decree No. 65, which explicitly mandated the protection of historical monuments and sites. However, between 1946 and 1979, the country remained largely in a state of war and experienced slow socio-economic development, resulting in limited substantive progress in heritage conservation. The promulgation of the Decree on the Protection of Cultural Heritage in 1984 marked the initial establishment of a national legal framework for heritage protection. The implementation of the Đổi Mới (Renovation) policy in 1986 further promoted the gradual institutionalization and professionalization of cultural heritage policies. Vietnam's accession to the Convention in 1987 marked the beginning of its alignment with international standards for cultural heritage conservation. In 2001, the Law on Cultural Heritage was officially enacted, replacing the previous decree and establishing a comprehensive legal framework covering both tangible and intangible cultural heritage. The first amendment to this law in 2009 expanded the scope of protection to include living heritage, such as traditional crafts, and initially established a two-tier management structure comprising the Ministry of Culture, Sports and Tourism and provincial department of culture. In 2024, the 8th Session of the 15th National Assembly further refined relevant legal provisions by introducing more detailed regulations on heritage inventories, digital conservation, community participation, and cross-sectoral collaborative governance. These amendments have promoted the deeper integration of cultural heritage preservation into the national development strategy[4].

As Vietnam's cultural heritage protection system has gradually improved, related academic research has also expanded. Existing studies on Vietnam’s cultural heritage show three main characteristics: First, the range of research topics is broad, covering both intangible and tangible cultural heritage. Intangible heritage studies have addressed topic such as Nha Nhac (Vietnamese court music)[5], Bronze Drums culture[6], and the epic poems of the Muong people[7], while research on tangible heritage has examined blue-and-white ceramic kilns [8] and Catholic heritage[9]. Second, the scale of analysis tends to focus on the meso and micro levels. Most studies adopt a micro-level perspective, with detailed investigations of representative individual heritage sites, such as the Hue Imperial City[10], Hoi An Ancient Town[11], the Con Dao Islands[12], and Cham Ruins[13]. A smaller number of studies have been conducted at the meso-level, for example by examining the impacts of flooding on cultural heritage sites in Quang Nam Province[14]. By contrast, studies at the national scale remain limited. Third, the research content is relatively diverse. In terms of heritage value assessment, Bui et al. evaluated heritage adaptability and resilience from the perspective of socio-ecological systems[15]. Regarding conservation methods, Thuc et al. applied the fuzzy TOPSIS method to identify key obstacles in cultural heritage protection[16], while Dat et al. explored mechanisms of heritage transmission and community participation[17]. With respect to heritage development and change, Quang investigated the social functions and tourist memories associated with war heritage in Ho Chi Minh City[18], and Pham highlighted the damage to heritage and the associated impacts caused by rapid urbanization in the city[19].

Overall, although research on Vietnam’s cultural heritage has accumulated to a certain extent, most existing studies focus on specific topics of representative heritage sites at the micro-level. Systematic

research from a national perspective remains limited, particularly with regard to the spatiotemporal distribution of cultural heritage sites. This gap constrains a comprehensive understanding of the overall pattern of Vietnam's cultural heritage sites and hinders the formulating macro-level conservation strategies at the national-scale. In recent years, many countries have carried out national-scale studies on the spatiotemporal distribution of cultural heritage sites. In terms of research objects, these studies have examined both tangible and intangible cultural heritage sites[20,21,22,23,24]. In terms of methods, ArcGIS has been widely used to analyze the spatial distribution characteristics of heritage sites[25,26,27,28]; methods such as buffer analysis[29], GeoDetector[30], multi-scale geographically weighted regression models[31], and space syntax[32] have been employed to identify the factors influencing heritage distribution; and approaches such as historical research[33] and participatory surveys[34] have been applied to reveal mechanisms of heritage transmission. These studies provide valuable references for investigating the distribution patterns of Vietnam's cultural heritage sites.

Therefore, this study uses data on tangible cultural heritage and employs GIS-based spatial analysis together with the GeoDetector model to systematically examine the distribution characteristics and influencing factors of Vietnam's cultural heritage sites at the national-scale. The study aims to address the gaps in existing research on Vietnam's cultural heritage, provide a scientific basis for the formulation of a nationwide, integrated conservation strategy, and offer a reference for cultural cooperation between China and Vietnam.

2 Materials and methods

2.1 Study area

Vietnam is located at the eastern edge of the Indochinese Peninsula, bordered by Laos and Cambodia to the west, China to the north and the South China Sea to the east, with a coastline of approximately 3,260 km. The country has an elongated, S-shaped territory and covers an area of about 330,000 km². Its terrain generally descends from the northwest to the southeast, and mountains and plateaus account for approximately three-quarters of the national territory (Fig. 1b)[35]. According to the 2023 Statistical Yearbook published by the Vietnam National Statistical Office, the country is administratively divided into 63 provincial-level units including 5 central-affiliated cities and 58 provinces. These are grouped into three major regions (northern, central and southern region) and six sub-regions: the Northern Midlands and Mountain Areas (NMMA), the Red River Delta (RRD), the North Central and Central Coastal Areas (NCCA), the Central Highlands (CH), the South East (SE), and the Mekong River Delta (MRD) (Fig. 1a; Table 1). Vietnam has a population of approximately 100 million and a GDP per capita of USD 4,323.

Table 1
Vietnamese geographical regions, provinces/central-affiliated cities and corresponding abbreviations

Region	Sub-region	Provinces/central-affiliated cities and corresponding abbreviations
Northern region	RRD	Ha Noi-HN, Vinh Phuc-VP, Bac Ninh-BN, Quang Ninh-QN, Hai Duong-HD, Hai Phong-HP, Hung Yen-HY, Thai Binh-TB, Ha Nam-HA, Nam Dinh-ND, Ninh Binh-NB
	NMMA	Ha Giang-HG, Cao Bang-CB, Bac Kan-BK, Phu Tho-PT, Dien Bien-DB, Lai Chau-LC, Son La-SL, Hoa Binh-HB, Lang Son-LS, Lao Cai-LI, Yen Bai-YB, Thai Nguyen-TN, Tuyen Quang-TQ, Bac Giang-BG
Central region	NCCA	Thanh Hoa-TH, Nghe An-NA, Ha Tinh-HT, Quang Binh-QB, Quang Tri-QT, Thua Thien-Hue-TTH, Da Nang-DN, Quang Nam-QA, Quang Ngai-QG, Binh Dinh-BD, Phu Yen-PY, Khanh Hoa-KH, Ninh Thuan-NT, Binh Thuan-BT
	CH	Kon Tum-KT, Gia Lai-GL, Dak Lak-DL, Lam Dong-LD, Dak Nong-DO
Southern region	SE	Binh Phuoc-BP, Tay Ninh-TI, Binh Duong-BU, Dong Nai-DA, Ba Ria-Vung Tau-BRVT, Ho Chi Minh City-HCMC
	MRD	Long An-LA, Tien Giang-TG, Can Tho-CT, Hau Giang-HI, Soc Trang-ST, Bac Lieu-BL, Ca Mau-CM, Dong Thap-DT, An Giang-AG, Ben Tre-BR, Vinh Long-VL, Tra Vinh-TV, Kien Giang-KG

According to Vietnam's Law on Cultural Heritage (No. 45/2024/QH15), cultural heritage is classified into three main categories: tangible cultural heritage, intangible cultural heritage, and documentary heritage. These categories can be further divided into subcategories and finer subcategories according to their value, characteristics, significance, and ownership (Fig. 2). (1) In terms of value and characteristics, tangible cultural heritage is divided into two subcategories: historical-cultural monuments and scenic spots (immovable), and relics and antiquities (movable). The former is further classified into five finer subcategories: historical monuments (HM), architectural and artistic monuments (AAM), archaeological monuments (AM), scenic spots (SS), and mixed monuments (MM). Intangible cultural heritage is divided into six subcategories, including oral expressions and traditions, and performing arts among folk arts, et al. Documentary heritage is divided into three subcategories: traditional documentary heritage audio and visual documentary heritage digital documentary heritage. (2) In terms of significance, historical-cultural monuments and scenic spots are classified into three subcategories: special national level, national level, and provincial level. Relics and antiquities, intangible cultural heritage, and documentary heritage are classified into two subcategories: national level and provincial level. (3) In terms of ownership, Vietnam's cultural heritage is divided into three subcategories: owned by the entire people, privately owned, and collectively owned. Furthermore, Vietnam is also home to five World Cultural Heritage sites, such as Hoi An Ancient Town and My Son Sanctuary, as well as one mixed World Cultural and Natural Heritage site. These heritage sites represent Vietnam's distinctive history, culture, and natural landscapes and constitute some of the country's most important objects of cultural heritage protection.

This study focuses on immovable tangible cultural heritage sites in Vietnam at the national level and above (hereafter referred to as "heritage sites"). As of November 2024, a total of 4,245 heritage sites had

been identified in Vietnam, including 6 World Cultural Heritage and Mixed Heritage sites (WHS), 147 special national-level historical-cultural monuments and scenic spots (SNHS) and 4,092 national-level historical-cultural monuments and scenic spots (NHS). WHS and SNHS are collectively defined as high-level heritage sites in this study (Fig. 1c).

2.2 Data source

(1) **Heritage-related data.** The list of WHS was obtained from the UNESCO World Heritage List (https://whc.unesco.org/en/list/). The list and number of SNHS were derived from the “National List of Intangible Cultural Heritage” published by Vietnamese government authorities. The number of NHS was sourced from the inventory of national-level historical and cultural relics (https://cn.baochinhphu.vn/). (2) **Geospatial data.** The spatial location data for WHS and SNHS were collected using Python-based web scraping from Google Maps. Administrative boundary data for Vietnam were obtained from Database of Global Administrative Areas (https://gadm.org/data.html), and the base map was used without modification. Digital Elevation Model (DEM) data were obtained from General Bathymetric Chart of the Oceans (https://www.gebco.net/). Data on water systems and road networks were retrieved from OpenStreetMap (OSM) (https://openstreetmap.maps.arcgis.com/home/index.html). (3) **Socioeconomic statistical data for 2023.** Socioeconomic indicators, including population density, GDP, and tourism revenue, were obtained from the General Statistics Office of Vietnam (https://www.nso.gov.vn/en/) and the statistical yearbooks issued by the 63 provinces and central-affiliated cities. (4) **Other data.** Land surface observation data, such as temperature, precipitation, and forest cover, were obtained from the National Geomatics Center of China (NGCC) (https://www.ngcc.cn/zdchgc/qqdbfg/) and National Aeronautics and Space Administration (NASA) (https://ldas.gsfc.nasa.gov/gldas/).

2.3 Methods

(1) **Methods for analyzing distribution characteristics.** The geographic concentration index[36] and the imbalance index[37] were employed to assess the degree of concentration and balance in heritage site distribution. Global Moran's I, local Moran's I, and Getis-Ord Gi* index[38] were used to identify global spatial autocorrelation, local spatial association patterns, and the cold and hot spots of heritage site distribution. The nearest neighbor index[39] was applied to examine the spatial distribution patterns of different types of heritage sites. Kernel density analysis[40] was conducted to investigate the clustering trends of heritage sites. (2) **Methods for identifying influencing factors.** The GeoDetector model[41] was employed. Through single-factor detection, the explanatory power of each independent variable (X) for the spatial distribution of heritage sites was evaluated. Through factor interaction analysis, the combined effect of multiple natural and socioeconomic factors on the spatial differentiation of heritage sites were further revealed (Table 2).

Table 2
Research methods

Method	Formula	Parameter
Geographic concentration index	$G = 100\sqrt{\sum_{i=1}^{n}\left(\frac{X_i}{T}\right)^2}$	*G* denotes the geographic concentration index, where *G*∈[0,100]; a higher value of *G* indicates a more concentrated distribution. X_i represents the number of heritage sites in the i-th spatial unit, *T* denotes the total number of heritage sites in Vietnam, and n represents the total number of spatial units.
Imbalance index	$S = \frac{100n - 50(Y_i + 1)}{\sum_{i=1}^{n}(Y_i + 1)(n+1)}$	*S* denotes the imbalance index, where *S*∈[0,1]. A value of *S* = 0 indicates a perfectly balanced distribution; whereas a larger value of *S* reflects a more concentrated distribution; *S* = 1 indicates complete concentration within a single spatial unit. Y_i represents the cumulative percentage of heritage sites in Vietnam after the spatial units have been ranked in descending order and n denotes the total number of spatial units.
Nearest neighbor index	$R = \frac{r_1}{r_E} = 2\sqrt{r_1 D}$	r_1 represents the observed mean nearest-neighbor distance among heritage sites, r_E denotes the expected mean nearest-neighbor distance under a random distribution, and *D* denotes the density of heritage sites. *R* < 1 indicates a clustered distribution, with smaller values of *R* reflecting a higher degree of clustering; *R* = 1 indicates a random distribution; and *R* > 1 indicates a dispersed distribution with larger values of *R* reflecting a higher degree of dispersion.
Global Moran's I	$I = \frac{n\sum_{i=1}^{n}\sum_{j\neq i}^{n} w_{ij}\left(X_i - \bar{X}\right)\left(X_j - \bar{X}\right)}{\sum_{i=1}^{n}\sum_{j\neq i}^{n} w_{ij}\sum_{i}^{n}\left(X_i - \bar{X}\right)^2}$	*n* denotes the number of spatial units; X_i and X_j represent the numbers of heritage sites in spatial units *i* and *j*, respectively; $\bar{X}$ denotes the mean number of heritage sites, and W_{ij} represents the spatial weight matrix. *I*∈[-1,1], where *I* > 0 indicates positive spatial correlation, *I* < 0 indicates negative spatial correlation, and *I* = 0 indicates no spatial correlation.
Local Moran's I	$I_i = Z_i \sum_{j=1}^{n} W_{ij} Z_j (i \neq j)$	Z_i and Z_j denote the standardized values of spatial units *i* and *j*, respectively. Based on the value of the I_i, spatial units can be classified into four types of local spatial association patterns: HH, HL, LH, and LL.
Getis-Ord Gi* index	$G_i{}^* d = \sum_{i=1}^{n} W_{ij} dy_i$	G_i* denotes the local spatial association index; a significantly positive G_i* indicates that spatial unit *i* is a hot spot of high-value clustering, whereas a significantly negative G_i* indicates that spatial unit

Method	Formula	Parameter
		i is a cold spot of low-value clustering; *d* denotes the distance threshold.
Kernel density analysis	$f(x)=\frac{1}{nh}\sum_{i=1}^{n}K\left(\frac{x-x_i}{h}\right)$	$K\left(\frac{x-x_i}{h}\right)$ denotes the kernel function, and *h* denotes the bandwidth.
GeoDetector model	$q=1-\frac{\sum_{h=1}^{L}N_h\sigma_h^2}{N\sigma^2}=1-\frac{SSW}{SST}$	*q* denotes the explanatory power; *L* represents the zoning of variable; N_h and *N* denote the number of units in zone *h* and in the entire study area, respectively; ${\sigma_h}^2$ and σ^2 denote the variances of the dependent variable within zone *h* and across the entire study area, respectively; and *SSW* and *SST* represent the sum of within-zone variances and the total variance of the entire study area, respectively.

3 Distribution characteristics

The analysis was conducted from two perspectives. First, based on quantitative data, the overall distribution characteristics of the 4,245 heritage sites were examined at the levels of geographical regions and provincial-level administrative divisions. Second, based on spatial location data, the distribution characteristics of high-level heritage sites were explored, with a particular focus on the 153 sites comprising WHS (6 sites) and SNHS (147 sites).

3.1 Overall distribution characteristics of heritage sites

3.1.1 Concentration in the RRD at the regional scale

In terms of the quantity and density of heritage sites, the six geographical regions can be grouped into three tiers. (1) **In terms of quantity.** The first tier is the RRD, hosting 2,338 heritage sites, accounting for approximately 55% of the national total. The second tier comprises the NCCA and the NMMA, together accounting for 34% of the national total. The NCCA ranks second in the number of heritage sites, following the RRD, yet its count is nearly three times lower. The third tier consists of the MRD, the SE and the CH, which collectively account for only 11% of the national total. The CH has the fewest heritage sites, with a number 33 times lower than that of the RRD. (2) **In terms of density.** The first tier is the RRD, with a heritage density of 0.098 sites/km², far exceeding that of other regions. The second tier includes the NCCA, the SE, the NMMA, and the MRD, with heritage densities ranging from 0.005 to 0.008 sites/km². The third tier is the CH, where heritage distribution is sparse, with a density of merely 0.001 sites/km², nearly 100 times lower than that of the RRD. In summary, the RRD stands as a region of high heritage site concentration, exhibiting a significant disparity compared to other regions, whereas the CH represents a region of low heritage site concentration (Table 3).

From the perspective of the imbalance index and geographic concentration index, the overall distribution of heritage sites in Vietnam exhibits a concentrated pattern, with significant inter-regional disparities. (1) The national imbalance index for Vietnam is 0.62, approaching a state of high imbalance (>0.70), indicating an over-concentration of heritage sites in specific regions or provinces. The MRD and the CH record the lowest imbalance indices, suggesting a relatively balanced distribution of heritage sites among provinces within these regions. The RRD has the highest imbalance index, 2.59 times that of the MRD, indicating a high concentration of heritage sites in a few provinces, such as Hanoi. The NMMA has an imbalance index second only to the RRD, with heritage sites mainly concentrated in provinces adjacent to Hanoi. (2) The national geographic concentration index for Vietnam is 30.68. The geographic concentration index of the MRD is below the national average, reflecting a relatively dispersed distribution of heritage sites. The RRD records the highest geographic concentration index, 1.81 times that of the MRD, indicating the strongest clustering of heritage sites. The CH and the SE have geographic concentration indices second only to the RRD, also showing a relatively strong clustering of heritage sites (Table 3).

Table 3 | The number and density, the geographical concentration index and imbalance index of Vietnam's heritage sites in six geographical regions

Region	Sub-region	Number of heritage sites	Heritage density (sites/km²)	Imbalance index	Geographic concentration index
Northern region	RRD	2338	0.098	0.57	53.26
	NMMA	636	0.006	0.53	38.31
Central region	NCCA	806	0.008	0.43	33.70
	CH	70	0.001	0.26	47.94
Southern region	SE	176	0.007	0.33	46.10
	MRD	219	0.005	0.22	29.44
Total		4245	0.013	0.62	30.68

3.1.2 Concentration in Hanoi and its surrounding areas at the provincial scale

In terms of heritage quantity and density at the provincial scale, Hanoi holds a dominant leading position, while severe polarization exists among provinces. (1) **In terms of quantity.** Hanoi exhibits a prominent primacy advantage, hosting 1,181 heritage sites, nearly 5.65 times that of Bac Ninh (209 sites), which ranks second, and accounting for approximately 28% of the national total. Furthermore, provinces surrounding Hanoi generally possess a relatively high number of heritage sites, collectively forming a heritage cluster with Hanoi as its core. Tuyen Quang (185 sites) constitutes a heritage core within the NMMA, while Thanh Hoa (145 sites) and Nghe An (151 sites) serve as heritage cores within the NCCA. However, these cores have not formed significant heritage clusters with their surrounding provinces.

Provinces in the CH and MRD generally have a low number of heritage sites, with most provinces, except An Giang, having fewer than 23 sites. Lai Chau has the fewest heritage sites, with only five, a figure 236 times lower than that of Hanoi, indicating severe polarization in the distribution of Vietnam's heritage sites (Fig. 3a). (2) **In terms of density.** Hanoi ranks first nationally, with a heritage density of 0.305 sites/km², followed by Bac Ninh (0.220 sites/km²) and Hung Yen (0.168 sites/km²). The top 10 provinces by heritage density are all situated in the RRD, forming a high-density cluster centered on Hanoi. In the NMMA, except for five provinces adjacent to Hanoi, such as Bac Giang and Thai Nguyen, heritage densities in the remaining provinces are all below 0.005 sites/km². In the NCCA, with the exception of Phu Yen, Khanh Hoa, and Binh Thuan, heritage densities range between 0.005 and 0.027 sites/km². Provinces in the CH generally exhibit heritage densities below 0.005 sites/km². Heritage densities in most provinces of the SE and the MRD are higher than those in the CH. Additionally, the provinces with the lowest heritage densities are Gia Lai (0.0007 sites/km²) in the CH and Lai Chau (0.0005 sites/km²) in the NMMA, which are 443 times and 620 times lower than Hanoi, respectively, demonstrating an extremely high degree of disparity (Fig. 3b).

Based on the spatial autocorrelation analysis, Hanoi and its surrounding provinces constitute a hot spot and a High-High (HH) cluster for heritage site distribution. (1) The global Moran's I index for the distribution of Vietnam's heritage sites is 0.2408, considerably higher than the expected value for a random distribution (-0.0161), indicating a clustered distribution pattern, with a P-value of 0.0000, demonstrating extremely high significance. Meanwhile, the Z-value reaches 6.4466 (Z > 0), suggesting a pronounced positive spatial autocorrelation in heritage site distribution: high-value areas tend to be adjacent to other high-value areas, while low-value areas are also proximate to each other. The heritage site distribution exhibits clustering inertia, representing a structural spatial clustering rather than a random outcome (Table 4).

Table 4 | Global Moran's I index for the distribution of Vietnam's heritage sites

Global Moran's I Index	Expected index	Variance	Z-value	P-value	Distribution characteristics
0.2408	-0.0161	0.0016	6.4466	0.0000	Clustered distribution

(2) Hot spot and cold spot analysis reveals an extreme pattern characterized by significant concentration in Vietnam's heritage site distribution. Nationwide, only one statistically significant hot spot is identified (Z > 1.96, P < 0.01), which radiating from Hanoi to the surrounding provinces. However, no significant cold spot emerges nationwide, as low-value areas are discretely distributed and fail to reach the threshold for statistical significance (Fig. 4a). (3) The LISA cluster map is further employed to supplement the detection of High-Low (HL) / Low-Low (LL) clusters, compensating for the limited sensitivity of Gi* to cold spot. The results indicate that HH clusters are situated in Hanoi and its surrounding provinces, largely overlapping with the hot spot, thereby validating their spatial coherence as a heritage site cluster. Thai Nguyen and Hoa Binh, located adjacent to the HH cluster, are identified as Low-High (LH) clusters; these two provinces themselves do not host a high number of heritage sites but are situated near high-value areas, exhibiting marginalization characteristics. LL clusters are found in the MRD and Ho Chi Minh City,

as well as in Dien Bien in the NMMA, indicating that these areas not only have a sparse distribution of heritage sites but also lack positive linkages with surrounding provinces, resulting in an isolated pattern. Although provinces such as Quang Nam, Quang Ngai, and Thua Thien-Hue in the NCCA possess a relatively large number of heritage sites, they do not form significant HH clusters due to the influence of discretely distributed heritage sites in adjacent provinces (Fig. 4b).

3.2 Distribution characteristics of high-level heritage sites

3.2.1 Two peaks in the temporal distribution

In terms of temporal distribution, Vietnam's high-level heritage sites exhibit a wave-like pattern, with two prominent peaks occurring during the Feudal Period and the Period of North and South Vietnam. The Feudal Period has the largest number of heritage sites, with 73 sites, accounting for 47.71% of the total high-level heritage sites. The Period of North and South Vietnam ranks second, with 39 sites, accounting for 25.49%. The heritage sites from the Feudal Period and the Period of North and South Vietnam together constitute 73.20% of the total, marking these as the primary formation periods for Vietnam's high-level heritage sites. The number of heritage sites from the remaining four periods is relatively small: the Reunification Period, being the most recent, has the fewest, with only one site; the Prehistoric Period and the Period of Northern Domination, being more remote in time, have 15 and 12 sites, respectively; the French Colonial Period, spanning 60 years, is associated with 13 heritage sites. Although the Period of North and South Vietnam lasted only 31 years, it contains three times as many heritage sites as the French Colonial Period. The reason for this is that the frequent warfare during this time led to the formation of a substantial number of revolutionary and war-related heritage sites.

The types of heritage sites from the Feudal Period are more fully developed, while the Period of North and South Vietnam has the largest number of HM sites. The 153 high-level heritage sites can be classified into five types: 75 HM, 32 MM, 28 AAM, 10 SS, and 8 AM sites. The Feudal Period encompasses four heritage types, notably possessing 25 AAM and 26 MM sites, ranking first among the six periods; it also has a relatively large number of HM sites (20), ranking second. This reflects the accumulation of rich historical and cultural landscapes from this era, including religious architecture, palaces, and citadels. Although the Period of North and South Vietnam features only one heritage type—HM, its number reaches 39, ranking first and being nearly twice that of the Feudal Period. The reason for this is that the Period of North and South Vietnam witnessed the outbreak of the resistance wars against France and the United States, and the resulting heritage sites are all HM associated with revolution and warfare. In particular, “linear heritage” sites such as the Ho Chi Minh Trail and the Ho Chi Minh Sea Trail were formed, leaving HM sites across more than ten provinces. Furthermore, heritage sites from the French Colonial Period are exclusively HM sites. The prehistoric period and the Period of Northern Domination each encompass four heritage types, with both periods having four AM sites each, and the prehistoric period possessing eight SS sites (Table 5).

Table 5 | Temporal distribution and type composition of Vietnam’s high-level heritage sites

Historical Periods	Number of Heritage Sites					
	HM	AAM	AM	SS	MM	Total
Prehistoric Period (Stone Age – 2nd century BC)	0	1	4	8	2	15
Period of Northern Domination (207 BC – 10th century AD)	2	2	4	0	4	12
Feudal Period (968 AD – 1885)	20	25	0	2	26	73
French Colonial Period (1885 – 1945)	13	0	0	0	0	13
Period of North and South Vietnam (1945 – 1976)	39	0	0	0	0	39
Reunification Period (1976 – present)	1	0	0	0	0	1
Total	75	28	8	10	32	153

3.2.2 Significant north–south disparities in the spatial distribution

The distribution of Vietnam's high-level heritage sites is characterized by high-intensity clustering on the whole, with the observed average nearest neighbor distance (21,094.74 m) being significantly smaller than the expected average distance under a random distribution (38,596.83 m). The R-value is 0.55 (R < 1), with a Z-value of -10.73 and a P-value of 0, passing the 1% significance test. HM, AAM, and MM sites exhibit relatively high clustering intensity, all presenting clustered distribution patterns. AM and SS sites display relatively low clustering intensity, exhibiting random distribution patterns (Table 6).

Table 6 | Nearest neighbor index for Vietnam's high-level heritage sites

Heritage types	Number of heritage sites	Observed mean nearest-neighbor distance /m	Expected mean nearest-neighbor distance /m	R-value	Z-value	P-value	Distribution characteristics
Overall	153	21094.74	38596.83	0.55	-10.73	0.00	Clustered
HM	75	36263.43	55127.29	0.66	-5.67	0.00	Clustered
AAM	28	41060.15	58218.95	0.71	-2.98	0.00	Clustered
MM	32	48284.10	59778.56	0.81	-2.08	0.04	Clustered
AM	8	98478.58	123020.99	0.80	-1.08	0.28	Random
SS	10	116051.25	94156.32	1.23	1.41	0.16	Random

The spatial distribution of Vietnam's high-level heritage sites is extremely uneven, generally presenting a pattern characterized by a high concentration in the northern region (NMMA, RRD) and a sparse, dispersed distribution in the central region (NCCA, CH) and southern region (SE, MRD). (1) From an overall perspective, the majority of heritage sites are distributed in the northern region, forming a concentrated

core in and around Hanoi. A smaller number of heritage sites are dispersedly distributed across central and southern region, forming two belt-shaped areas with slightly higher kernel density values along the “Quang Tri - Quang Nam - Binh Dinh” and “Dong Nai - Ho Chi Minh City - Tra Vinh” corridors. This “one core, two corridors” pattern broadly corresponds to the layout of ancient Vietnamese capitals and the axes of modern urban development (Fig. 5a). (2) From a typological perspective, HM, AAM, and MM sites all exhibit pronounced north-south disparities in their spatial distribution, while AM and SS sites show less pronounced north-south differences due to their smaller numbers. Specifically, MM and AAM sites have the highest peak kernel density values, being highly concentrated in Hanoi and its surrounding provinces, with sparse distribution in the central and southern region (Fig. 5c, 5f). HM sites have a lower peak kernel density value than MM and AAM sites. Besides forming a high-density cluster that spreads outward from Hanoi in the northern region, HM sites are also widely distributed in the central and southern region. However, most HM sites in the central and southern region are war-related (Fig. 5b). AM and SS sites have peak kernel density values far lower than the other three types, being dispersedly distributed across a few provinces (Fig. 5d, 5e).

(3) In terms of different historical periods, the heritage site distribution from the Feudal Period exhibits pronounced clustering characteristics and north-south disparities, while heritage sites from other periods do not show evident clustering patterns, although certain north-south differences also exist. Specifically, the peak kernel density value for heritage sites from the Feudal Period is as high as 47.27, more than 40 times that of heritage sites from other periods. They are highly concentrated in and around Hanoi in the north, with only a sparse distribution in the central and southern region (Fig. 6d). The peak kernel density value for heritage sites from the Period of North and South Vietnam is only 1.44; heritage sites in the central and southern region are relatively numerous and show a weak clustering trend, while those in the northern region are fewer and scattered. This distribution pattern is completely different from the north-south disparity characteristic of the Feudal Period (Figure 6f). The peak kernel density values for heritage sites from the Prehistoric Period and the French Colonial Period are slightly lower than that of the Period of North and South Vietnam; heritage sites in the northern region are relatively numerous and show a weak clustering trend, while those in the central and southern region are fewer and dispersedly distributed (Fig. 6b, 6e). Heritage sites from the period of Northern Domination have the lowest peak kernel density value, with the least pronounced clustering characteristics and north-south disparities (Fig. 6c). As the Reunification Period has only one heritage site, located in An Giang province, its spatial pattern was not analyzed here.

4 Influencing factors

4.1 Indicator construction and detection results

Employing the GeoDetector model, this study investigated the factors influencing the overall distribution of Vietnam’s heritage sites at the provincial scale. Considering data availability and applicability, 16 factors were selected from both natural and socio-economic dimensions, encompassing terrain, climate, and population, et al[42,43,44]. Among these, seven factors passed the significance test, ranked in descending

order of explanatory power (q-value) as follows: X7 (population density) > X14 (tourism revenue) > X9 (road passenger transport volume) > X16 (number of intangible cultural heritage items) > X8 (road network mileage) > X13 (Human Development Index, HDI) > X4 (precipitation). The top six factors are all socio-economic factors, with only X4, ranked seventh, being a natural factor. This suggests that socio-economic factors play a dominant role in shaping the distribution of Vietnam's heritage sites (Table 7). Further interaction detection results show that all pairwise interactions exhibit bivariate enhancement, with the explanatory power of most interactions being significantly greater than that of individual factors alone. This suggests that the distribution of Vietnam's heritage sites results from the coupled effects of multiple interacting factors. The interaction factor combinations with the highest explanatory power include X3∩X16, X6∩X16, X13∩X16, X1∩X6, X15∩X16, X8∩X16, and X4∩X16. All of these have explanatory power values above 0.955, and most of these involve interactions with X16. Notably, natural factors, which show relatively weak explanatory power when considered individually, display a certain degree of improvement in explanatory power after bivariate interactions (Fig. 7).

Table 7 | Indicator system and detection results of influencing factors of Vietnam's heritage distribution

Influencing factors	Driving factors	q-value	p-value	Ranking of q-value
Natural factors	X1 Elevation	0.142	0.146	9
	X2 Slope	0.034	0.729	15
	X3 Temperature	0.129	0.117	10
	X4 Precipitation	0.143*	0.095	8
	X5 Forest cover	0.039	0.683	14
	X6 Length of river systems	0.023	0.861	16
Socio-economic factors	X7 Population density	0.591***	0.000	1
	X8 Road network mileage	0.290**	0.026	5
	X9 Road passenger transport volume	0.450**	0.014	3
	X10 Gross Regional Product index	0.071	0.411	13
	X11 Per capita GRP	0.163	0.105	7
	X12 Urbanization level	0.108	0.220	11
	X13 Human Development Index	0.164*	0.087	6
	X14 Tourism revenue	0.452**	0.014	2
	X15 Domestic tourist arrivals	0.094	0.298	12
	X16 Number of intangible cultural heritage items	0.304**	0.034	4

Note：*** indicates significance at the 0.01 level ($p < 0.01$); ** indicates significance at the 0.05 level ($0.01 < p < 0.05$); * indicates significance at the 0.1 level ($0.05 < p < 0.1$).

4.2 Analysis of influencing factors

4.2.1 Natural factors

Natural factors impose basic constrains on the distribution of Vietnam's heritage sites. First, from the perspective of single-factor analysis, only X4 (precipitation) passed the significance test, indicating relatively strong explanatory power. Precipitation constitutes a basic condition for agricultural production and human settlement. Regions with abundant precipitation, such as the RRD and NCCA, are more favorable for agricultural development and the expansion of urban and rural settlements, thereby promoting the accumulation and formation of heritage sites.

Second, from the perspective of dual-factor interaction, the explanatory power of natural factors improved to varying degrees after interaction, indicating that natural factors exhibit characteristics of implicit constraint and explicit synergy. A single natural factor alone is unlikely to determine settlement formation and cultural accumulation. However, when two natural factors, or a natural factor and a socio-economic factor, interact to form a composite niche, they can provide a appropriate environment for social development and create favorable conditions for cultural transmission. Among the interactions between natural factors, X1∩X6 shows the strongest explanatory power, with the q-value increasing dramatically from 0.142 for X1 and 0.023 for X6 to 0.958 for X1∩X6, indicating an extremely significant enhancement effect. This suggests that the interaction between elevation and river systems has a substantial influence on heritage site distribution, as favorable elevation and water-resource conditions are conducive to the emergence and development of civilizations. The RRD, characterized by low elevation and dense river networks, served as a core area of ancient agricultural civilization in Vietnam and contains both the largest number and the highest density of heritage sites. By contrast, the CH, with high elevation and poorly developed river systems, remained relatively less developed culturally, resulting in the fewest and most sparsely distributed heritage sites. However, apart from X1∩X6, the q-values of the remaining interaction pairs involving two natural factors are all below 0.900. In contrast, 22 interaction pairs between natural factors and the socio-economic factors X7, X8, X9, X14, and X16 have q-values greater than 0.900. Notably, the q-values for interactions between X1 (elevation), X5 (forest cover), and these five socio-economic factors all exceed 0.925, while the q-values for interactions between X3 (temperature), X4 (precipitation), and four of these socio-economic factors all exceed 0.936. This indicates that interactions between natural and socio-economic factors have a far greater effect on heritage site distribution than interactions between two natural factors. Therefore, when superimposed on socio-economic activities, natural conditions can exert a much stronger influence on the distribution of Vietnam's heritage sites. However, natural factors alone are not a sufficient condition for heritage formation; under equally favorable natural conditions, heritage sites tend to be concentrated in areas with better socio-economic conditions.

4.2.2 Socio-economic factors

Socio-economic factors constitute the core driving force shaping the distribution of Vietnam's heritage sites, with six factors passing the significance test. (1) X7 (population density) has a q-value of 0.591, representing the strongest individual explanatory power among all factors. In addition, its interactions with other factors are also notably strong, as the q-values of X7∩X1, X7∩X10, X7∩X16, X7∩X4, and X7∩X14 all exceed 0.949. These results indicate that population density is a key factor influencing heritage site distribution. Densely populated areas often function as political or economic centers and tend to exhibit higher levels of urban and rural development as well as greater cultural prosperity, thereby directly promoting heritage formation. By contrast, sparsely populated areas are generally less favorable for cultural development and heritage formation. The RRD, which has the highest population density, also contains the largest number and highest density of heritage sites, whereas the CH, with the lowest population density, has the fewest and most sparsely distributed heritage sites. (2) X14 (tourism revenue) ranks second in explanatory power, suggesting a positive relationship

between tourism development and heritage site distribution. Heritage sites can serve as important tourism resources, while the tourism industry can in turn support heritage conservation. As a result, many major tourist cities, such as Hanoi, Nghe An, and Haiphong, are also areas rich in heritage resources. In recent years, with the rapid development of Vietnam's tourism industry, the government has intensified efforts in heritage preservation and revitalization. For example, in 2024, Hoi An City in Quang Nam received 4.5 million visitors[45]. The local government has actively pursued heritage designations to promote tourism development and has reinvested tourism revenues into heritage conservation, thereby forming a positive cycle of "heritage protection - tourism revenue - conservation investment"[46]. (3) X9 (road passenger transport volume) and X8 (road network mileage) rank third and fifth in explanatory power, respectively, indicating that transportation conditions significantly affect heritage site distribution. Well-developed transport networks facilitate cultural exchange and heritage formation. Areas along the ancient mandarin roads, such as the "Hanoi - Hue, Hoi An - Ho Chi Minh City" route, are characterized by dense populations, numerous settlements, and frequent cultural interactions, which contribute to the concentration of heritage sites in these regions. (4) X16 (number of intangible cultural heritage items) ranks fourth in explanatory power, with a single-factor q-value of 0.304. After interaction with any other factor, its q-values increases to above 0.940, suggesting a strong synergy between tangible and intangible cultural heritage in Vietnam. (5) X16 (HDI) reflects the health, education, and living standards of a country or region[47]. Areas with higher HDI generally have better public services and a more educated population, thereby providing a favorable social foundation for heritage conservation. Hanoi, as the national center of heritage site concentration, also exhibits a relatively high HDI.

5 Discussion and conclusions

5.1 Discussion

Most existing studies have emphasized the significant influence of natural factors, such as topography, climate and river systems, on the distribution of tangible cultural heritage[48,49,50]. However, this study reveals that natural factors provide only the basic constrains on the distribution of Vietnam's heritage sites, whereas socio-economic factors constitute the primary driving force. Moreover, the MRD and the SE, which share similar natural conditions with the RRD, as well as Ho Chi Minh City, which is economically comparable to Hanoi, exhibit pronounced north-south disparities in heritage site distribution. The underlying reason for this phenomenon lies in Vietnam's distinctive political and cultural landscape, which are concealed behind socio-economic factors.

From the perspective of the political landscape, Vietnam underwent a tortuous process of north-south division and reunification. From 207 BC to the 10th century AD, northern Vietnam was long administered as Chinese commanderies and counties. From the 10th to the 15th century, although successive dynasties continuously expanded southward, the political center of gravity remained in the north for a long period, with Thang Long (now Hanoi) as the capital. From the 16th to the 18th century, a north-south division took shape, and Hue was established as the political center of the southern regime. In 1802,

following the establishment of the Nguyen Dynasty, Hue was designated as the capital in an effort to unify the north and south and promote centralized rule. From 1885 to 1945, France imposed colonial rule over Vietnam, dividing the country into Cochinchina, Annam, and Tonkin, adopting a strategy of “divide and rule”, which institutionalized north-south differences. From 1945 to 1976, Vietnam was split into the Democratic Republic of Vietnam in the north and the Republic of Vietnam in the south; the north, with Hanoi as its capital, adopted a socialist system, while the south, with Saigon (now Ho Chi Minh City) as its capital, followed a capitalist system. After reunification in 1976, Hanoi was established as the national capital, although certain political and economic differences between the north and south have persisted[51]. The north-south differences in Vietnam’s political landscape, together with the fact that Hanoi has remained the country’s political center for nearly a millennium—apart from brief interruptions—have continuously promoted socio-economic development, cultural prosperity, and urban construction in Hanoi and its surrounding areas, as well as across the RRD. As a result, the RRD has become a major concentration area of heritage sites, with Hanoi and its vicinity forming a core cluster, particularly for heritage sites dating from the Feudal Period. However, during the modern period of north-south division, the Vietnam War was fought more intensely, with its main battlefields located in the CH and SE, and the corridor “Quang Tri - Hue - Quang Nam - Quang Ngai” along the NCCA. Consequently, heritage sites from this period—consisting primarily of war-related HM sites—display a distribution pattern characterized by a greater concentration in the south than in the north.

From the perspective of the cultural landscape, Vietnam has undergone an evolutionary process characterized by north-south differentiation and multicultural integration. During the Period of Northern Domination, northern Vietnam was ruled by China and profoundly influenced by Chinese civilization, while the south, inhabited by Cham and Khmer peoples, was deeply shaped by Indian civilization. This formed the underlying cultural foundation of Vietnam’s north-south cultural pattern. After the 11th century, the Kinh polity continued its southward expansion, gradually incorporating Cham and Khmer-inhabited areas into Kinh rule. As a result, Kinh culture spread southward and fused with local Cham and Khmer cultures. After the Nguyen Dynasty unified the country in the 18th century, its rulers attempted to integrate northern and southern cultures through Confucianism, but these efforts did not completely eliminate north-south differences; by then, the south had already developed a cultural complex distinct from that of the north. From the mid-19th century onward, French colonial rule further reinforced the cultural divide between north and south. Western education, legal systems, and administrative institutions were introduced earlier into the south, whereas although French culture also spread to the north, its influence there was comparatively weaker[51]. Even after national reunification, north–south cultural differences have continued to manifest in social character, religious beliefs, and language. It can thus be seen that in the north, centered on Hanoi, the fusion of Kinh and Chinese cultures came to constitute the mainstream of Vietnam’s traditional culture. In contrast, Cham, Khmer, and Western cultures in the south did not become part of this mainstream tradition. Because most heritage sites in Vietnam are remnants of historically mainstream traditional culture, HM, AAM, and MM sites are all concentrated in Hanoi and its surrounding areas. In particular, the latter two categories are distributed almost exclusively in the northern region of Vietnam and are only rarely found in the central and southern regions.

In summary, the distribution of Vietnam's heritage sites is shaped primarily by socio-economic factors and the underlying political and cultural landscape behind them. The natural geographical environment provided the initial setting and resources for cultural formation and heritage site distribution, but it serves only as a background condition rather than a determining factor. Socio-economic factors constitute the core driving force shaping cultural accumulation and heritage site distribution: population density, the intensity of economic activity, transport accessibility, and the level of social development directly affect the degree of regional cultural prosperity and determine the quantity and density of tangible cultural heritage sites such as settlements, citadels, palaces, and temples. As a traditional economic center, the RRD has therefore naturally become a zone of heritage site concentration. Nevertheless, the deeper force that has truly shaped the north-south disparity in Vietnam's heritage site distribution is the political and cultural landscape formed over the course of Vietnamese long history. Moreover, this political and cultural landscape is closely intertwined with socio-economic factors. It has guided the direction and trajectory of socio-economic development, while socio-economic structures and levels of development, in turn, reflect its configuration. Through socio-economic mechanisms, the political and cultural landscape has ultimately determined the distribution characteristics of Vietnam's heritage sites (Fig. 8).

5.2 Conclusions

(1) Overall, Vietnam's heritage sites are concentrated in the RRD, particularly in Hanoi and its surrounding provinces. The country's six geographical regions can be grouped into three tiers in terms of heritage site distribution: the RRD constitutes the first tier, accounting for 55% of the national total of heritage sites and exhibiting the highest density, whereas the CH falls into the third tier. Severe polarization among provinces is pronounced: Hanoi has the highest number and density of heritage sites, while Lai Chau has the lowest, with Hanoi exceeding Lai Chau by 236 times in number and 620 times in density. Centered on Hanoi and radiating outward, Vietnam displays the country's only significant hot spot and HH cluster, whereas the MRD together with Ho Chi Minh City constitutes a LL cluster. (2) With regard to high-level heritage sites, their temporal distribution exhibits two peaks, while the spatial distribution shows a significant north-south disparity. Heritage sites from the Feudal Period accounts for the largest number, comprising 47.71% of the total high-level heritage sites, followed by heritage sites from the Period of North and South Vietnam, which accounting for 25.49%. AAM sites, as well as MM sites, are highly concentrated in Hanoi and its surrounding areas and are only rarely distributed in the central and southern regions. HM sites, by contrast, not only forming a high-density cluster centered on Hanoi but are also widely distributed across the central and southern regions. Heritage sites from the Feudal Period are highly concentrated in Hanoi and its surrounding areas, with only limited distribution in the central and southern regions, whereas heritage sites from the Period of North and South Vietnam are found predominantly in the central and southern regions. (3) Socio-economic factors constitute the core driving force shaping the distribution of Vietnam's heritage sites, while natural factors play only basic constrains. The political and cultural landscape, in turn, represents the deeper force shaping the north-south disparity in heritage site distribution.

This study reveals the distribution characteristics and influencing factors of tangible cultural heritage sites in Vietnam, thereby providing a scientific basis for the nationally coordinated implementation of region-

specific and category-based conservation strategies. However, due to the lack of data from the NHS inventory, the spatiotemporal distribution analysis could only be conducted for high-level heritage sites. Future research could be advanced by supplementing the NHS data, including information on site location and dating, and by undertaking comparative studies with other Southeast Asian countries.

Declarations

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Author Contribution

ZHAO Min, ZHANG Sisi, WUHUANG Yanling and JIANG Siyi wrote the main manuscript text. CHENG Yuelu, ZHANG Sisi and WUHUANG Yanling prepared Figures 1-5. LI Peng (corresponding author) supervised the research and reviewed the manuscript. All authors reviewed the manuscript.

Data Availability

The list of WHS was obtained from the UNESCO World Heritage List (https://whc.unesco.org/en/list/).The spatial location data for WHS and SNHS were collected using Python-based web scraping from Google Maps. Socioeconomic statistical data for 2023. Socioeconomic indicators, including population density, GDP, and tourism revenue, were obtained from the General Statistics Office of Vietnam (https://www.nso.gov.vn/en/) and the statistical yearbooks issued by the 63 provinces and central-affiliated cities. Land surface observation data, such as temperature, precipitation, and forest cover, were obtained from the National Geomatics Center of China (NGCC) (https://www.ngcc.cn/zdchgc/qqdbfg/) and National Aeronautics and Space Administration (NASA) (https://ldas.gsfc.nasa.gov/gldas/).

References

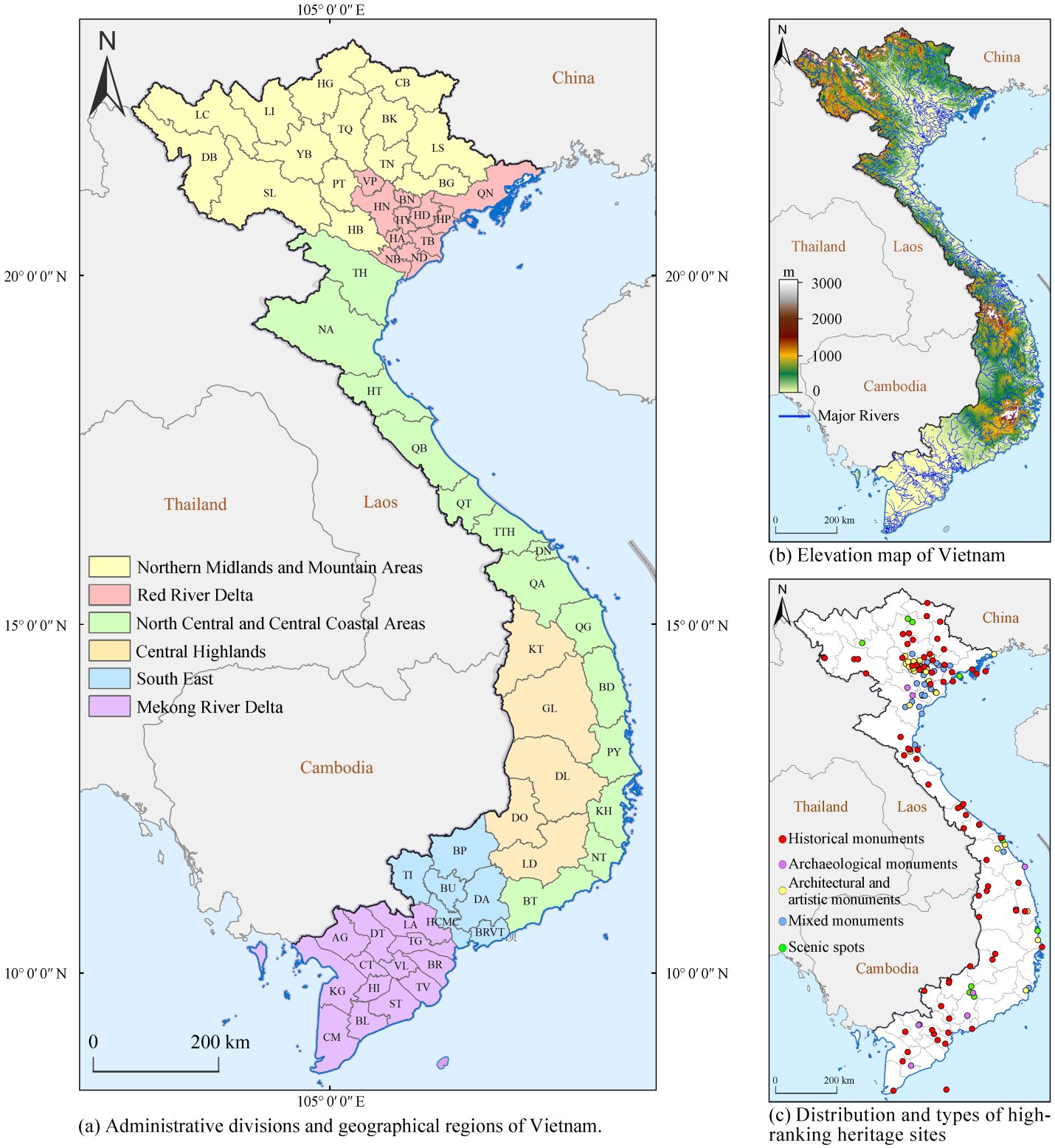
1. Li, X., Zhou, X. & Weng, F. Interpretation of cultural landscape layering and assessment of heritage value of urban historical parks: A case study of Xiamen Zhongshan Park. Landsc. Archit. 32, 132–141 (2025).
2. Shan, J. & Liu, L. Research on public interest litigation of cultural heritage in urban and rural construction. Urban Dev. Stud. 32, 32–37 (2025).
3. Jia, L. The frontier and trend of foreign research on intangible cultural heritage. J. Ethn. Cult. 16, 112–124 (2024).
4. VietnamPlus. Vietnam’s 15th National Assembly eighth session: Discussing cultural heritage protection mechanisms and resources. https://zh.vietnamplus.vn/article-post227735.vnp, Accessed 28 March 2025.

5. Cannon, M. A. Tradition, still remains: Sustainability through ruin in Vietnamese music for diversion. Ethnomusicology Forum 25, 146–171 (2016).
6. Elias, H. Bronze drums of Vietnam and south-west China: A shared heritage. Arts Asia 52, 106–117 (2022).
7. Nina, G. The Muong epic cycle of 'The birth of the earth and water': Main themes, motifs, and culture heroes. Folklore 75, 47–70 (2019).
8. Carmen, S., Philip, P., Nguyen, K. T. K. et al. Diverse ceramic technologies in Neolithic southern Vietnam: The case of Rach Nui. Asian Perspect. (2022).
9. Nam, K. N. & Anh, Q. P. The management of minority heritage: Critical challenges to Vietnamese Catholic heritage seen from the case study of Bui Chu Cathedral. Int. J. Herit. Stud. 27, 734–751 (2021).
10. Pham, V., Nghiem, V. S., Pham, V. C. et al. Urbanization impact on landscape patterns in cultural heritage preservation sites: A case study of the complex of Huế monuments, Vietnam. Landsc. Ecol. 36, 1–26 (2021).
11. Nguyen, N. K., Mai, D. V., Phan, A. Q. et al. Adaptation and adversity acceptance as resilience to flooding at World Heritage Sites: A case study of Hoi An Ancient Town, Vietnam. Hist. Environ. 15, 383–408 (2024).
12. Dang, P. K. T. Tourism imaginaries and the selective perception of visitors: Postcolonial heritage in Con Dao Islands, Vietnam. Isl. Stud. J. 16, 249–270 (2021).
13. Quang, V. S. & Noseworthy, W. B. A view of Champā sites in Phú Yên Province, Vietnam: Toward a longue durée of socio-religious context. Religions 13, 656 (2022).
14. Linh, T. N., Chisato, A., An, T. T. et al. Indicator-based approach for flood vulnerability assessment in ancient heritage city of Hoi An, Central region of Vietnam. Nat. Hazards 114, 2357–2385 (2022).
15. Bui, T. H., Tran, E. T. J., Bui, D. W. et al. The adaptive resilience of living cultural heritage in a tourism destination. J. Sustain. Tour. 28, 1022–1040 (2020).
16. Thuc, D. L., Nguyen, V. M., Duy, H. K. et al. Prioritizing barriers to the conservation of cultural heritage buildings in adaptation to urbanization and climate change. J. Clean. Prod. 473, 143529 (2024).
17. Dat, L. Q., Chou, S. Y., Tam, P. M. et al. Factors influencing residents' willingness to pay for mangrove forest environmental services in Phu Long, Vietnam. SAGE Open 14, 21582440241264604 (2024).
18. Quang, T. D., Dang Vo, N. M., Van Nguyen, H. et al. Understanding tourists' experiences at war heritage sites in Ho Chi Minh city, Vietnam: A netnographic analysis of TripAdvisor reviews. Leis. Stud. 43, 624–643 (2024).
19. Pham, V., Nghiem, V. S., Pham, V. C. et al. Urbanization impact on landscape patterns in cultural heritage preservation sites: A case study of the complex of Huế monuments, Vietnam. Landsc. Ecol. 36, 1–26 (2021).
20. Liang, Y., Yang, R., Wang, P. et al. A quantitative description of the spatial–temporal distribution and evolution pattern of world cultural heritage. Herit. Sci. 9, 80 (2021).

21. Liu, J., Liu, S., Ma, M. et al. The spatiotemporal distribution characteristics and influencing factors of architectural heritage in the 20th century in China. South Archit. 88–97 (2024).
22. Xu, X., Sun, X. & Liu, J. Spatial-temporal characteristics and determinants of World Heritages in Italy. World Reg. Stud. 28, 187–196 (2019).
23. Zhao, Y., Zheng, R., Ma, J. et al. Landscape characteristics and conservation and utilization mechanisms of composite agricultural heritage systems in Japan. Landsc. Archit. 31, 65–73 (2024).
24. Yin, G. Geographical distribution characteristics of African world heritages. Prog. Geogr. 32, 958–966 (2013).
25. Li, Q., Guo, S. & Xu, Z. Temporal and spatial patterns of modern industrial heritage in China: Considering the national key protection units of cultural relics. South Archit. 44–54 (2022).
26. Travis, C. Heritage GIS: Deep mapping, preserving, and sustaining the intangibility of cultures and the palimpsests of landscape in the west of Ireland. Sustainability 17, 6870 (2025).
27. Yong, H. Bibliometric analysis of GIS applications in heritage studies based on Web of Science from 1994 to 2023. Herit. Sci. 12, 57 (2024).
28. Jiao, M., Lu, L., Li, T. et al. Spatial distribution characteristics and the relevant influencing factors of intangible cultural heritage in the Grand Canal Cultural Belt. J. Zhejiang Univ. Sci. 52, 591–604 (2025).
29. Zhou, C., Zhou, L. & Zhang, X. Spatial differentiation and driving factors of multi-category intangible cultural heritages in China. Geogr. Geo-Inf. Sci. 39, 72–80 (2023).
30. Xu, Q. & Shi, S. Spatial relationship and influencing factors of traditional villages and intangible cultural heritage along the Grand Canal. Geogr. Sci. 45, 603–612 (2025).
31. Wang, F., Zhang, T. & Zhang, S. MGWR reveals scale heterogeneity shaping intangible cultural heritage distribution in China. npj Herit. Sci. 13, 367 (2025).
32. Zhang, B., Fan, J. & Huang, Z. Research on spatial morphological characteristics and influencing factors of industrial heritage: A case study of nine industrial heritages in Guizhou Province. Land 13, 1785 (2024).
33. Lu, S. & Wang, L. Study on spatial distribution characteristics of intangible cultural heritage in Huizhou region. Resour. Environ. Yangtze Basin 30, 23–31 (2021).
34. Chami, F. M., Ndyanabo, S. A. & Stoecker, H. Finding solutions for managing, protecting, and promoting Tendaguru palaeontological site in Tanzania. Geoheritage 17, 44 (2025).
35. Fan, P., Ouyang, Z., Nguyen, D. et al. Urbanization, economic development, environmental and social changes in transitional economies: Vietnam after doimoi. Landsc. Urban Plan. 187, 145–155 (2019).
36. Ju, X., Yang, C., Zhao, M. et al. Spatial distribution characteristics and influencing factors of traditional villages in Zhejiang, Anhui, Shaanxi, Yunnan provinces. Econ. Geogr. 42, 222–230 (2022).
37. Nie, X., Ma, M., Ji, J. et al. The spatial distribution of traditional intangible cultural heritage medicine of China and its influencing factors. Herit. Sci. 11, 118 (2023).
38. Yang, D., Zou, J., Ma, X. et al. Spatial distribution characteristics and sustainable development of sports tourism resources: A case of Xinjiang. http://kns.cnki.net/kcms/detail/65.1103.X.20250228.1619.001.html, Accessed 9 April 2025.

39. Jiang, L. & Cai, J. Research on the spatial and temporal distribution and evolution characteristics of ancient architectural heritage in southeastern Zhejiang. Sustainability 15, 16618 (2023).
40. Niu, X., Tan, L., Liu, F. et al. System structure of marine cultural heritage resources and spatial distribution characteristics of marine cultural heritages in China. Econ. Geogr. 43, 211–219 (2023).
41. Liao, Y., Cenci, J. & Zhang, J. Chinese modern architectural heritage resources: Perspectives of spatial distribution and influencing factors. ISPRS Int. J. Geo-Inf. 12, 358 (2023).
42. Li, K., He, J., Meng, Y. et al. Spatial distribution and influencing factors of key rural tourism villages in the Yellow River Basin. https://link.cnki.net/urlid/65.1103.X.20250801.1157.001, Accessed 31 October 2025.
43. Tian, L., Sun, F. & Zhang, S. Spatial distribution characteristics of intangible cultural heritage in the Yellow River Basin. J. Arid Land Resour. Environ. 36, 186–192 (2022).
44. Zhang, Y., Yang, M., Li, Z. et al. Study on the spatial distribution characteristics and influencing factors in the reuse of national industrial heritage sites in China. Sustainability 15, 16685 (2023).
45. VietnamPlus. Quang Nam province takes measures to promote sustainable tourism development in Hoi An heritage core area. https://zh.vietnamplus.vn/article-post233688.vnp, Accessed 13 August 2025.
46. Nguyen, A. L., Nguyen, H. M., Hoang, N. V. et al. Tourists' preferences and willingness to pay for protecting a World Heritage site from coastal erosion in Vietnam. Environ. Dev. Sustain. 26, 27607–27628 (2023).
47. Chen, Y., Zhu, L., Hong, W. et al. Study on the evaluation of comprehensive rural development level and obstacles in countries worldwide. World Reg. Stud. 34, 84–96 (2025).
48. Fan, X. & Sun, L. Geographic distribution characteristics and influencing factors for industrial heritage sites in Italy based on GIS. Sustainability 16, 2085 (2024).
49. Huang, Y., Huang, Y., Chen, Y. & Yang, S. Spatial evolution of traditional waterside settlements south of the Yangtze River and the distribution of settlement heritage: Evidence from the Nanxi River Basin. npj Herit. Sci. 13, 62 (2025).
50. Fu, J., Li, Q., Xie, W., Mao, H. & Zhang, C. Tracing the historical development and spatial distribution of Buddhist temples in Xiamen, China. npj Herit. Sci. 13, 397 (2025).
51. Qin, D. & Du, D. Vietnam Geography (The Commercial Press, Beijing, 2024).

Figures



(a) Administrative divisions and geographical regions of Vietnam.

(b) Elevation map of Vietnam

(c) Distribution and types of high-ranking heritage sites

Figure 1

Overview of Vietnam and its high-level heritage sites

Data source: The vector data for Vietnam'sadministrative divisions were obtained from the GADM (Database of Global Administrative Areas), Version 4.1(2025). The national boundary vector data were derived from the standard base map provided by the National Administration of Surveying, Mapping and

Geoinformation of China (Map Approval No. GS [2016] 1666). The base map was not modifiedand the same applies hereafter.

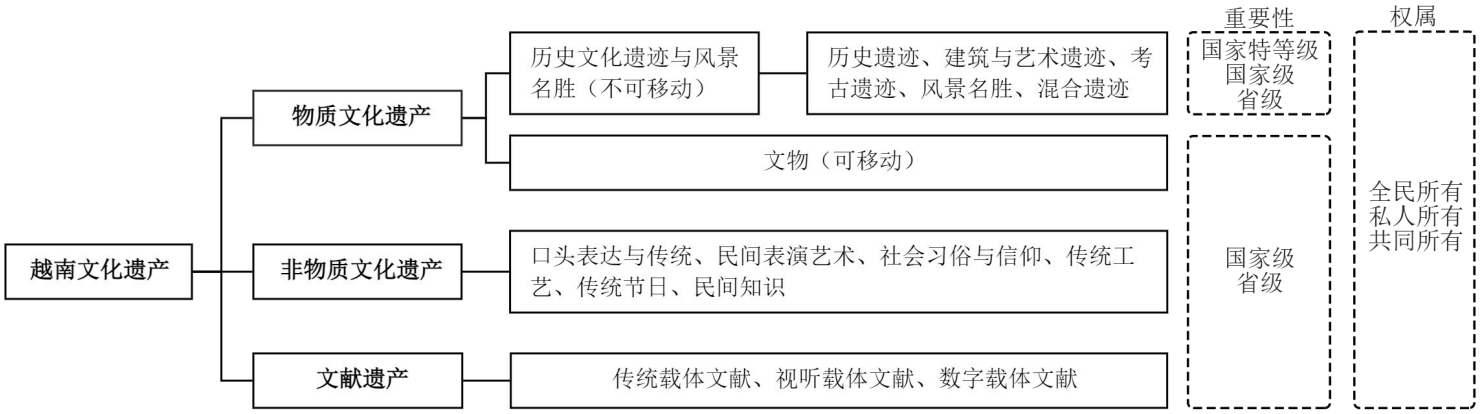


Figure 2

The cultural heritage system of Vietnam

Data source: According to Vietnam's Law on Cultural Heritage (45/2024/QH15).

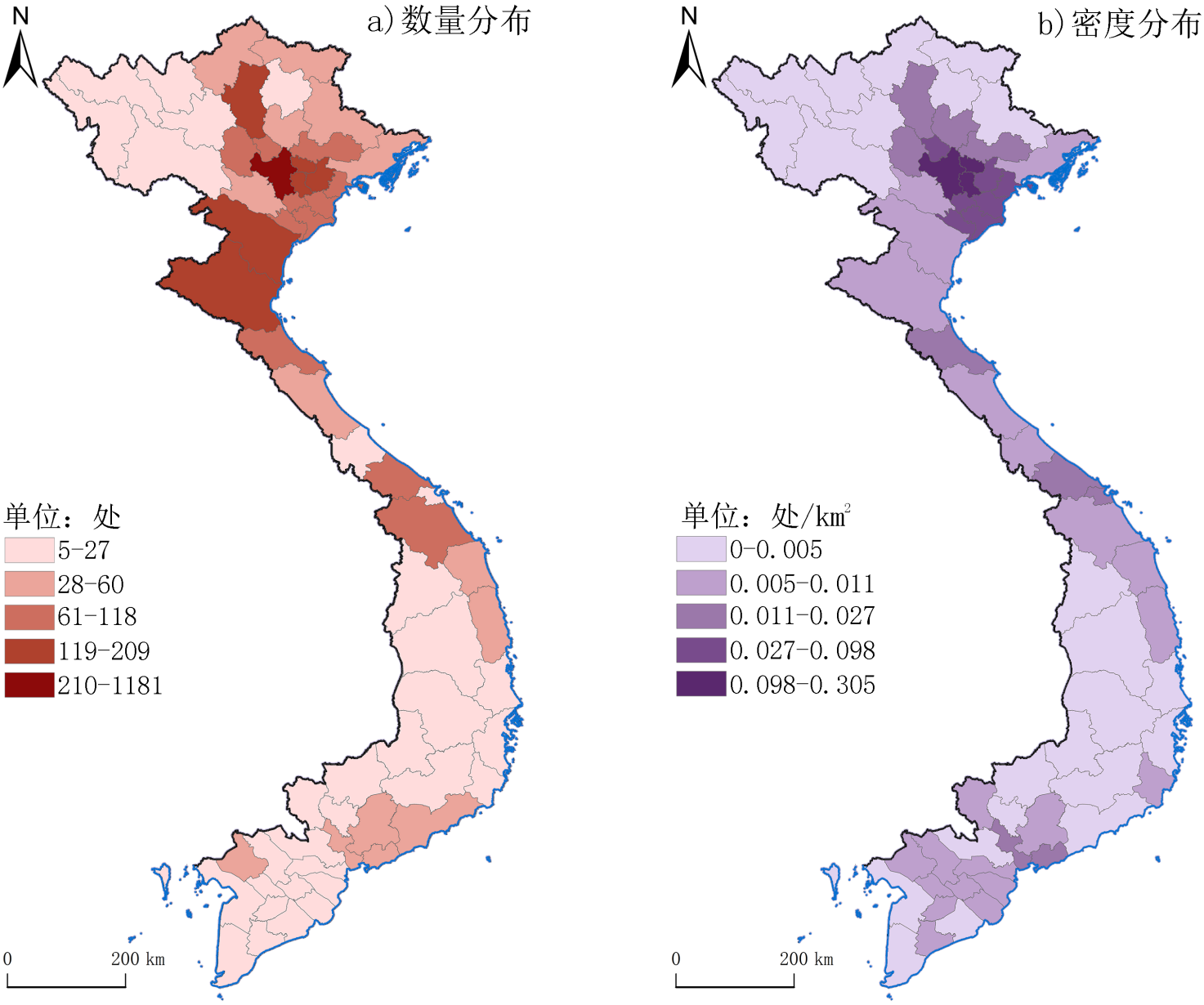


Figure 3

Quantity and density of Vietnam's heritage sites at the provincial scale

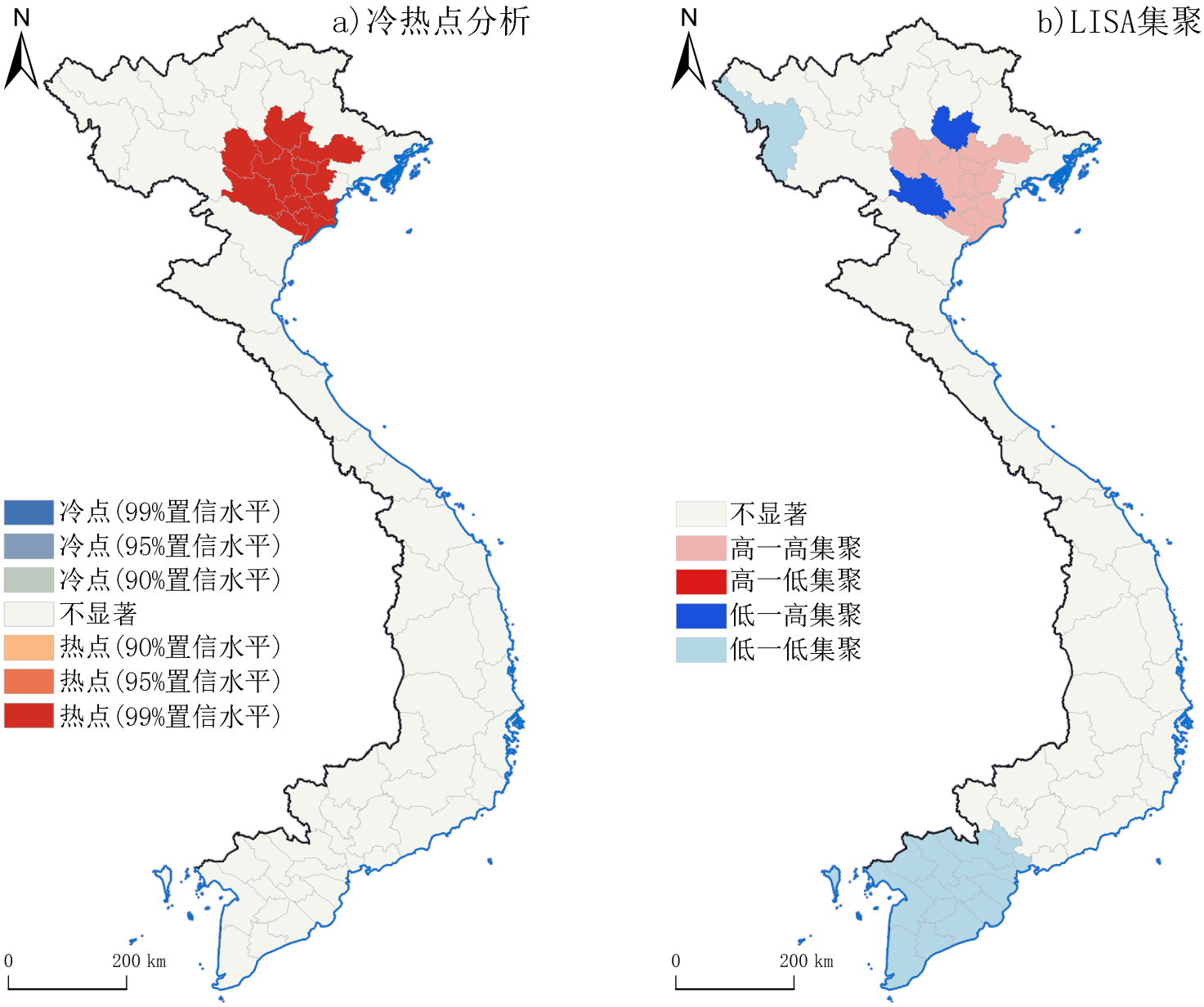


Figure 4

Spatial autocorrelation analysis of Vietnam's heritage site distribution

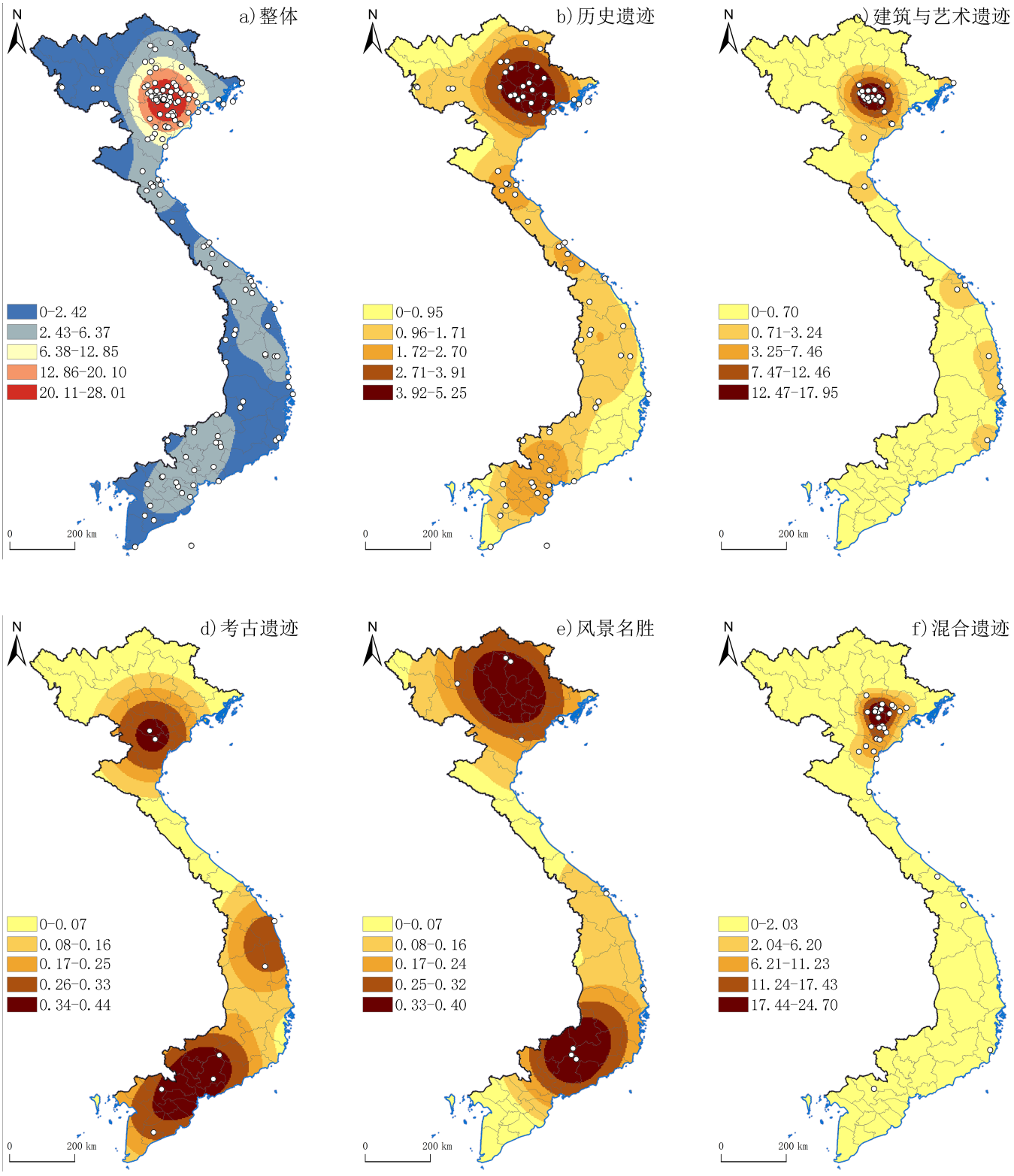


Figure 5

Spatial differentiation of Vietnam'shigh-level heritage sites by types

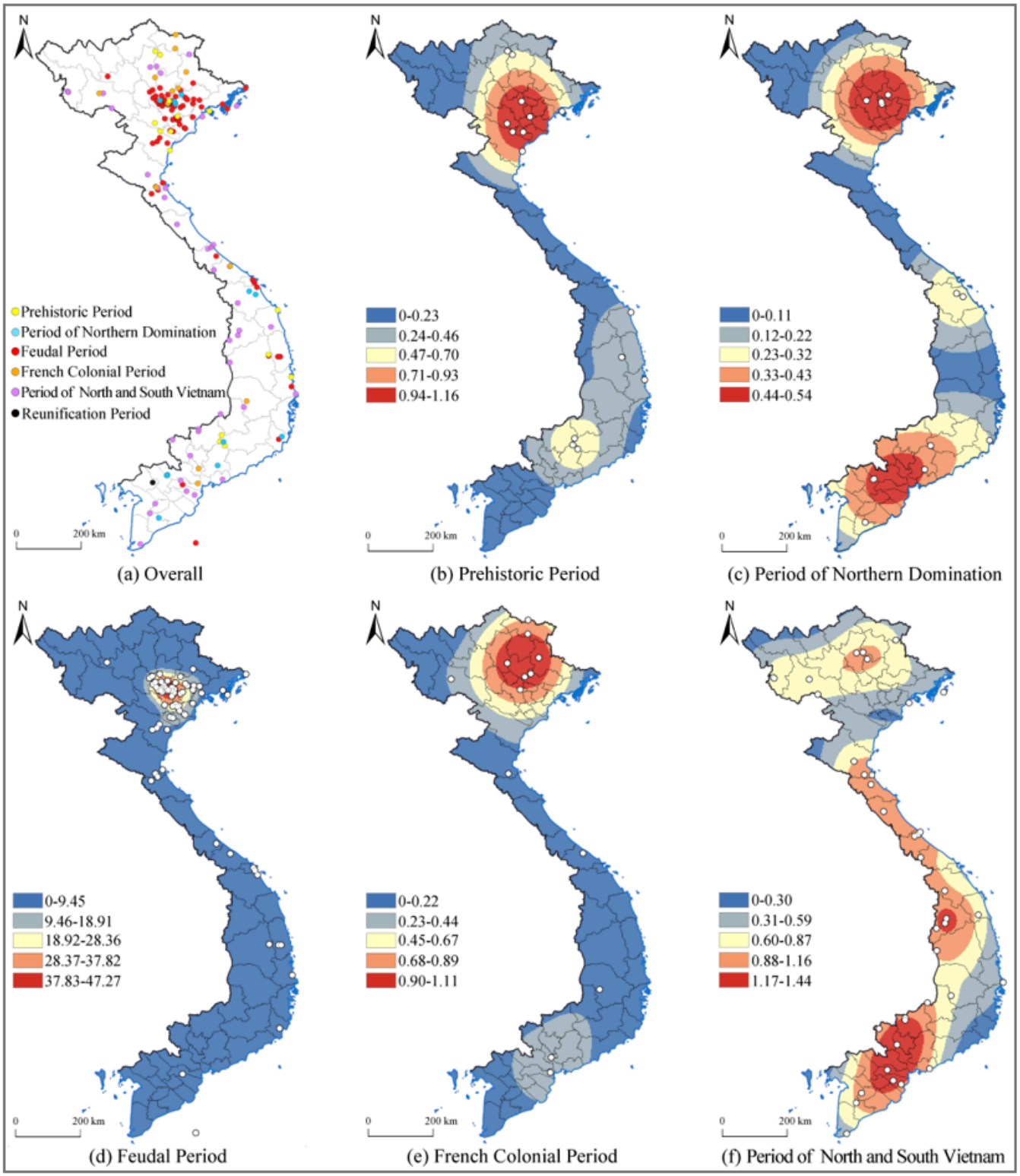


Figure 6

Spatial differentiation of Vietnam'shigh-level heritage sites by periods

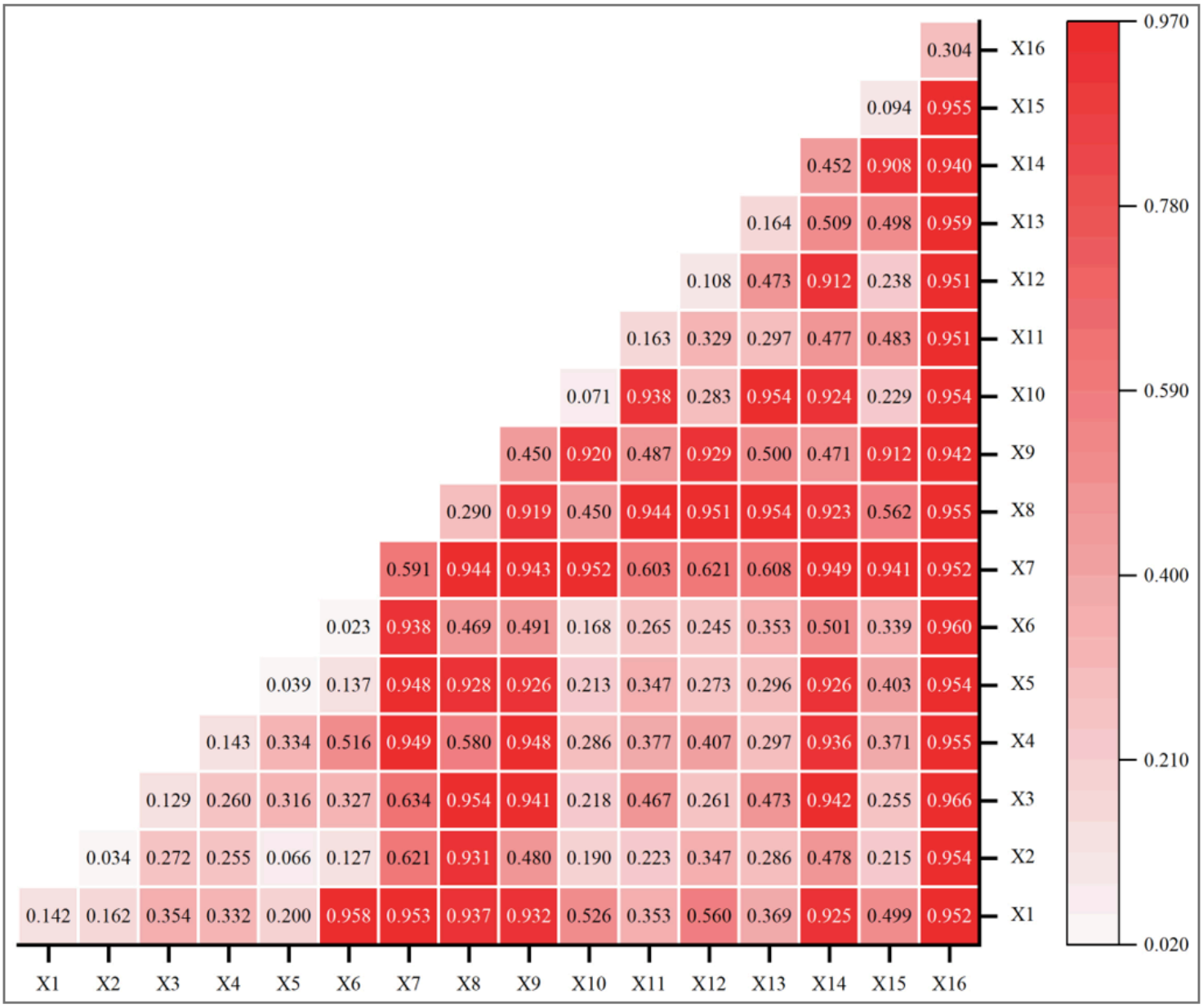


Figure 7

The interaction heat map of influencing factors of Vietnam's heritage site distribution

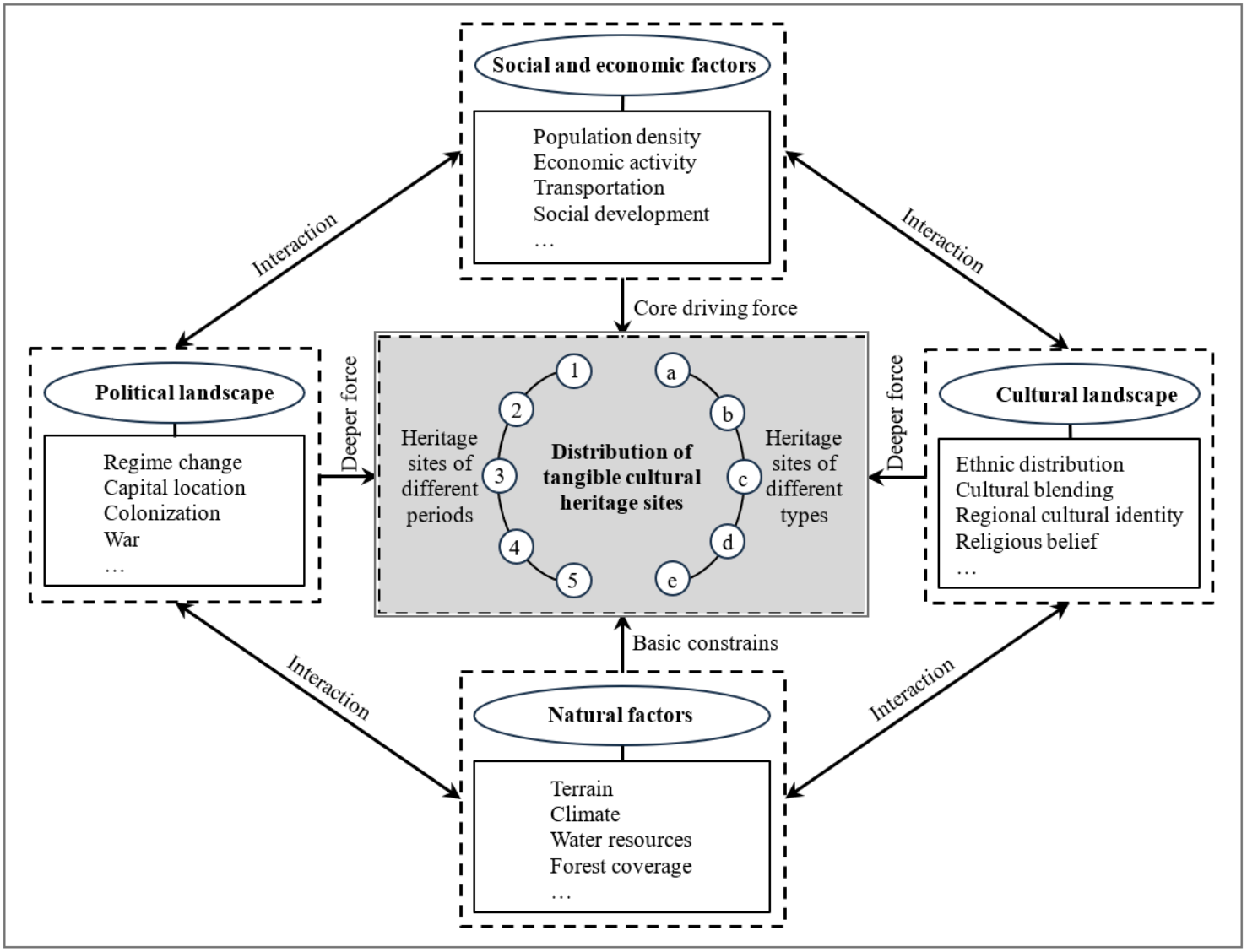


Figure 8

The influence mechanism of Vietnam's heritage site distribution