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Ecological Sensitivity Assessment of Hangzhou City Based on GIS and AHP

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***Abstract*—** *Ecological sensitivity analysis is an important basis for urban planning and layout. This article selects six ecological factors, including elevation, slope, aspect, water area, and vegetation index (NDVI), and land use type, to construct an ecological sensitivity evaluation system for Hangzhou City. GIS's spatial analysis technology, combined with the Analytic Hierarchy Process (AHP), is used to comprehensively evaluate the six ecological factor sensitivity indices. Meanwhile, the natural breakpoint method was used to divide the results into 5 levels: extremely sensitive region, highly sensitive region, meso-sensitive region, low sensitive region, and non-sensitive region. The results indicate that the ecological sensitivity of the study area is generally high, with land use type, vegetation coverage, and water area being the main sensitive factors. The proportion of the five sensitive areas from extremely sensitive to non-sensitive regions is 19%, 34%, 18%, 16%, and 13%, respectively. The highly sensitive regions in Hangzhou are mainly distributed in the southwest, while the non-sensitive regions are mainly distributed in the northeast. Finally, based on the comprehensive evaluation of ecological sensitivity and spatial layout in Hangzhou, this article provides targeted countermeasures and suggestions, providing a basis for land use construction planning and promoting ecological environment protection.*

***Keywords*— Ecological Sensitivity Assessment; Geographic Information System (GIS); Analytic Hierarchy Process (AHP); Multifactor comprehensive evaluation; Hangzhou City.**

I. INTRODUCTION

With the development of industry and urbanization, the impact of human activities on the natural environment continues to expand and increase in intensity. Regional ecological problems such as ecosystem degradation, ecological environment degradation, and resource overuse are becoming increasingly prominent, seriously affecting the sustainable development of the natural ecological environment and human normal production and life. This has attracted the attention of many experts and scholars. A good ecological environment is an important foundation for human survival and sustainable development, so protecting the ecological environment and conducting ecological environment assessments are particularly important [1].

Ecological sensitivity is the result of the combined effects of natural environmental changes and human activities, reflecting the difficulty and probability of ecological environmental problems occurring when an ecosystem is disturbed by natural or human factors [2]. If the ecological factors in a region are difficult to

recover after being damaged, the ecological sensitivity of the region is strong, while the sensitivity is weak [3]. The essence of its evaluation is to clearly identify potential ecological problems in the current natural environment and implement them in specific spatial areas [4]. This type of research began in the late 20th century and was defined by the academic community as the self-recovery ability of ecosystems to resist external adverse effects under specific spatio-temporal conditions. By establishing a model for ecological sensitivity evaluation, it is possible to analyze regional ecological suitability and reflect national or regional ecological changes and spatial differentiation patterns, laying the foundation for land and resource utilization and ecological environment protection [5]. Through a review of domestic and foreign literature, it has been found that ecological sensitivity assessment has a wide range of research areas and diverse research scales. Among them, the research areas include watersheds, cities, wetlands, nature reserves, etc. The research scale extends from the country, geographical region, and provincial level to the city and county level. The research methods mainly adopt traditional weight determination methods such as principal component analysis, the analytic hierarchy process, expert scoring, and the maximum value method [6].

Hangzhou is one of the first batches of national historical and cultural cities, the central city of the G60 Science and Technology Innovation Corridor, and the core city of the Greater Bay Area around Hangzhou Bay, as approved by the Zhejiang Provincial Government. The booming emerging economy and tourism industry have produced a series of negative impacts, such as tightening resource constraints, severe environmental pollution, and ecosystem degradation. Therefore, a comprehensive evaluation of Hangzhou's ecological sensitivity has important reference value for Hangzhou's environmental protection planning and industrial layout.

This article takes Hangzhou as the research area and uses ArcGIS spatial analysis technology to analyze its ecological sensitivity, explore its spatial layout, and provide a decision-making basis for land use planning, environmental remediation, and sustainable development in Hangzhou. The use of GIS' spatial analysis and the AHP for single analysis of six factors as well as the weighted superposition of multiple factors for comprehensive analysis can provide a scientific basis for the future economic development, construction, and ecological environment protection of Hangzhou.

II. STUDY AREA

Hangzhou, also known as Lin'an, Qiantang, and Wulin, is located in the northern part of Zhejiang Province, the southeastern coast, the southern wing of the Yangtze River Delta, the western end of Hangzhou Bay, and the southern end of the Beijing-Hangzhou Grand Canal in East China. It is an important central city in the Yangtze River Delta and a transportation hub in southeastern China, ranging from 29 ° 11 ′ -30 ° 33 ′ N to 118 ° 21 ′ -120 ° 30 ′ E. It covers an area of 16596km^2 (Figure 1).

The terrain within the city is complex and diverse, with a natural environment that blends rivers, lakes, and mountains. The city's hilly and mountainous areas account for 65.6% of the total area, plains account for 26.4%, and rivers, lakes, and reservoirs account for 8%. The Beijing-Hangzhou Grand Canal and the Qiantang River, known for their large tidal bores, pass through. The western part belongs to the hilly area of western Zhejiang, with mountain ranges such as Tianmu Mountain. The eastern part belongs to the northern Zhejiang Plain, with low and flat terrain, dense river networks and lakes, and abundant natural resources. It has typical characteristics of "Jiangnan Water Town". The lower jurisdiction of Hangzhou includes 10 districts, including Shangcheng District, Gongshu District, Xihu District, Binjiang District, Xiaoshan District, Yuhang District, Linping District, Qiantang District, Fuyang District, and Lin'an District, as well as the two counties of Tonglu and Chun'an. It manages one county-level city in Jiande, borders Hangzhou Bay to the east, and borders Anhui on land.

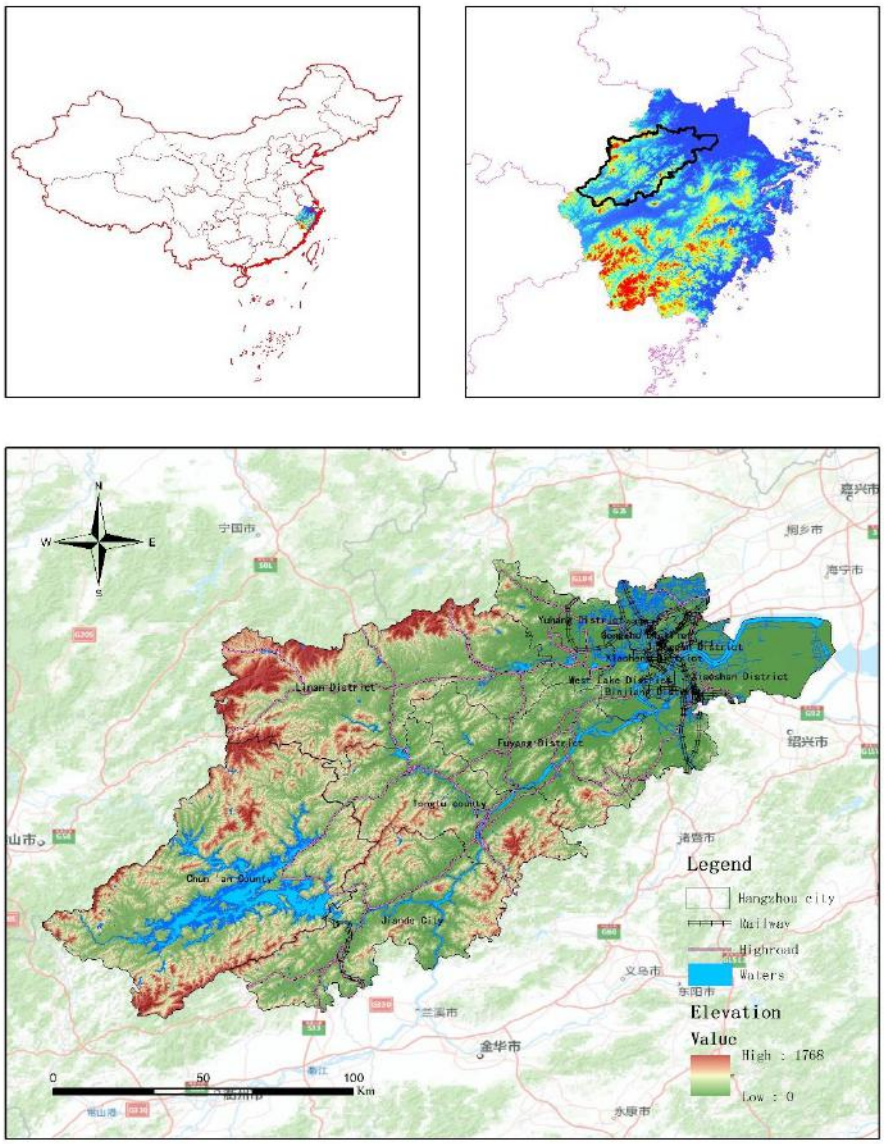

Fig.1 Overview of the research area

III. METHODOLOGY

3.1 Data Sources

The data used in this study mainly includes:

(1) DEM digital elevation data, with cloud cover less than 5% and spatial resolution of 30m, sourced from geospatial data clouds （https://www.gscloud.cn/search）.

(2) GlobeLand30 surface cover data, which divides land use types into 10 types: forest land, cultivated land, grassland, shrub land, wetland, water body, tundra, artificial surface, bare land, glacier, and permanent snow cover;

(3) MODIS MOD13A3 NDVI data with a spatial resolution of 1 km normalized vegetation index year by year from 2000 to 2022;

(4) In the actual operation process, in order to avoid the situation where spatial coordinates cannot be matched, it is necessary to establish a unified coordinate system for DEM data, county-level administrative division vector data, land use type data, surface water resource distribution data, etc. The projection coordinates used in this study are: WGS_ 1984_ UTM_ Zone_ 50N

(5) National County Boundary Administrative Data (Source: Ovi Map)

3.2 Research Method

After collecting data sources, this study selected six single ecologically sensitive factors, namely elevation, slope, aspect, water area, normalized vegetation index (NDVI), and land use, based on the characteristics of the study area. The single factor evaluation was graded, and an ecologically sensitive factor analysis status map was established using the ArcGIS tool. Next, the AHP was used to establish the weight values for analysis and evaluate the classification level. Finally, the comprehensive ecological sensitivity analysis results were obtained (Figure 2), and relevant data such as spatial distribution and area proportion were analyzed.

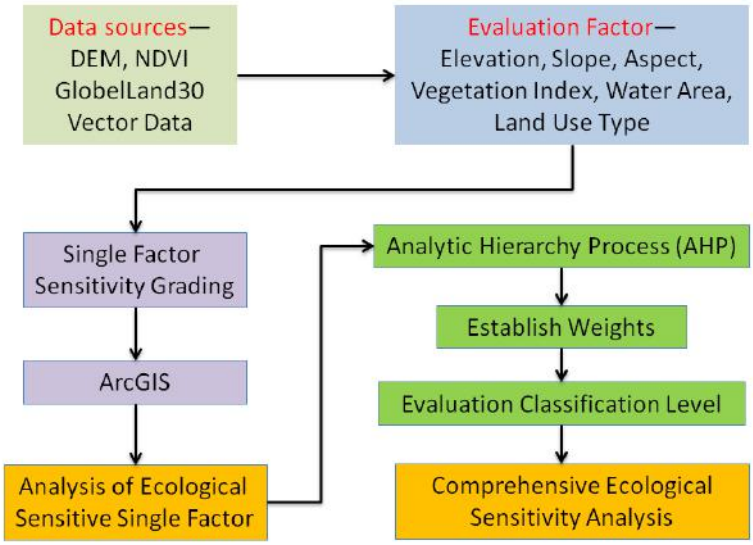

Fig.2 The Schema of This Study

3.3 Ecological Sensitivity Assessment

The ecological sensitivity evaluation method usually uses the multifactor-weighted superposition method. At present, the main methods for analyzing ecological sensitivity include ecological factor scoring, remote sensing (RS) technology, and geographic information system (GIS) technology. At present, the technical means used for ecological sensitivity research are mainly GIS and RS technology. This article will use the GIS and AHP to complete the ecological sensitivity evaluation of Hangzhou [7].

Ecological sensitivity refers to the adaptability of various factors in the ecological system within the study area to external interference. Ecological sensitivity evaluation, as a scientific method that utilizes multiple data points for reasonable digital analysis, can accurately reflect the adaptability of the study area to external interference under the influence of various factors [11]. It is worth noting that the factors that affect ecological sensitivity are very complex, with diverse causes and manifestations [3]. The size of the study area, the ecological environment status of the study area, and the level of socio-economic development all affect the selection of evaluation indicators [12]. China has rich ecological diversity and highly complex ecosystems, with varying ecological sensitivity factors in different regions. There is no unified standard for the selection of ecological sensitivity factors. Therefore, in the selection of ecological sensitivity factors, it is necessary to select representative sensitive factors that reflect the main environmental characteristics of the study area based on the internal mechanisms of ecological environmental problems and the environmental conditions of the study area.

In the preliminary preparation for studying the ecological sensitivity of Hangzhou, reasonable evaluation factors are selected using the method of ecological sensitivity evaluation. And relevant data is analyzed and graded to ultimately generate comprehensive evaluation results as a reasonable basis for planning. This avoids the lack of scientific data guidance in the planning process and the bias towards the personal subjective thinking of design decision-

makers, which can cause difficult damage to the ecological environment. At the same time, ecological sensitivity assessment can also be used to repair and protect damaged environments during the planning process [11].

3.4 Selection of Evaluation Indicators and System Construction

The AHP method used in this study was first proposed by American operations researcher A. L. Saaty in the early 1970s. When studying the topic of "power distribution based on the contribution of various industrial sectors to national welfare" for the US Department of Defense, a hierarchical weight decision analysis method was proposed using network system theory and a multi-objective comprehensive evaluation method. This method can easily solve the problem of complex factor ranking. It is now widely used in various research fields and topics.

After analysis, combined with GIS, visualization can be achieved [10], and spatial analysis and related data calculation and extraction can be carried out. GIS is a new technological tool that gradually developed in the mid-1960s [8]. It collects and integrates massive geographic data within a certain period of time based on geographical conceptual space and makes decisions accordingly. It is an important tool used in ecological sensitivity research [9].

3.4.1 Single Factor Graded Assignment

Different evaluation factors have varying degrees of impact on the study area. In order to improve the research on the impact of single factors, this article uses literature research methods, case analysis methods, and references relevant papers and research results on ecological sensitivity evaluation within the region. Based on the study objectives, the comprehensive characteristics of the ecological environment in Hangzhou, as well as the principles of ecological sensitivity and the availability of data, this article starts from the perspective of the natural environment and human activities. Select ecological sensitivity evaluation factors with characteristics of the study area [5]: elevation, slope, aspect, vegetation index, water area, and land use type. Assign ecological sensitivity values of 9, 7, 5, 3, and 1 to each single factor, representing extreme importance, strong importance, more importance, slightly important, and equally important. Meanwhile, we divide ecological sensitivity into five levels, namely extremely high sensitivity, highly sensitivity, meso-sensitivity, low sensitivity and non-sensitivity (Table 1).

Extremely sensitive region: This area is the most sensitive to human development and construction. If there is interference or destruction, it will not only affect the area but also cause catastrophic damage to the ecosystem. For this purpose, the protection zoning plan should list the area as the most in need of key protection.

Highly sensitive region: This area is highly sensitive to development and construction, and ecological restoration is difficult. It plays a very important role in protecting the ecosystem and its functions in the most sensitive area. In the protection zoning plan, this type of area can be considered a sub-key ecological protection area.

Meso-sensitive region: This area can withstand a certain level of human activity, but excessive activities (especially project construction activities) can also damage the natural ecological environment in the area, resulting in slow ecological restoration and difficult ecological restoration. Therefore, reasonable protection measures need to be considered in the planning of protection zones.

Low sensitivity region: This area can withstand a lot of human activities, but it is also prone to land damage, ecological pollution, and other problems when severely affected, resulting in slow ecological restoration. In protection zoning planning, these areas can be considered as general-level protection areas.

Non-sensitive region: This area can withstand larger economic construction projects, and the land use methods can be more diverse. In protection zoning planning, this area can be considered the lowest level of protection [7].

Table 1 Single Factor Sensitivity Grading Criteria

Ecological sensitivity grading	Index factor					
	Slope	Elevation	Aspect	Water buffer zone	NDVI	Land use type
Extremely sensitive (score 9)	>55	>1700	Due north	50<	>0.8	Water bodies, wetlands
Highly Sensitive (score 7)	40-55	1300-1700	Northeast, Northwest	50-200	0.6-0.8	Forest land and cultivated land
Meso -sensitivity (score 5)	25-40	900-1300	True East, True West	200-500	0.4-0.6	Grassland, shrubs
Low-sensitivity (score 3)	10-25	500-900	Southeast, Southwest	500-800	0.2-0.4	Bare land
Non-sensitivity (score1)	0-10	<500	Due south	>800	<0.2	Artificial surface

3.4.2 Determine Weight

The AHP method used in this article distinguishes between the target layer and the indicator layer. The target layer is comprehensive ecological sensitivity, and the indicator layer refers to the six factors mentioned above. Based on the actual situation of the study area, the weight calculation method of relevant literature is cited to conduct a comprehensive factor evaluation, which mainly involves experts scoring each factor, establishing a factor judgment matrix, and calculating the weight values between each factor based on the specific scores of each ecologically sensitive factor. This article cites the comparative weight values between each factor obtained from it (Table 2) [1,5]. During the calculation and verification of the one-time test results, it was found that the maximum feature root was 6.3548, the CI value was 0.0710, the RI value was 1.26, and the CR value was 0.0563<0.1, indicating that the weight value was reliable (Table 3).

Table 2 Index Factor Judgment Matrix and Its Weights

Index factor	Elevation	Slope	Aspect	Water buffer zone	NDVI	Land use type
Elevation	1	1/2	1/2	1/3	1/4	1/5
Slope	2	1	1/2	1/2	1/3	1/4
Aspect	2	2	1	1/2	1/3	1/5
Water buffer zone	3	2	2	1	1/2	1/3
NDVI	4	3	3	2	1	1/2
Land use type	5	4	5	3	2	1
Weights	0.0531	0.0780	0.0947	0.1487	0.2407	0.3847

Table 3 Judgment Matrix RI Values

Order	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.52	0.89	1.12	1.26	1.36	1.41	1.46	1.49

IV. ANALYSIS AND RESULT

After selecting six ecologically sensitive factors, a single factor sensitivity grading standard was established, including extremely high sensitivity, highly sensitivity, meso-sensitivity, low sensitivity, and non-sensitivity. Visualize and analyze through GIS, allocate and calculate its area and proportion (Table 4), and conduct spatial analysis and subsequent exploration.

Table 4 Single Factor Sensitivity Grading Area and Proportion

Single factor indicator	Unit	Non-sensitive	Low sensitive	Meso-sensitive	Highly sensitive	Extremely sensitive
Elevation	Area/km²	13955.06	2178.26	548.83	159.46	16.36
	percentage	0.82	0.13	0.03	0.01	0.01
Slope	Area/km²	5769.06	5959.30	4591.26	535.07	2.85
	percentage	0.34	0.34	0.23	0.03	0.01
Aspect	Area/km²	2033.36	4131.92	4039.74	4027.00	2625.49
	percentage	0.11	0.25	0.24	0.24	0.16
Water buffer zone	Area/km²	501.58	1433.69	2621.46	2373.01	9928.32
	percentage	0.03	0.09	0.15	0.14	0.59
Vegetation coverage	Area/km²	1314.42	1077.45	2363.89	7265.82	4797.88
	percentage	0.08	0.06	0.14	0.43	0.29
Land use	Area/km²	4881.75	0.02	634.01	10339.63	1027.16
	percentage	0.29	0.01	0.03	0.61	0.06

4.1 Elevation Ecological Sensitivity

The highest elevation in Hangzhou is 1,768m. The western, central, and southern parts belong to the middle and low mountains and hills of western Zhejiang, while the northeastern part is the plain of northern Zhejiang. The overall terrain and topography are high in the west, low in the east, and high in the central and southeastern parts (Figure 3). According to the analysis of the results, the ecological sensitivity of the elevation factor is generally low, and non-sensitive areas dominate. The extremely sensitive region, highly sensitive region, and meso-sensitive region account for 0.01%, 0.01%, and 0.03%, respectively, with a total area of 724.65 Km², mainly distributed in Lin'an District, Chun'an County, and Tonglu County; the low sensitivity region is 2,178.26 Km², 13%, also distributed in the upper region; and the non-sensitive region is 13,955.06 Km², which accounts for 82% of the total area and is mainly distributed within the urban area of the northeast.

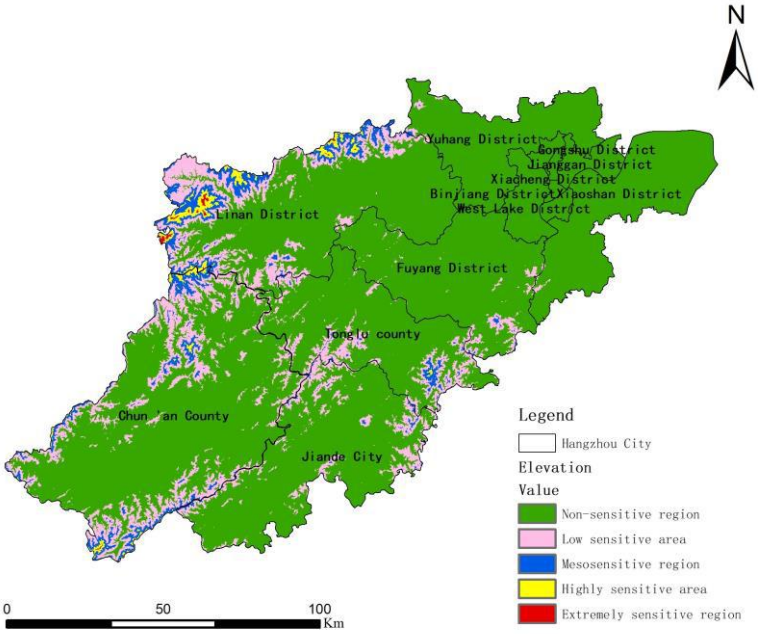

Fig.3 Ecological Sensitivity Analysis of Elevation

4.2 Slope Ecological Sensitivity

The slope size can reflect the height of the terrain, thereby affecting the flow and bearing capacity of surface materials. It is closely related to soil erosion, soil

moisture content, and soil fertility in the region and also restricts the use of land and building layout. It is one of the important factors affecting ecological sensitivity. Under the same ecological conditions, the greater the slope, the more severe the soil erosion in the area, the more fragile the ecosystem, and the higher the sensitivity of the region. The research results indicate that the natural terrain of Hangzhou is relatively flat, and the slope sensitivity is mainly non-sensitive and low-sensitive. With an area of 11728.36 km², accounting for 68%, these two sensitive areas are widely distributed in the study area. Next is the meso-sensitive region, with an area of 4591.26 km², 23% of the total area, mainly distributed in other areas outside the northeast of the city. Highly sensitive and extremely highly sensitive areas with slopes greater than 40° account for 0.03% and 0.01%, respectively, with an area of 535.07 km² and 2.85km², It is concentrated in Lin'an District and Chun'an County, occupying a very small area (Figure4).

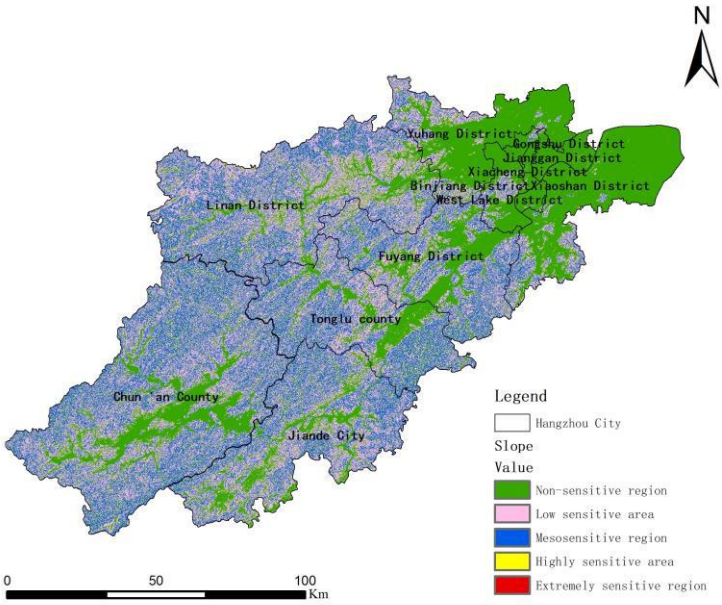

Fig.4 Ecological Sensitivity Analysis of Slope

4.3 Aspect Ecological Sensitivity

There are significant differences in the intensity and duration of solar radiation received by different slope orientations. Which have a significant impact on the types and distribution of vegetation and animals, rainwater runoff, and building layout. China is located in the Northern Hemisphere, and the southern, southeastern, southwestern, and eastern slopes of the Northern Hemisphere have good ventilation and lighting, which is conducive to the growth and reproduction of species. The terrain of the study area is complex and diverse, with many mountains and hills and mainly sunny slopes. It has a natural environment where rivers, lakes, and mountains blend, and the overall slope sensitivity is relatively uniform.

Among them, non-sensitive and low-sensitive region account for 36% of the total area, totaling 6165.28 Km²; facing due south, southeast, and southwest; the meso-sensitive region, highly sensitive region, and extremely high sensitive region account for 24%, 24%, and 16%, respectively. With an area of 4039.74 km², 4027.00 km² and 2625.49 km², oriented towards the east, west, northeast, northwest, and north, it can be seen that in the future development and construction process of the study area, regional land use planning should be done in advance to achieve coexistence of ecological environment protection and socio-economic development under complex terrain and geomorphic conditions and promote sustainable regional development (Figure 5).

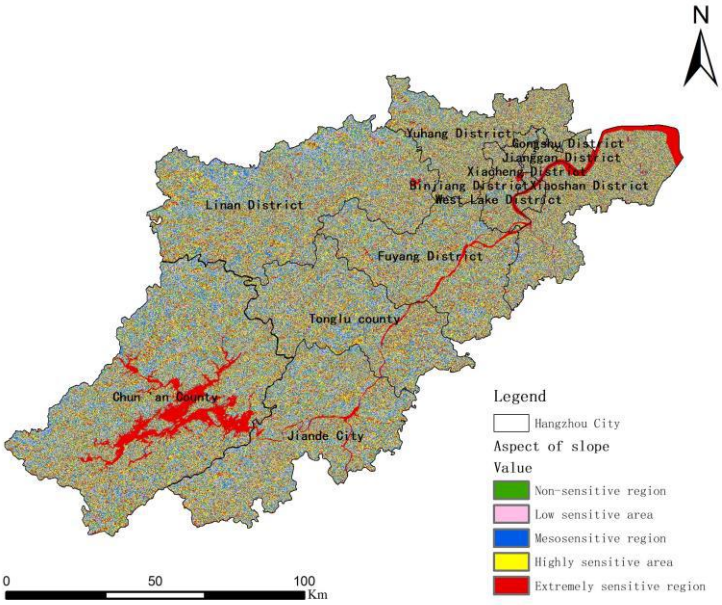

Fig.5 Ecological Sensitivity Analysis of Aspect

4.4 Water Ecological Sensitivity

Through the analysis of data obtained from the implementation of GIS buffer zones in the water system of Hangzhou, it was found that the water environment has different sensitivities depending on the distance from the river. The water environment far from the river has lower ecological sensitivity, and vice versa. The research area has a large water area and a dense surface river network. The overall sensitivity of the water environment is high, with extremely sensitive and highly sensitive regions accounting for 73% of the total area of the city. It has a significant impact on natural processes and human activities and is highly sensitive to ecology. The river buffer zone exceeding 800 meters in this article is a non-sensitive area, and the water environment in this area is not easily affected by human activities (Figure 6).

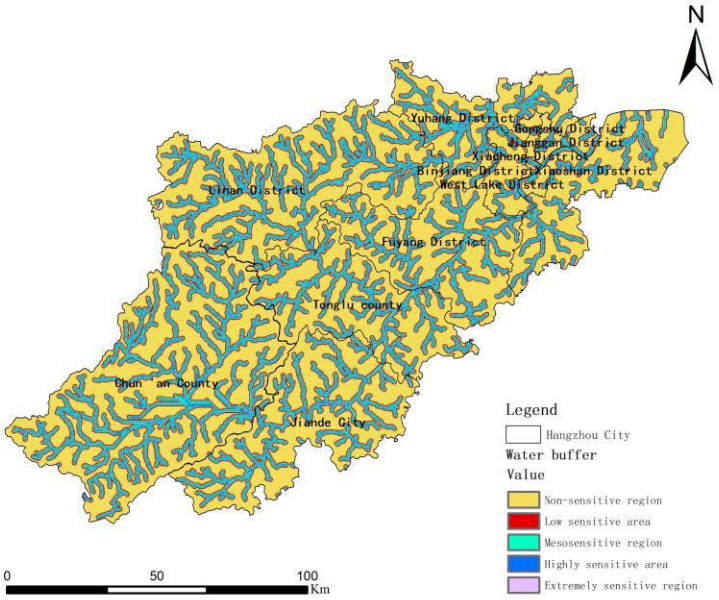

Fig.6 Ecological Sensitivity Analysis of Waters System

4.5 Ecological Sensitivity of Vegetation Coverage

Hangzhou has a forest area of 16.89 million acres, a forest storage volume of 67.9 million cubic meters, and a forest coverage rate of 66.85%. It is a well-known "forest city" in China. The vegetation index of the city shows a characteristic of being high in the southwest and low in the northeast, especially the lowest in the urban area. Nevertheless, based on the actual situation analysis, under the implementation of the green development policy by the municipal government, the urban greening rate of Hangzhou is not low compared to other provincial capital cities or economically developed cities, or even higher than the vast majority of developed cities.

However, compared with other regions in the study area, the urban area is still expanding due to highly developed urbanization and has less vegetation coverage compared to other regions such as Lin'an District and Chun'an County. The results indicate that the ecological sensitivity of vegetation cover in the study area is generally high, with extremely sensitive and highly sensitive region accounting for 29% and 43%, with an area of 4,797.88 km² and 7,265.82 km², meso-sensitive region account for 14%, with an area of 2,363.89 km², low-sensitive and non-sensitive region account for 0.06% and 0.08%, with an area of 1,077.45 Km² and 1,314.42 Km² (Figure 7).

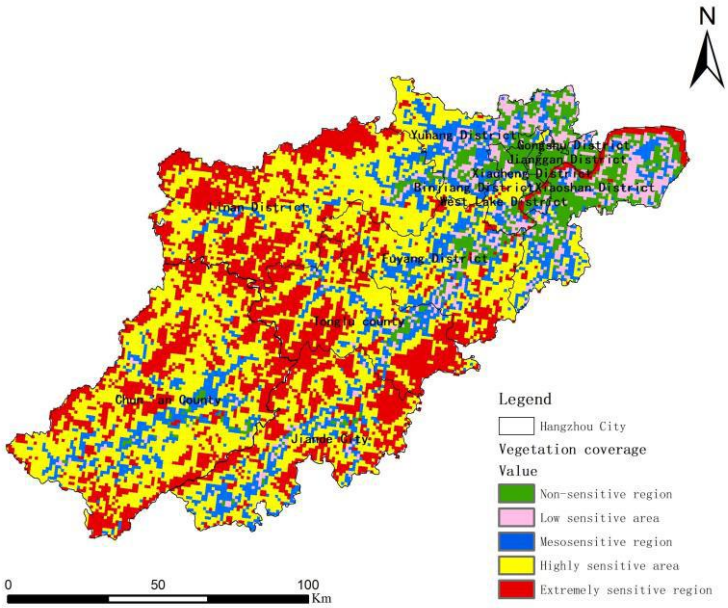

Fig.7 Ecological Sensitivity Analysis of Vegetation

4.6 Ecological Sensitivity of Land Use Types

The land use types in Hangzhou are divided into five types: water bodies, forest land, grassland, construction land, and non-construction land. Among them, the forest area is 10,339.63 km², covering 61% of the study area. It is a highly sensitive region. From research, it can be seen that the ecological sensitivity of land use types in Hangzhou is relatively high, mainly distributed in densely forested mountains and river systems in the central, southern, and western regions. The ecological service functions of forests, grasslands, and water bodies play an extremely important role in protecting the ecological environment of Hangzhou and promoting regional sustainable development. Thus, scientific and rigorous construction planning must be done in the development and utilization processes. The construction land in Hangzhou is mainly concentrated in the urban area, with an area of 4,881.75 km², the proportion is 0.29%, While the proportion of non-constructed land in the study area is small, only 0.10% (Figure 8).

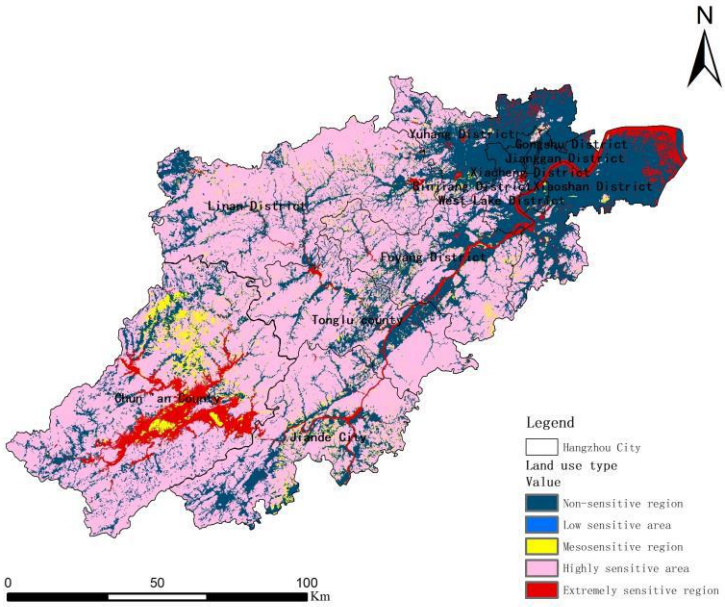

Fig.8 Ecological Sensitivity Analyses of Land Use Types

4.7 Comprehensive Analysis of Ecological Sensitivity and Multiple Factors

Elevation, slope, aspect, water area, vegetation coverage, and land use type are the six indicator factors selected in this article. Based on AHP and GIS, weighted overlay analysis is conducted on each factor to obtain the distribution map of ecological sensitivity levels in the study area (Figure 9), the area and proportion of each ecologically sensitive area (Table 5), and the ecological sensitivity of each city (county) in the study area (Table 6). From the chart, it can be seen that the overall ecological sensitivity of Hangzhou is relatively high, showing a pattern of increasing from northeast to southwest. The proportion of extremely sensitive and highly sensitive regions is 19% and 0.34%, with a total area of 858,859.85 km², Mainly distributed in other areas outside the northeast of the research area, this area is mostly mountainous and hilly, with high terrain and obvious slopes.

Qiandao Lake is also located in it, and human construction and utilization need to pay special attention to ecological environment protection. The meso-sensitive region and low-sensitive region are 307,149.63 km² and 254,361.45 km², the proportion is 18% and 16%, mostly human settlements outside the city center, with a certain scale of construction land. Non-sensitive region are concentrated in the northeast of Hangzhou, accounting for 13% of the city's area, totaling 218,922.22 km², the degree of urbanization in the region is high, with large-scale construction land, high transportation accessibility, and convenient production and life for people. However, in the process of social and economic development, ecological security still needs to be valued and maintained to achieve sustainable development.

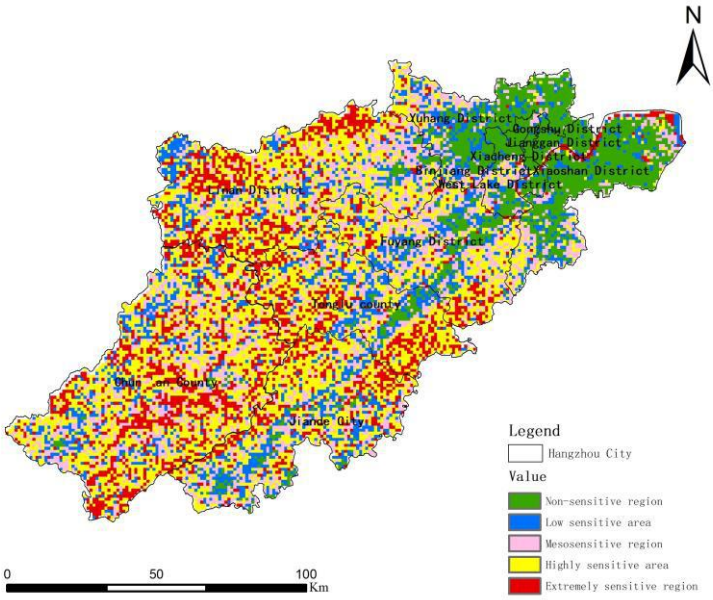

Fig.9 Comprehensive Evaluations and Analysis of Ecological Sensitivity

Table 5 Comprehensive Ecological Sensitivity Factors Ecological Sensitivity Statistics

Ecological sensitivity evaluation level	Comprehensive evaluation index	Area/km²	Percentage /%
Non-sensitive region	(0.99,1.78]	218922.22	0.13
Low sensitive region	(1.78, 2.55]	254361.45	0.16
Meso-sensitive region	(2.55, 3.16]	307149.63	0.18
Highly sensitive region	(3.16, 3.52]	551414.44	0.34
Extremely sensitive region	(3.52, 4.47]	307445.41	0.19

Table 6 Ecological Sensitivity of Each County (City)

County (City)	Unit	Non-sensitive	Low sensitive	Meso-sensitive	Highly sensitive	Extremely sensitive
Shangcheng	Area/Km²	800.89	3.65	7.03	9.04	2.01
	percentage	97.4%	0.44%	0.84 %	1.09%	0.24%
Gongshu	Area/Km²	798.88	4.39	6.03	2.01	0.00
	percentage	98.4%	0.55%	0.77%	0.28%	0.00%
West Lake	Area/Km²	1599.54	74.48	84.40	66.52	17.07
	percentage	87%	4%	4.5%	3.5%	1%
Binjiang	Area/Km²	1590.50	12.00	15.44	8.03	13.06
	percentage	97.4%	0.74%	0.94%	0.48%	0.8%
Xiaoshan	Area/Km²	1581.38	204.93	255.67	187.05	74.13
	percentage	68.7%	8.9%	11.1%	8.1%	3.2%
Yuhang	Area/Km²	889.64	249.53	230.35	221.94	39.23
	percentage	54.6%	15.3%	14.1%	13.6%	0.24%
Xiacheng	Area/Km²	798.88	1.38	0.00	0.00	0.00
	percentage	99.8%	0.2%	0.00%	0.00%	0.00%
Jianggan	Area/Km²	800.89	27.70	15.92	4.70	22.93
	percentage	91.8%	3.19%	1.84%	0.54%	2.63%
Fuyang	Area/Km²	241.49	368.01	621.86	903.10	225.72
	percentage	10.22%	15.57%	26.34%	38.25%	9.62%
Lin'an	Area/Km²	75.07	469.33	693.16	1472.50	817.25
	percentage	2.2%	13.4%	19.6%	41.7%	23.1%
Tonglu	Area/Km²	88.31	359.19	291.89	1433.81	550.41
	percentage	3.24%	13.19%	10.72%	52.64%	20.21%

Chun'an	Area/Km²	47.12	546.47	800.29	2097.23	1406.18
	percentage	0.96%	11.16%	16.34%	42.83%	28.71%
Jiande	Area/Km²	88.66	439.97	466.18	1171.28	497.59
	percentage	3.33%	16.52%	17.50%	43.97%	18.68%

V. CONCLUSION

The advent and deepening development of the industrial and information age have brought about the widespread development of urbanization for people. While enjoying the convenience of production and life, people should be prepared for danger, dialectically view the prosperity and destruction brought about by development, and face the varying degrees of ecological and environmental problems that have already been caused. As a new first-tier city in China, Hangzhou has a high level of development and construction efforts, inevitably causing damage to the ecological environment. In order to protect the ecological environment, maintain ecological security, and provide a certain reference basis for the future development of the city in Hangzhou, this article selects six sensitive factors: elevation, slope, aspect, water bodies, vegetation coverage, and land use type, to establish an ecological sensitivity evaluation system for the area. The conclusions drawn from the study are as follows:

(1) Hangzhou is mainly composed of highly sensitive region and extremely sensitive region, with overall high ecological sensitivity. The proportion of environmental development is relatively small and concentrated in the northeastern city of Hangzhou.

(2) The main influencing factors of ecological sensitivity in the study area are land use type, vegetation coverage, and water environment.

(3) The spatial distribution of ecological sensitivity shows a pattern of increasing from northeast (low) to southwest; with extremely high and highly sensitivity region mainly distributed in areas with high terrain, complex terrain, and large water bodies in the study area. Non-sensitive areas are concentrated in the urban center of the northeast, with flat terrain suitable for human production and life and a large area of construction land; low and meso-sensitive areas are mainly distributed in human settlements outside the central urban area, with large construction land within the area.

(4) Overall, Chun'an County, Tonglu County, and Lin'an District have the highest comprehensive ecological sensitivity, and special attention should be paid to their future development, construction, and land use, with scientific and rigorous decision-making and planning in place;

Finally, ecological sensitivity evaluation is based on the selection of indicator factors and evaluation methods, which is the result of a comprehensive effect of multiple factors such as nature, economy, and humanities. In this study, the selection of indicators is only based on natural conditions for exploration. In the process of using AHP to establish a judgment matrix and calculate weights, there is also a certain degree of subjectivity. In future studies, humanistic conditions will be included for comprehensive evaluation, which can ensure that the evaluation results are more diverse in objectivity and rigor.

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