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Analysis of Land Use Evolution of Suzhou Wetlands Based on RS and GIS

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***Abstract*— *The purpose of this study is to analyze the land use evolution and characteristics of Suzhou wetlands. Located in the Taihu Lake basin, Suzhou has abundant wetland resources, covering 339,500 hectares and accounting for 40% of the land area. The huge wetlands have high environmental and ecological indicators. With the support of RS and GIS technology, Landsat OLI 30 m remote sensing images, vector data, 30 m DEM, and other data are used. Through analysis and processing, land use type maps, wetland distribution maps, and research area overview maps are generated, and their land use area, dynamic degree, and transfer matrix are calculated. The results show that from 2013 to 2020, the total area of Suzhou wetlands showed a decreasing trend, with a total change of -8.77%. In the past seven years, Suzhou's urban construction rate has been relatively fast, and the main supply sources of construction land were lakes, mudflats, wetlands, and woodlands. Based on this, the impact of economic development and construction on the protection of environmental ecology should be emphasized and implemented in wetland management and protection strategies in order to promote sustainable environmental development.*
Keywords*— *Land Use, Wetlands, Remote sensing (RS) & Geographic Information System (GIS), Transfer Matrix, Dynamic Degree.

I. INTRODUCTION

In the context of the modernization process of national development goals, the Yangtze River Delta is trying to integrate strategies to achieve a green economy, high-quality life, and sustainable development; deeply implement the concept of ecological civilization construction; adhere to ecological priority development; and promote social and economic development mutually. Based on this, the construction and practice of ecological civilization are increasingly valued, becoming the top priority of current urban and rural development.

Wetlands are one of the most abundant natural resources in the Yangtze River Delta, playing a crucial role in supporting national sustainable development and becoming one of the important subjects of regional ecological environment protection (Guo et al., 2017; Wang, 2022). From the perspective of national ecological security, that is, a country's ecological environment is relatively small or undamaged and is in a healthy and sustainable development state. Wetlands, as a unique ecosystem, can provide habitat for waterfowl and wildlife, improve biodiversity, and fully self-repair and regulate themselves.

They can also improve the ecological carrying capacity of the region to a certain extent, making them an important component of the national ecological security system. Among various ecosystems, wetlands are the most productive ecosystem in nature, possessing the characteristics of both wetland and terrestrial ecosystems. They play a crucial role in soil and water conservation, climate regulation, pollution degradation, and biodiversity protection and can maintain regional natural ecological balance and sustainable economic and social development, providing reliable guarantees for national ecological security. Therefore, conducting in-depth research and analysis on wetlands has important national strategic value and significance (Du, 2021; Yi, 2021).

This study mainly analyzes the land use evolution of Suzhou wetlands, explores the trend of wetland area evolution, and analyzes its influencing factors from a multi-level perspective, aiming to provide reference data for ecological security support for regional sustainable development. The research results will provide decision-making support for the protection and management of regional wetlands. The specific research objectives and methods are based on remote sensing image data by 2013 and 2020, using remote sensing (RS) and geographic information system (GIS) technology to analyze the dynamic trend of land use change (Liang and Wang, 2023; Zhang and Wang, 2023), analyze the changes in the value of wetland ecosystem services, and propose relevant strategies on this basis to provide suggestions for promoting the sustainable development of the ecological environment in the region.

II. LITERATURE REVIEW

2.1. Land Use and Wetlands

Land use refers to the way and purpose of human use of the natural attributes of land, and is a dynamic process. Its development and changes are influenced by natural, social, economic, and technological conditions, which collectively determine the function of land. The working group of the Land Use Planning Department of the Food and Agriculture Organization of the United Nations (FAO) pointed out that land use refers to the land function determined by natural conditions and human intervention. In the process, human beings manage land resources to fully utilize land functions while seeking better environmental quality, which is the core issue.

In the process of land use, economic benefits and ecological benefits have symbiosis and interdependence but may also generate exclusion. Because of land are an ecological and economic system that is coupled by the natural ecosystem of the land and the land economic system. In the process of land use activities or social production and reproduction, a certain amount of labor is occupied and consumed. Not only do we need to produce a certain amount of products that meet social needs (i.e., produce a certain economic effect), but we must also remove and inject some substances and energy, as well as some pollutants, from the land ecological system. In this process of 'taking' and 'returning', the land ecological and economic system undergoes significant changes, resulting in certain ecological benefits (Ge and Ma, 2022).

There are various definitions of wetlands, and currently the internationally recognized definition of wetlands is proposed by the Wetlands Convention, which refers to natural or artificial, permanent or temporary swamps, peatlands or water areas, static or flowing, fresh water, brackish water, and saline water bodies, including water bodies with a depth of no more than 6 meters at low tide. Wetlands include many types, including coral reefs, mudflats, mangroves, lakes, rivers, estuaries, marshes, reservoirs, ponds, rice fields, etc. Their common feature is that their surfaces are constantly covered or filled with water, forming a transitional zone between land and water bodies (Wu, 2022; Porras-Rojas et al., 2023).

Wetlands are widely distributed around the world and are a symbol of biodiversity on Earth, with rich and highly productive ecosystems. It plays an important role in resisting floods, regulating runoff, controlling pollution, regulating the climate, and beautifying the environment. It is not only a natural water storage reservoir on land but also a breeding and wintering ground for many wild animals and plants, especially rare waterfowl. It can provide water and food for humans. Its natural diversity function has become a precious resource possessed by humans; therefore, wetlands are also known as the "cradle of life", "kidney of the earth", and "paradise of birds" (Guo et al., 2017; Yi, 2022).

2.2 Progress in Wetland Research

The research progress of wetland land use has led to significant changes in the wetland ecological environment over time and with the development of society, as well as the natural geographical environment and human social activities. From the perspective of wetland types, the degradation of natural wetlands is significant; the scale of artificial wetlands continues to expand; wetland habitats are damaged; diversity decreases; and habitat fragmentation intensifies, thereby weakening the original functions of wetland ecosystems. From the perspective of land use types, wetlands are also constantly being replaced by construction land, resulting in environmental and human hazards. Therefore, in the natural and social context, research on the evolution of wetland land use has also received attention.

Against the aforementioned background, numerous scholars are committed to studying the spatio-temporal evolution of laws of land use. With the deepening of land use research, relevant principles and research methods have begun to be applied to wetland research. This study used the China National Knowledge Infrastructure (CNKI) to search for 915 papers related to wetland landscape patterns published between 1980 and 2023. Quantitative analysis (Figure 1) showed that research on wetland land use has shown a significant increase since the 21st century and is currently on a fluctuating upward trend. On the one hand, it reflects the maturity and improvement of wetland land use analysis technology and research methods due to the development of information technology. On the other hand, it also demonstrates the importance that scholars attach to ecological research such as wetland land use in the new context of continuous promotion. In addition, most scholars focus on the spatio-temporal evolution characteristics and internal and external driving mechanisms of dynamic changes in wetland land use research.

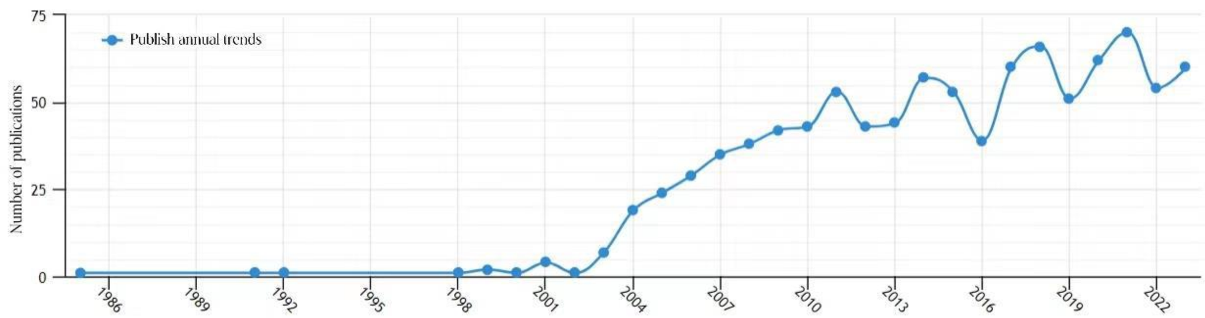


Fig.1: Trends in the number of publications related to Wetland Land Use (source: CNKI)

The research method for wetland land use mainly relies on existing land use analysis methods, using transfer matrix and dynamic degree analysis to quantify the dynamic change process and trend of wetland land use through indicators such as the area and size of the study area. In recent years, there has also been a focus on the use of RS technology, collecting and processing various types of RS images to obtain basic data (Guo et al., 2017; Jamali et al., 2021). Through RS classification and the use of GIS software, corresponding maps have been created for quantitative analysis of spatial data, and the dynamic change process of wetlands and their spatial differentiation patterns have been explored.

In addition, given the comprehensiveness and complexity of wetland ecosystems and land use, it is necessary for subsequent research to study the influencing factors of wetland land use evolution from a multidisciplinary perspective. The research on statistical wetland land use involves the display of disciplinary classification charts (Figure 2). Currently, research on wetland land use mostly involves multiple disciplinary categories, mainly focused on environmental science and resource utilization. Therefore, it is necessary to strengthen interdisciplinary communication and cooperation, study the optimization of wetland land use, and conduct quantitative analysis of influencing factors from a more diverse and accurate perspective, which is more conducive to comprehensive research and understanding.

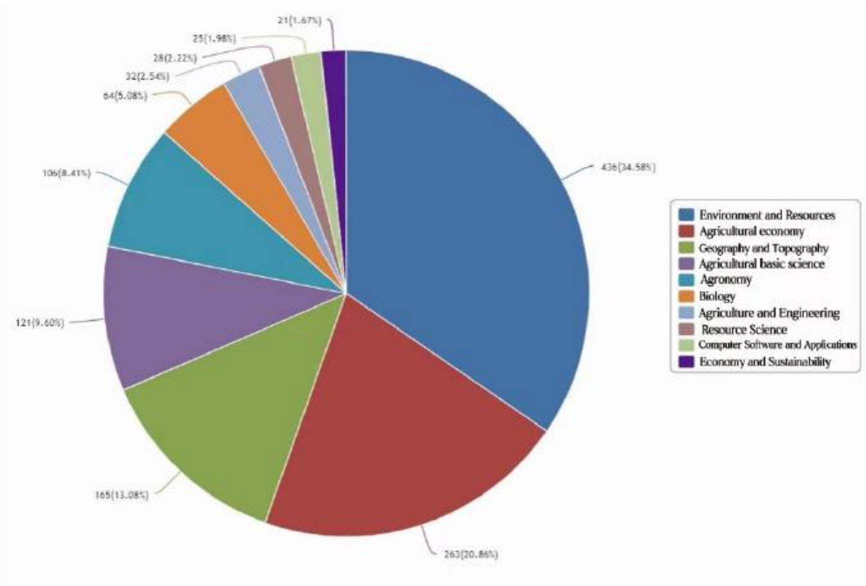


Fig.2 Distribution Map of Disciplines Involved in Wetland Land Use Research (Source: CNKI)

2.3 Research on Wetlands in Suzhou Area

Wetlands are known as the kidney of the earth, carbon storage, the resource pool of species, and the home of birds. Together with forests and oceans, they are called the three major ecosystems in the world and are one of the ecosystems with the strongest self-purification ability in the natural environment. Suzhou wetland protection closely focuses on the Yangtze River protection, the Yangtze River Delta integration, and the ecological protection strategic layout of the Taihu Lake. It promotes the goal of wetland protection and management and attempts to establish the "Suzhou model". The protection capacity has also been continuously valued and improved. The city has added 200,000 acres of newly protected wetlands, and the protection rates of natural wetlands and artificial wetlands have increased to 70.4% and 55.4%, respectively, ranking first in the province.

Given the importance of Suzhou wetlands and the complexity they exhibit with environmental changes, relevant scholars are continuously advancing and improving their research on wetlands, and the entry points for research are also being refined (Figure 3). Previous studies focused on the correlation between Suzhou Wetland Park and ecological restoration or on the study of wetland refinement types in the Taihu Lake basin of Jiangsu Province. Among them, there is relatively little research on breaking through provincial boundaries and analyzing the changes in wetland conditions in Suzhou from a holistic perspective. Therefore, in the context of implementing sustainable ecological protection strategies, exploring the impact of changes in the value of wetland ecosystem services in Suzhou will become a new perspective for wetland research (Wang, 2022).

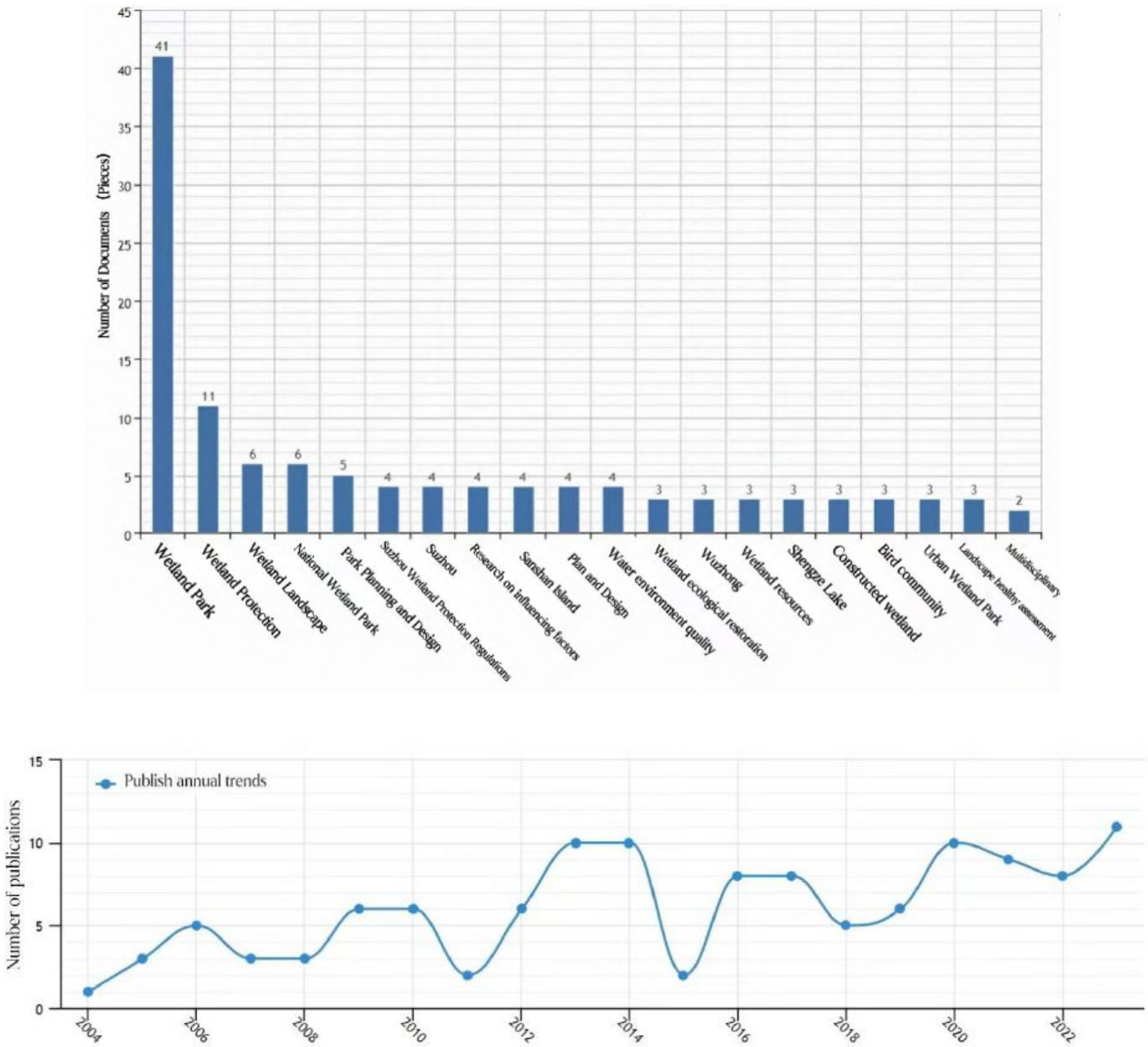


Fig.3 Trends and Theme Content of Literature on Wetland Research in Suzhou (Source: CNKI)

III. STUDY AREA

Suzhou is located in East China, the southeast of Jiangsu Province, the middle of the Yangtze River Delta, and the east bank of the Taihu Lake, bordering Shanghai in the east, Jiaxing City and Huzhou City in Zhejiang Province in the south, Wuxi City in the west, and the Yangtze River in the north, between 119° 55′ -121° 20′ E and 30° 47′ -32° 02′ N (Figure 4); the total area is 8657.32 km^2. The terrain of the city is low and flat. There are many rivers and lakes in the city. Most of the water surface of Taihu Lake is in Suzhou. The area of rivers, lakes, and mudflats accounts for 36.6% of the land area of the city. It is a famous water town in the south of the Yangtze River.

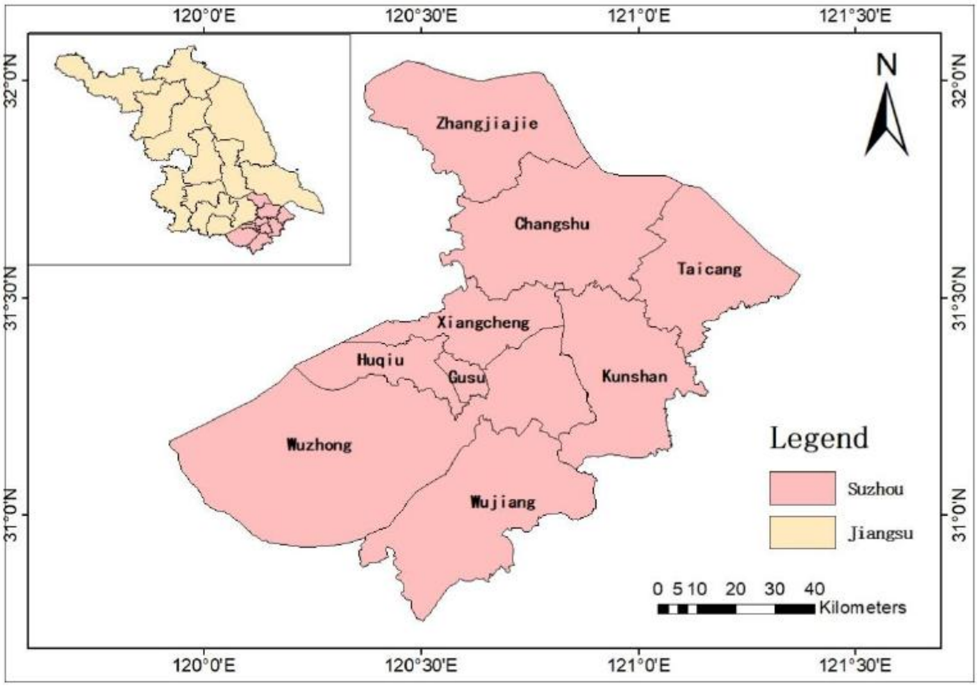
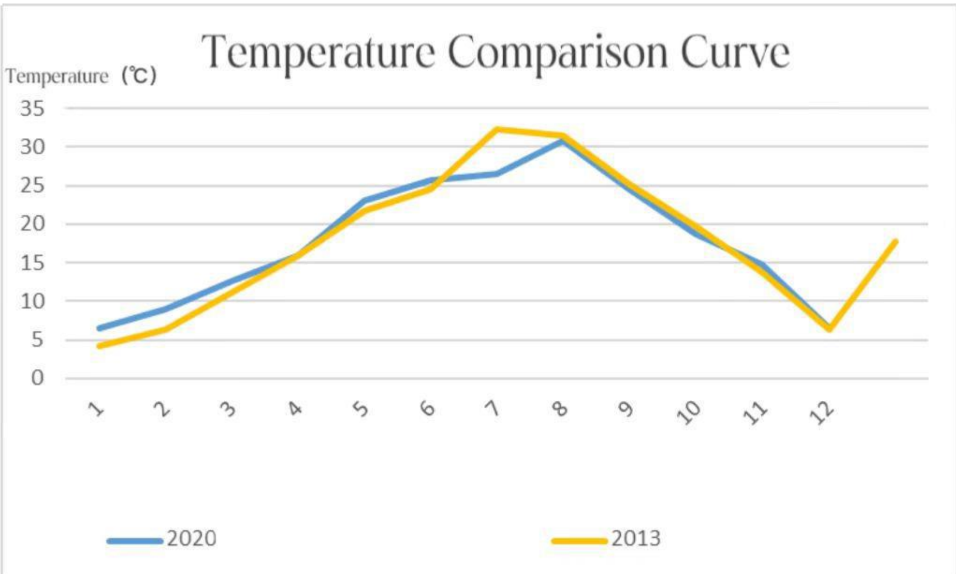


Fig.4 Map of Suzhou City

In terms of climate conditions, it is located in the humid monsoon climate zone of the northern subtropical zone, with warm, humid, and rainy weather. The monsoon is distinct and has four distinct seasons, with long winter and summer seasons and short spring and autumn seasons. The average annual frost-free period is 233 days. Due to the differences in terrain and latitude, various unique microclimates are formed in the territory. The Taihu Lake is the high center of solar radiation, sunshine, and temperature, and the areas along the river are the low value areas. The distribution of precipitation also follows the same pattern (Figure 5).

There is a significant correlation between climate change and wetland dynamics in Suzhou. Relative humidity and temperature are the main climate factors that affect the increase and decrease of wetlands, respectively. A warm and humid climate is an important factor leading to the increase of wetlands, while the decrease of wetlands is mainly related to the hot and dry climate. The different trends of climate change are important factors affecting wetland changes.



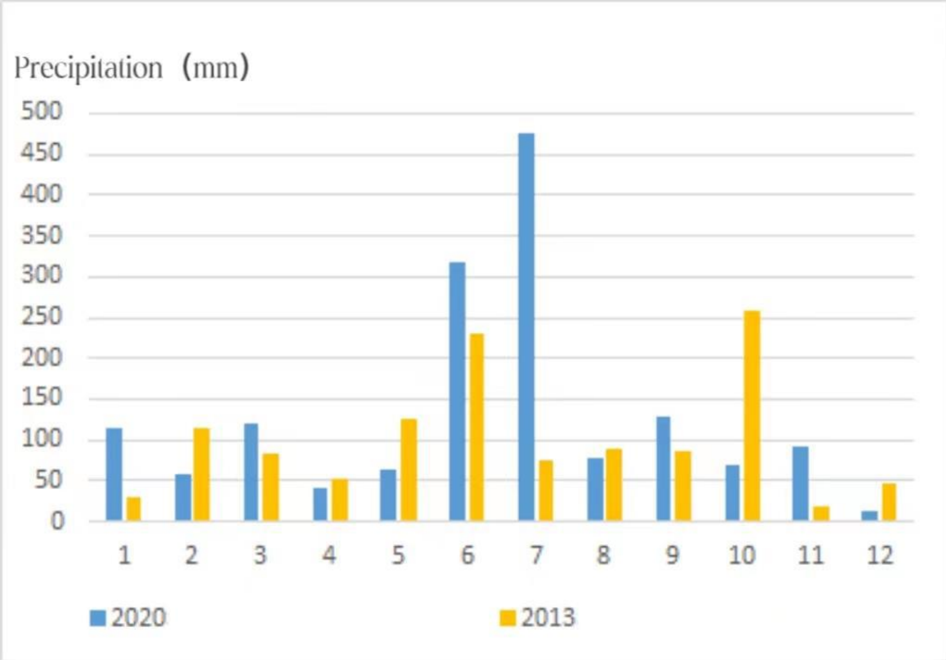


Fig.5 Comparison of temperature and rainfall in Suzhou

The average precipitation in Suzhou (1956~2000 series) is 1086.3 mm, which is equivalent to a total precipitation of more than 9 billion m^3; among them, 1999, the year with the most precipitation, averaged 1513.8 mm, and the average rainfall of plum rains was 630 mm, which is 3 times. The second was 1452.7 mm in 1993, and the least was 598.2 mm in 1978, with a difference of 2.53 times between abundance and dryness.

In 2022, Suzhou will achieve a regional GDP of 2,395.834 billion yuan, an increase of 2.0% over the previous year at comparable prices, of which the added value of the primary industry is 19.298 billion yuan, an increase of 3.0%. The secondary industry was 1,152.141 billion yuan, an increase of 1.8%. The tertiary industry was 1,224.395 billion yuan, an increase of 2.1%. The ratio of the three industrial structures is 0.8:48.1:51.1. Calculated by the permanent population, the per capita GDP was 186,000 yuan, an increase of 1.3% over the previous year. With the acceleration of urbanization, Suzhou's economy continues to develop, and construction land increases. How to coordinate the relationship between economic development and ecological protection is an important issue for sustainable development.

IV. MATERIAL AND METHOD

4.1 Data Source and Preprocessing

The research data sources include: (1) Landsat images in 2013 and 2020 were obtained from Geospatial Data Cloud (GDC) (https://www.gscloud.cn/sources/index?pid=1&rootid=1) (Table 1); (2) The verification data for Suzhou Wetland is sourced from the satellite map of the Eight-Nine Network; (3) Average precipitation, annual average temperature, and population data for the two periods were acquired from Yearbook Statistics.

Table 1 Information of Remote Sensing Images

SN	Satellite	Sensor	Track Number	Acquire time	Resolution (m)
1	Landsat-8	OLI	119/039	2013.7.19	30
2	Landsat-8	OLI	119/038	2020.5.03	30

In addition, data preprocessing involves radiometric calibration, atmospheric correction, and mosaic clipping of two Landsat-8 images to obtain the image area of the study area. According to the "Overall Plan for Land Use in Jiangsu Province" and the "Technical Regulations for Land Use Status Survey", referring to the national classification standards and Yancheng City's land use status, the landscape types in the research area are divided into four categories, including construction land (urban and rural, industrial and mining, residential land) forests, arable land, wetlands (Fan et al., 2014). Then, using the ISODATA unsupervised classification method, wetland land use is classified, and the classification results are processed to obtain wetland land use classification data (Wang et al., 2023).

4.2 Methods

This study is based on the 30 m RS images of Suzhou in 2013 and 2020, the vector data of the administrative area, the 30 m DEM, temperature, and precipitation data. The main research and analysis steps (Figure 6) are briefly described as follows:

1. Data collection and processing: Download the RS images required for land use type maps and wetland distribution maps from the geospatial data cloud, Data.geoatlas, and other platforms; preprocess the Landsat-8 images: including radiometric calibration, atmospheric correction, mosaic, and clipping.

2. RS image classification: Using ENVI software to perform ISODATA unsupervised classification on the image, and after distinguishing the characteristics of the ground features, merge the similar ground features. Then use ArcGIS to make a land use type map and a wetland distribution map.

3. Transfer the processed raster image to ArcGIS, extract the attribute elements of each land use type, and calculate its area.

4. Calculate the dynamic degree and transfer matrix of each land use type according to the formula.

5. Obtain the monthly average temperature and precipitation in 2013 and 2020 through the yearbook, make a comparison Table between the two periods, and analyze the factors affecting the change of the total wetland area.

6. Finally, conduct a comprehensive analysis, obtain the results, and make suggestions.

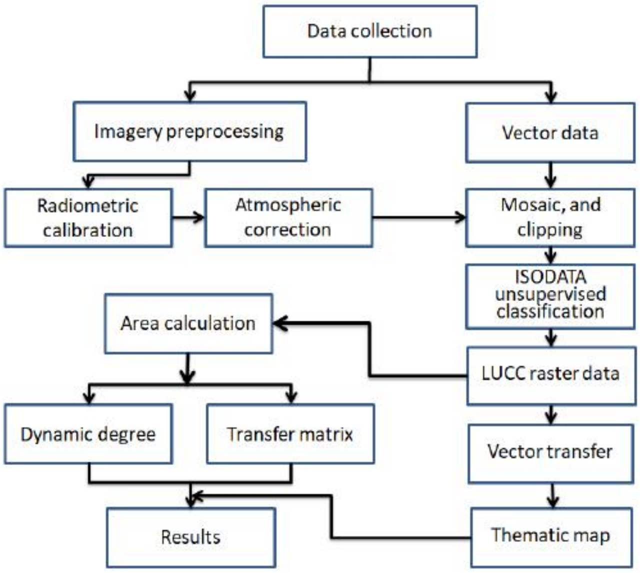


Fig.6 The Schema of The Study

4.3 ISODATA Unsupervised Classification

Unsupervised classification is also called cluster analysis, which means that no prior knowledge is applied to the classification process in advance but only based on the distribution law of the spectral characteristics of RS image features, using the characteristics of natural clustering to allow machines to learn and classify, which is based on the theory of clusters, and it is a method of pattern recognition to carry out cluster statistical analysis on images by computer. The main algorithms for unsupervised classification in the field of RS images are ISODATA and K-means. Among them, ISODATA classification is a repeated self-organizing data analysis technique that calculates the class mean value of the uniform distribution of data pixels, then uses the minimum distance algorithm to iteratively aggregate the pixels, recalculates the mean value in each iteration, and, according to the obtained new mean value, classifies the pixels again (Guo et al., 2017; Wang et al., 2023).

4.4 Land Use Dynamic Degree

The land use dynamic degree model can fully express the rate of land use change in a certain period of time in the study area (Zhang and Wang, 2023; Liang and Wang, 2023; Xie et al., 2023). According to different research objects, there are single land use dynamic degree and comprehensive land use dynamic degree, and the calculation formula is:

$$K = \left(\frac{H_b - H_a}{H_a}\right) \times \frac{1}{T} \times 100 \quad (1)$$

In the formula: K is the dynamic degree of a single land use; H_a, H_b are the area of the land use type before and after the study; T is the research period; the larger |k|, the greater the rate of change of a certain land use type in the study area.

$$L_c = \left[\frac{\sum_{i=1}^{n} \Delta LH_{i-j}}{2\sum_{i=1}^{n} LH_i}\right] \times \frac{1}{T} \times 100\% \quad (2)$$

In the formula: L_c is the dynamic degree of comprehensive land use; LH_is is the area of the i-th land use type in the previous period; ΔLH_{i-j} is the absolute value of the area of the i-th type of land converted into the j-th type of land use type; n is the number of land types (n=1, 2, 3...); T is the research period; the larger L_c, the faster the overall change rate of land use change in the study area.

4.5 Transfer Matrix

The transfer matrix method is used to quantitatively describe the system state and state transition. The transfer matrix can be used for quantitative analysis and in-depth understanding of the transfer area, transfer direction and supplementary sources of various species. It is mainly used to analyze the transfer rate and direction between different land use types in different periods, so as to analyze the internal correlation and change trend between land use types (Yu et al., 2018; Zhang and Wang, 2023; Liang and Wang, 2023; Xie et al., 2023). The transfer matrix formula is as follows:

$$S_{ij} = \begin{bmatrix} S_{11} & \cdots & S_{1n} \\ \vdots & \ddots & \vdots \\ S_{n1} & \cdots & S_{nn} \end{bmatrix} \quad (3)$$

In the formula: S represents the area of land use type transfer; n represents the classification number of land use types in the study area; i, j (i, j are integers of 1, 2, 3...n) represent the land use type before transfer and the area after the transfer of land use types; S_{ij} represents the number of land use types transferred from the i-th type of land use type to the j-th type of land use type.

V. ANALYSIS AND RESULTS

5.1 Changes in Land Use Types

By calculating the area of each land use type in Suzhou in 2013 and 2020, the proportion of land use type area and the dynamic analysis Table for the two-year period are obtained (Table 2). In addition, through ISODATA unsupervised classifications, four types of land use change maps were obtained for 2013 and 2020 (Figures 7 and 8) to present the characteristics of land use type change.

From the perspective of changes in land use types, the results show that over the past 7 years, the total wetland area in Suzhou has shown a downward trend, with a total change of -8.77%, while the construction land area has significantly increased, with a total change of 16.37%. Analysis shows that the main factors affecting the reduction of wetlands are the impact of human activities, especially such as building towns or scenic spots, cultivating arable land, and changing river channels, which have made the reduction of wetland area increasingly severe.

In addition, after calculating the area of four types of land use in Suzhou through ArcGIS, a single degree of land use dynamics was used to analyze land use changes, revealing the dynamic evolution process of land use in the study area in time and space. This can quantitatively describe the speed and severity of regional land use changes. Analysis of the dynamic degree of single land use in Suzhou from 2013 to 2020 (Table 2) shows that the absolute values of wetland and construction land dynamic degrees are relatively high, reaching 0.03 and 0.38, respectively. Over the past 7 years, except for construction land, other land use types have experienced varying degrees of reduction, especially the area of wetland types.

Table 2 Land Use Type Area Proportion/Dynamic Degree

Land-use type	2013 Area/k㎡	Rate%	2020年 Area/k㎡	Rate%	Variation	Land use dynamics degree
Water bodies	3337.41	39.05%	2583.63	30.28%	-8.77%	-0.03
Construction	521.81	6.11%	1917.69	22.48%	16.37%	0.38
Green land	2776.98	32.50%	2298.42	26.94%	-5.56%	-0.02

Arable	1909.6	22.35%	1732.23	20.30%	-2.04%	-0.01
Total	8545.8	100%	8531.97	100%	0.00%	0.00
Wetland area	3337.41	39.05%	2583.63	30.28%	-8.77%	-0.03
Area of Suzhou	8657.32	100%	8657.32	100%	0.00%	0

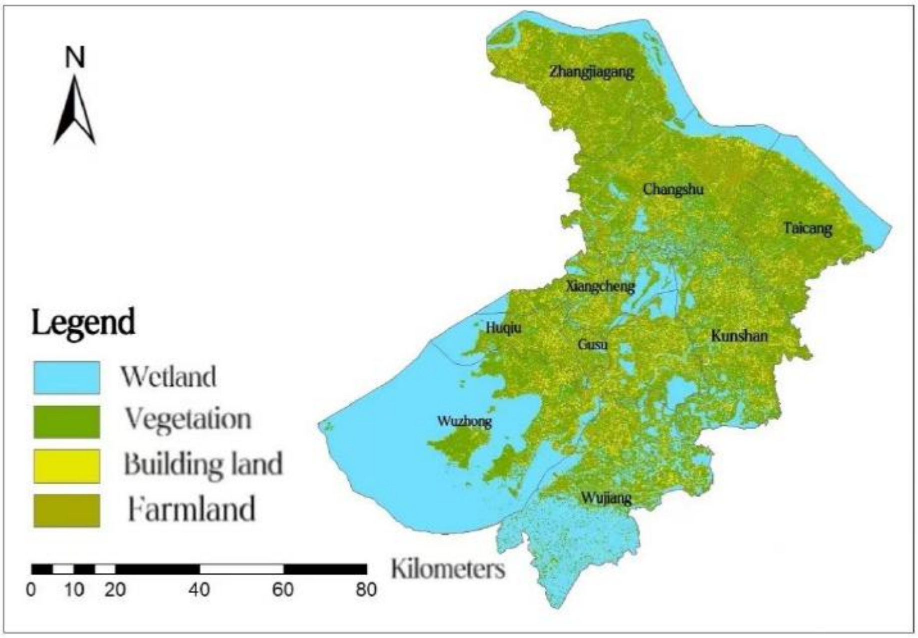


Fig.7 Land Use Types in 2013

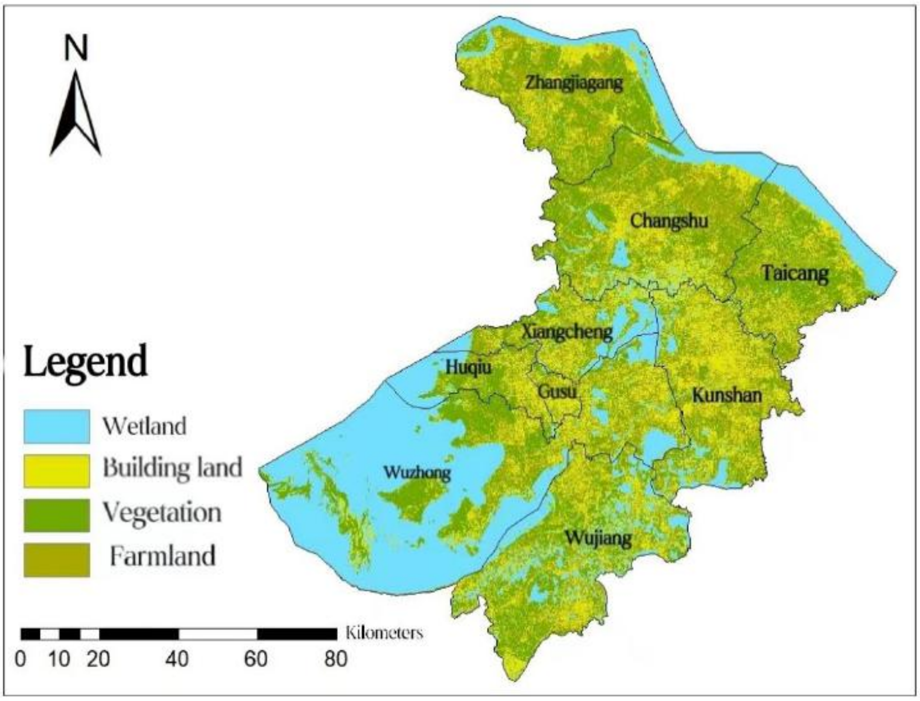


Fig.8 Land Use Types in 2020

The transfer matrix is used to present the magnitude and direction of changes between land types in different periods, so this method is used for specific analysis in this paper (Hu et al., 2023). Firstly, use ArcGIS to calculate the transfer situation between different categories in Suzhou in 2013 and 2020 (Table 3). From the perspective of the land use transfer matrix, it can be seen that (1) the conversion of construction land into green land has a high proportion; (2) the total area of construction land has significantly increased over the past 7 years; and (3) totally, the wetland area has decreased to a certain extent. Overall, with the rapid development of the social economy, the ecological environment has been damaged to varying degrees, and Suzhou wetlands show a decreasing trend in the land use transfer matrix (Li et al., 2023).

Table 3 Land Use Transfer Matrix /Unit： km²

Land types	Arable land	Construction land	Wetland	Green land	2020 year
Arable land	840.42	183.18	131.69	605.20	1760.50
Construction land	502.46	299.43	424.73	728.23	1954.85
Wetland	32.18	6.60	2491.04	60.80	2590.61
Green land	565.82	48.05	304.24	1414.34	2332.45
2013 year	1940.89	537.26	3351.70	2808.56	8638.41

5.2 Changes in Wetland Area

Based on the trend analysis of the total wetland area change, the RS classification results were combined with ArcGIS to create thematic maps and obtain the wetland distribution maps of Suzhou in 2013 and 2020 (Figures 9 and 10), which were processed and calculated using spatial data. The results show that from 2013 to 2020, the total area of wetlands showed an overall downward trend, with a total reduction of 753.78 km^2 a total change rate of -8.77% over 7 years. It can be seen from the comparison of the two thematic maps that the reduction of mudflat wetlands is the most severe, the reduction of mudflat wetlands in Wujiadng District is the most obvious, and the reduction of mudflat wetlands directly leads to the decline of natural wetland area. The overall area of lake wetlands shows a stable trend, mainly due to the increase in monthly average precipitation in Suzhou over the past 7 years. The large amount of precipitation has maintained the water storage area of the lake, thus keeping the lake wetland area stable. According to the statistical Table of land use types and areas, it can be seen that the construction land in this area has increased, thereby occupying the area of wetlands.

Based on the analysis of wetland land use evolution factors, urban construction has increased rapidly in the past seven years, and the main sources of construction land are Lake Mudflat wetlands and forestlands. The evolution of construction land and wetlands reflects the changing patterns of different land types in the process of economic development in Suzhou. In the early stages of urbanization and the transformation and development of related industries, most of them were achieved by converting natural wetlands. However, with the introduction of sustainable development concepts, this phenomenon has also improved (Zhu et al., 2017; Zhao et al., 2022; Yang et al., 2022).

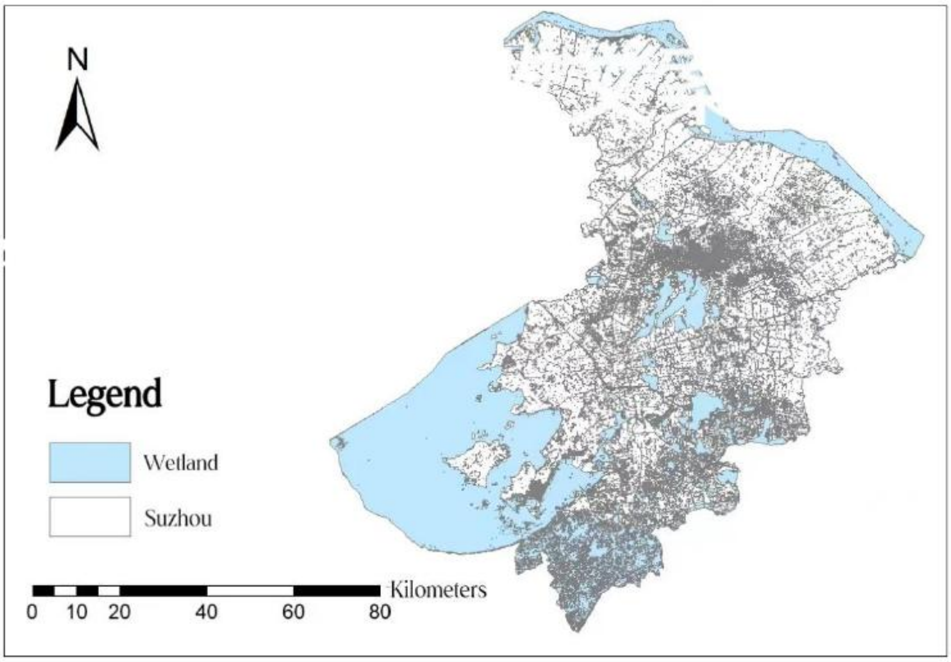


Fig.9 Distribution Map of Wetlands in Suzhou in 2013

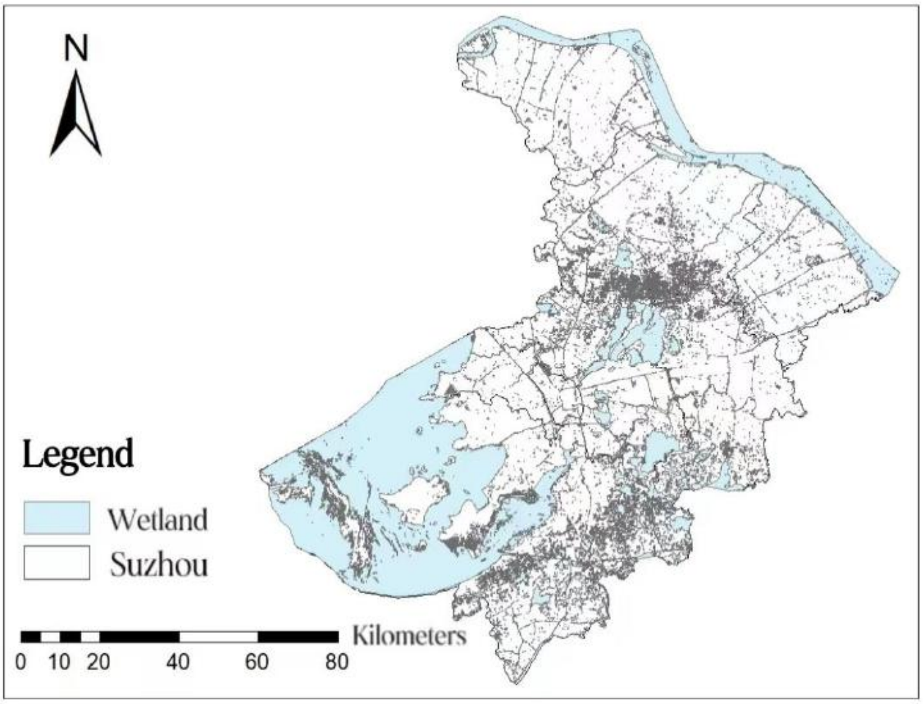


Fig.10 Distribution Map of Wetlands in Suzhou in 2020

5.3 Suggestions for Wetland Environmental Protection

Wetland protection is an important approach to achieve healthy and sustainable functions. The construction of wetland protection networks, the implementation of targeted protection methods, the construction of wetland special information databases, and phased evaluation of protection effectiveness are the crucial ways to protect wetlands. Based on the analysis results of this study and the evolution trend of wetland land use, several suggestions are proposed:

(1) Taking Wujiang District as an example, to deeply promote the high-quality development of sponge cities in various regions.

(2) Properly interfere with the reproduction of wetland species and maintain ecological balance.

(3) Utilizing the 3S system as a scientific method for monitoring the environment, continuously paying attention to the dynamics of the environment for a long time, in order to propose effective decision-making solutions in response to environmental changes.

(4) Design wetland tourism plans to help the public understand the wetland system and enhance their awareness of wetland protection.

(5) Regularly conduct large-scale water quality testing on wetlands to reduce water environmental pollution.

(6) Establish reasonable policies for the expansion of construction land to ensure the sustainability of wetlands.

VI. CONCLUSION

This study uses RS images of Suzhou in 2013 and 2020 as data sources and uses study methods and technical means such as ArcGIS, ENVI, land use dynamics, and a transfer matrix to analyze the dynamic degree in land use and wetland distribution in Suzhou over the past 7 years. Based on this, the dynamic degree and transfer matrix of various types of areas are analyzed. Finally, based on this, suggestions for optimizing and protecting the wetland environment in Suzhou and sustainable development are proposed.

Through land use evolution analysis, it is shown that the wetlands in Suzhou are affected by human activities, manifested in the accelerated urbanization process and the growth of construction land, resulting in a downward trend in the total area of wetlands. From the dynamic degree of land use, it can be seen that from 2013 to 2020, the growth rate of construction land was higher than that of other land uses, while wetlands, vegetation, and other land uses showed negative growth. From the land use transfer matrix, it can be seen that some areas of Suzhou have shown a decreasing trend in wetlands, while construction land has significantly increased, indicating that there is still a lack of coordinated development between Suzhou's economic development and wetland protection.

In summary, human production and life have a significant impact on changes in regional land use types. Faced with the increasing population and rapidly developing economic industries, how to balance the development and construction of artificial landscapes and natural wetland landscapes is a topic of continuous concern in the future. Therefore, establishing a reasonable wetland landscape planning system can stabilize regional economic development and ensure the balance of natural wetland ecosystems.

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