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Ecological Environment Planning and Diversity Protection Based on GIS And Computer Simulation

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A geographic information system (GIS) is a framework used to gather, store, quantify and analyse geographic and spatial data in the fields of information engineering and hydrology, among many others. The core of a GIS is the geographic information and data processing system based on spatial data. A GIS can be used not only to acquire information about a particular place, but also to find detailed data for a certain area within the system's huge database. Because of the strong data processing and storage capacity of a GIS, it is widely used in many fields including geological and environmental surveys, and the exploration of mineral and water resources. This paper comprehensively considers the various factors affecting the development of biodiversity, summarizes the advantages and methods of urban construction, and simulates a GIS-based urban construction. Previous research and analysis have shown that a GIS can assist with both urban construction and agricultural planning, can evaluate the actual construction work, and foresee and prevent errors.

Keywords: computer simulation; ecological environment; environmental planning; diversity protection

1. INTRODUCTION

A GIS is a comprehensive system that combines electronic information engineering, surveying and mapping engineering, computer technology and several other disciplines. Based on the intersectionality of the system, using the computer's high-speed computing power and rigorous logic processing capabilities, a large amount of data can be processed to obtain geographic information such as regional topography. From the perspective of data attributes, in addition to describing geographic information attribute data, the system also includes other related attributes after these data [1–2]. The system can collect a great amount of geographic data including topography and elevation, and meteorological information such as temperature and humidity. However, data collection is only the first and most basic function of a GIS. The collected information must be processed, as the ultimate purpose of the system is to effectively and efficiently process a large amount of data to obtain the information required by users [3].

In this paper, remote sensing images and GIS technology are further combined, and based on this practice, a series of analysis and investigation methods, such as literature research method, field survey method, landscape interval index method, etc. [4–5]. By studying the changes to the greening pattern, on the basis of ecological fragility, the evolving law of urban vegetation in the greening area after being destroyed by the outside world is explained. This paper investigates the factors that threaten a fragile ecological environment, and proposes protection and management mechanisms to address various ecological vulnerabilities [6]. It is hoped that future research and effective governance will help to safeguard the natural environment in the urban planning process.

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Table 1 The index system and weights of the identification model of biodiversity conservation priority areas in a province.

Composition level	Index system
Ecosystem protection (33.3%)	Native ecosystem (30%) Diversity of County Ecosystem (30%)
Human impact (33.3%)	Key ecological function area (40%) Human Interference Index (50%) 5-year human disturbance change degree (50%)
Biodiversity protection zoning (33.3%)	Biodiversity protection classification (60%) Nature reserves above the provincial level (40%)

2. EXPERIMENTAL PROCESS AND METHOD

2.1 Index System Design of Identification Model for Biodiversity Conservation Priorities in a Certain Area

Although society has evolved and developed due to technological and manufacturing innovations, people's activities have had a negative impact on human health and the natural environment. Gradually, we have come to realize that the world faces serious problems, one of which is environmental pollution and the decline of air quality that poses serious health threats. A great deal of research and analysis has shown that in recent decades although the level of economic development in various countries and regions has improved, it has been at the cost of human health and the natural environment, and the problems are increasing [7]. Environmental problems such as the changes brought about by global warming, the destruction of the ozone layer, the destruction of the development of biological diversity, the reduction of forested areas, and the emergence of air pollution in various regions, have become more and more serious. Positive measures must be taken to deal with these environmental problems which threaten both people and planet [8].

In order to safeguard biodiversity biological development must be protected and ensured. Hence, the main task is for people to align their economic and social development with the development of the natural environment [9]. For the purpose of ecological protection, we should analyze the survival status of different species, implement strong protection measures for any species facing extinction, and establish corresponding conservation areas to provide a suitable environment to ensure the survival of endangered species [10]. Biodiversity and other ecological issues should be considered when natural resources are being exploited and utilized, so that flora and fauna are not destroyed and the natural environmental balance is maintained [11]. This paper investigates the measures taken to protect biodiversity in a particular province, establishes an effective ecological protection mechanism by constructing a priority identification model for the protected areas, establishes several specific indicators of the priority protection areas in a province, and specifies the weight of the indicators These weights are given in Table 1 below.

2.2 GIS Data Source and Computer Simulation Calculation Method

2.2.1 Data Sources

In order to analyze the spatial distribution characteristics of China's terrestrial ecosystems, the 2015 spatial distribution data for China's terrestrial ecosystem types was selected for this study. In order to discover the specific ecological environment protection work undertaken in a certain province, the ecological function zones and the specific implementation of the protection work are established [12]. Moreover, in order to better determine the current level of biodiversity development, a specific analysis was conducted of the land use in the region. The data used in this paper are based on the 2015 land use distribution map [13–15].

2.2.2 Calculation Method

The first step of the data analysis process involves selecting all the data for the ecosystem of a certain province from China's 2015 spatial distribution data for terrestrial ecosystems. Then, the data in the grid network (i.e., the distribution of the system and its specific location) are analysed to determine the ecology of a certain province [16–17]. The following formula can be used to calculate the relevant index of the ecosystem diversity and indicate the complexity of the regional ecological composition of a province:

$$ESDI = \sum^{m} p_i \ln p_i \quad (1)$$

Calculation and analysis show that the higher the ecosystem distribution index, the more complex is the ecosystem in a certain area. Using the following calculations, the land type data for a certain province were extracted, and the land types such as forest land, grassland, cultivated land and artificiallycreated cultivated land were analyzed in detail. For the purpose of calculation, a 300m×300m grid is created in the computer to analyze the land use in different grids. The following formula can be used to calculate the degree to which human activities interfere with the land use in each grid.

$$HID = \sum i = \ln Si/S \quad (2)$$

After calculating the human interference index, the corresponding value can be standardized using this formula:

$$Si = (HDIi - HDI\min)/(HDI\max - HDI\min) \quad (3)$$

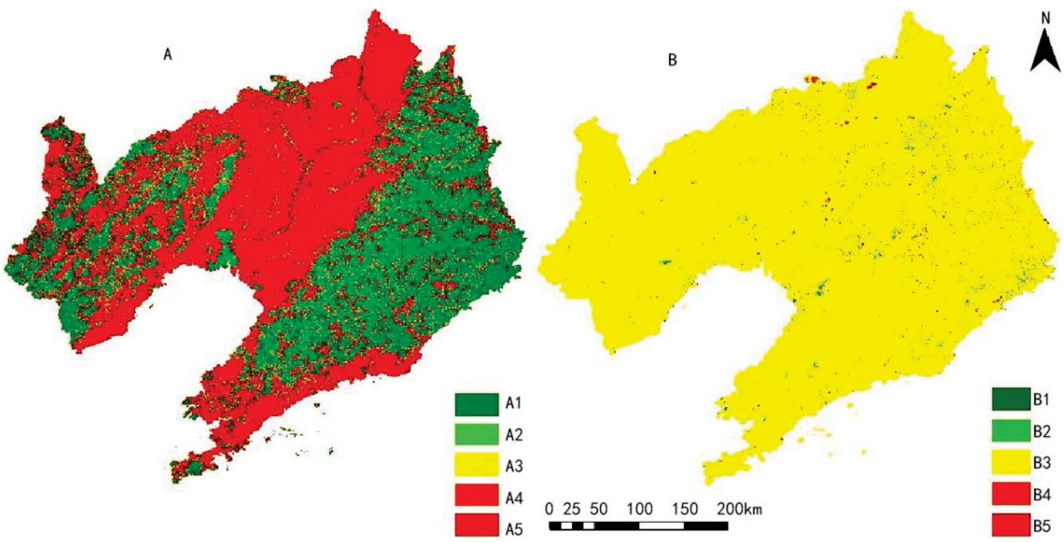

Figure 1 Results of human impact indicators in a province.

This formula yields values between 0 and 1. In this paper, the changes and size of the human interference index from 2010 to 2015 are compared. The following two formulas can be used to calculate the specific conditions of the human interference change.

$$R(i, j) = SIj - SIi \tag{4}$$

$$VHD(i, j) = R(i, j)/(j - i) \times 100\% \times 5 \tag{5}$$

Analysis results indicate that human activities will seriously affect the development of biodiversity, so the protection of biodiversity is essential. In order to improve the effectiveness of biological conservation work, it is necessary to determine the level of protection required by specific areas based on their biodiversity development. Areas are classified according to four levels: general importance, medium importance, important and very important [18–19]. To better identify the level of protection required by different areas, the four levels have been given values of 0.4, 0.6, 0.8 and 1, respectively.

2.2.3 Data Normalization

In order to determine the factors influencing biodiversity, evaluation indicators must be established and applied. To evaluate and analyze the specific conditions of environmental benefits, it is necessary to conduct an overall evaluation of different social development factors There are many differences between various evaluation indicators. In order to ensure the scientific nature of the evaluation results. The indicators are normalized and processed as follows:

$$\text{Positive indicators: } Nij = Xij / Ximax \tag{6}$$

$$\text{Negative indicators; } Nij = 1 - Xij / Ximax \tag{7}$$

2.2.4 Standard Level and Comprehensive Index Calculation

In order to analyze the overall situation of the development of biodiversity in a certain province, a grid model can be established in the GIS to determine the specific impacts of various influencing factors. The grid size established in this study is 300m×300m. Each grid is regarded as a unit of analysis, and calculation and analysis are carried out according to specific evaluation indicators.

3. RESULTS AND DISCUSSION

3.1 Analysis of the Status Quo of Ecological Environment Planning

During the development of an ecosystem, human activities will have a certain impact on the development of biodiversity. When analyzing the impact of human activities, formulas are used to obtain a human interference index. This index gives some indication of the extent to which human activities affect cultivated land, reservoir construction, urban and rural areas. The impact of land use and other aspects. Research has shown that the size of the human interference index can be used as the main basis for the establishment of biodiversity reserves. The larger the index, the greater is the impact of human activities on environmental development. In this paper, the interference index is standardized, and then classified according to five different levels based on the characteristics of the ecological environment of a certain province. The classification is shown in Fig. 1 below. The figure shows that the degree of interference from human activities in the central part of a province is relatively serious, while the interference level in most of the other areas ranges from moderate to extremely severe interference. A certain province is a typical coastal province. A coastal environment is conducive to urban development and can boost the economic development of a region. However, this means that coastal areas are also more affected by human activities.

When monitoring agricultural drought conditions, it is crucial that soil moisture data for farmland be timely, accurate and with high spatial resolution. At present, the methods for obtaining soil moisture information include: (1)

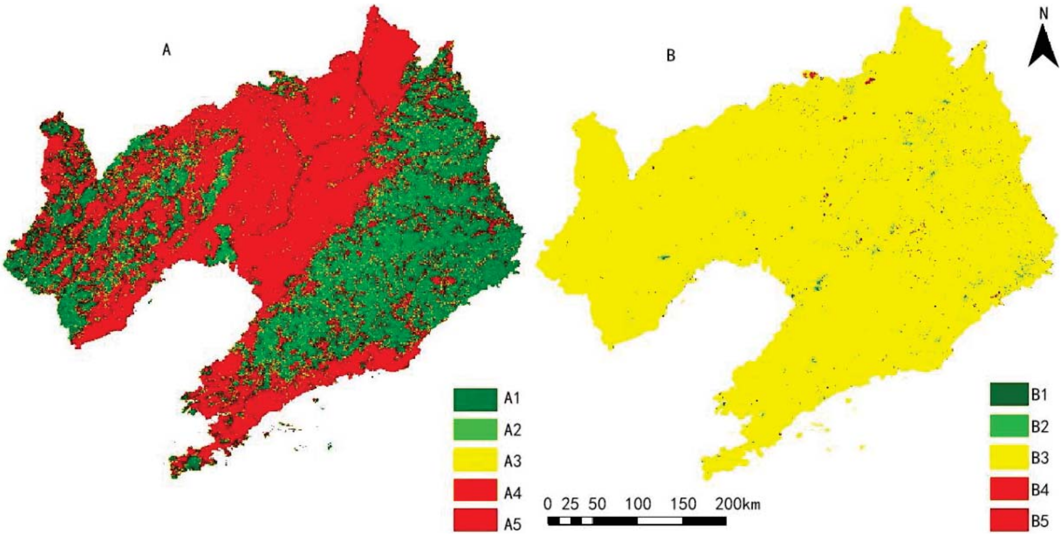

Figure 2 The level of human impact in a province.

constructing the correlation function of coarse-resolution soil moisture and high-resolution data such as vegetation index and LST for downscaling estimation; (2) using high-resolution synthetic aperture radar (SAR) data (such as Sentinel-1) combined vegetation index, based on semi-empirical models such as water cloud model and change detection model, or improved integral equation model (AIEM) and other microwave scattering models for inversion; and (3) calculation based on data-driven methods such as machine learning. Regardless of the type of method, relying solely on physical models or purely data-driven paradigms cannot achieve good soil moisture retrieval results. Future research will tend to use semi-empirical models or machine learning methods with physical mechanisms. At the same time, as mentioned earlier, on a global scale, active microwave and passive microwave soil moisture products have a certain complementarity in different vegetation coverage areas, so multi-source data fusion (including active and passive microwave fusion, visible light and microwave fusion) A future research focus will be on the improvement of methods for obtaining accurate soil moisture data.

In the process of analysis, it is also necessary to calculate the level of human influence in a region according to established criteria, and display the results hierarchically. The specific situation is shown in the figure below. Analysis has shown that the development of the eastern part of a province is affected by human activities to a relatively small extent, the influence of human activities in the western region on the development of the ecological environment is more obvious, while the central and coastal areas are most affected by human activities. The forested area in the eastern region is relatively large, which can play a role in water and soil conservation.

As shown in Table 2 above, forested land (66.47%) is the main green landscape, while cultivated land and artificial surface account for 27.41% and 2.49% respectively. Deciduous broad-leaved forest and deciduous broad-leaved shrub are the main woodland vegetation, accounting for 52.85% and 6.51% of forested areas, respectively. Evergreen coniferous forest accounts for 3.27%, deciduous coniferous forest for 2.47%, mixed coniferous forest for 1.35%, and shrub garden constitutes only 0.01% of vegetation. According to the statistics of the division, the species richness protection in a western region is prior to the ecosystem within the scope, and the species are mainly woodland, cultivated land and artificial surface, with woodland accounting for 52.4%, cultivated land accounting for 40.0%, and artificial surface accounting for 3.7%; the population richness protection in an eastern region is prior to that in the scope, with the highest proportion of forest land accounting for 78.88%, followed by cultivated land, accounting for only 16.37% of the land area.

3.2 Analysis on Planning Results of Biodiversity Conservation Area

Human activities will seriously affect the development of biodiversity, so the protection of biodiversity is essential. In order to improve the effectiveness of biological conservation work, it is necessary to specify the level of protected areas according to the development of biodiversity in different regions. According to different developments of biodiversity, the level of protected areas can be divided into four levels: general importance, medium importance, important and very important These classifications are demonstrated in Fig. 3 below.

The establishment of a nature reserve is the main way by which an ecosystem can be safeguarded; a nature reserve can help to maintain thriving populations of flora and fauna, as well as protect local species, key species and genetic resources. The protection of numerous species is particularly important as it is key to biodiversity. On the other hand, it can also provide for the needs of human beings. Numerous ecosystem services directly related to this are the main reference data for establishing priority areas for species richness. For the purposes of this paper, 47 national or provincial nature reserves and the vector edge areas of the Liaohe River Reserve were investigated, although they did not include the coastal and marine nature reserves. After dividing the nature reserves into national and provincial assigning

Table 2 Statistics of ecosystem types in a province's biodiversity conservation priority areas in 2015.

Class I classification	Code	Class II classification	Area (square kilometers)	Proportion in priority area%	Subtotal%
	102	deciduous broad leaved forest	21688.46	52.85%	
	103	evergreen coniferous forest	1343.15	3.27%	
	104	deciduous coniferous forest	1014.13	2.47%	
	105	coniferous broad leaved mixed forest	555.69	1.35%	
	107	deciduous broad-leaved shrub	2672.63	6 51%	66.47%
	108	evergreen coniferous shrub	1.67	0.00%	
Woodland	109	sparse forest	0.46	0.00%	
	110	open shrublands	0.21	0.00%	
	112	shrub garden	2.96	0.01%	
	201	temperate steppe	111.38	0 27%	1.29%
	205	thick growth of grass	418.68	1.02%	
	301	paddy field	181.77	0.44%	27.41%
	302	dry land	11070.74	26.97%	
	403	herbaceous wetland	245.36	0.60%	
Wetlands	404	lake	4.29	0.01%	2.23%
	405	reservoir / pond	276.18	0.67%	
	406	rivers	387.5	0.94%	
	501	land used for building	876.66	2.14%	
Artificial surface	502	traffic land	65.55	0.16%	2.49%
	503	mining area	81.42	0.20%	
	602	bare rock	8.37	0.02%	
Other	604	bare soil	4.82	0.01%	0.11%
	605	desert	7.94	0.02%	
	606	saline alkali land	21.19	0.05%	
Total			41041.21	100%	100%

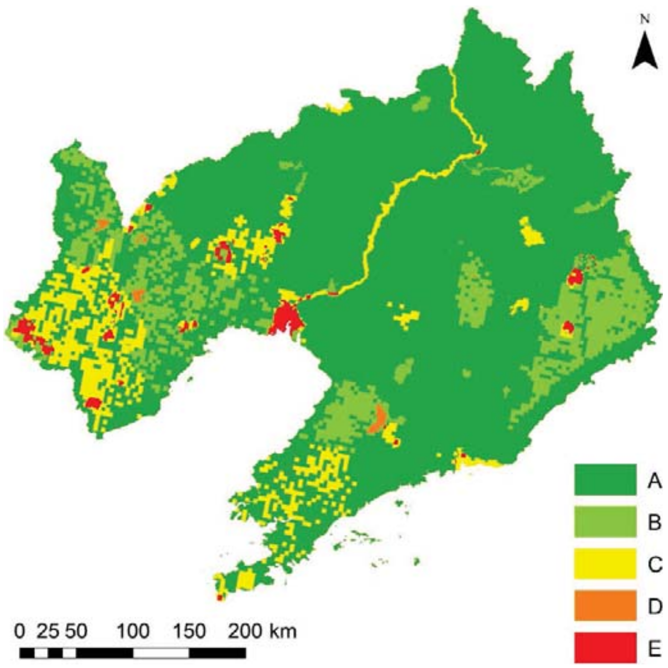

Figure 3 The value of the criteria layer of biodiversity protection regionalization in a province.

values, with species richness as the basis for identification and evaluation of priority reserves, as seen in Fig 3 below a large number of national and provincial nature reserves are in a certain western region. For the calculation of the criterion layer value of the species richness reserve in a certain province, it is displayed separately. According to the figure below, the population abundance of the first-level Liaohe Nature Reserve in a certain western region, southern region, and eastern region has high conservation value. In the nourishing area, the high value distribution area of the sub-layer value is wider, and the eastern high value distribution area the districts are distributed in blocks, and the distribution area of high scores in the south is relatively small and relatively scattered.

Table 3 Statistics of ecosystem types in priority areas of biodiversity conservation in a province (2015).

Class I classification	Code	Class II Classification	Some priority areas in Western Liaoning			Some priority areas in Eastern Liaoning		
			Area (km^2)	Proportion (%)	Subtotal (%)	Area (km^2)	Proportion (%))	Subtotal (%)
Woodland	102	deciduous broad leaved forest	7305.79	38.06%		14382.67	65.84%	
	103	evergreen coniferous forest	1219.32	6.35%		123.82	0.57%	
	104	deciduous coniferous forest	1.08	0.01%		1013.05	4.64%	
	105	coniferous broad leaved mixed forest	0.1	0 00%		555.59	2.54%	
	107	deciduous broad-leaved shrub	1518.22	7.91%	52.4%	1154.41	5.28%	78.88%
	108	evergreen coniferous shrub	0.71	0.00%		0.96	0.00%	
	109	sparse forest	0.46	0.00%				
	110	open shrublands	0.21	0.00%				
	112	shrub garden	2.76	0.01%		0.2	0.00%	
grassland	201	temperate steppe	111.01	0.58%	2.3%	0.37	0.00%	0.36%
	205	thick growth of grass	339.97	1.77%		78.71	0.36%	
Cultivated land	301	paddy field	3.46	0.02%	40.0%	178.3	0 82%	16.37%
	302	dry land	7673.02	39.97%		3397.72	15.55%	
Wetlands	403	herbaceous wetland	29.34	0.15%		216.02	0.99%	
	404	lake	3.93	0.02%	1.4%	0.36	0.00%	2.97%
	405	reservoir / pond	62.8	0.33%		213.38	0.98%	
	406	rivers	169.07	0.88%		218.44	1.00%	
Artificial surface	501	land used for building	602.88	3.14%		273.78	1.25%	
	502	traffic land	48.98	0.26%	3.7%	16.57	0.08%	1.40%
	503	mining area	65.07	0.34%		16.35	0.07%	
Other	602	bare rock	8.37	0.04%				
	604	bare soil	2.09	0.04%	0.02%			0.02%
	605	desert	6.82	0.04%			0.01%	
	606	saline alkali land	21.19	0.11%			0.01%	
Total			19196.65	100.00%	100%	21844.55	100%	100%

Table 4 Area statistics of functional districts in priority areas for biodiversity conservation in a province (no cultivated land is counted in category III areas).

Category	Priority areas for biodiversity conservation in Western Liaoning		Priority areas for biodiversity conservation in Eastern Liaoning		Provincial priority area	
	Area (hectare)	Proportion (%)	Area (hectare)	Proportion (%)	Area (hectare)	Proportion (%)
Type I	302350	15.75%	279609	12.80%	581958	14.18%
Type II	1569693	81.77%	1882348	86.17%	3452041	84.11%
Type III	47622	2.48%	22498	1.03%	70121	1.71%
Total	1919665	100%	2184455	100%	4104120	100%

3.3 Biodiversity Protection Strategy Based on Ecological Environment Planning

When devising strategies for biodiversity conservation, it is necessary to analyze the specific conditions of the protected area according to the development of its biodiversity and the calculation of the level of protection required according to the classification criteria. When carrying out conservation work, the establishment of protected areas should be consistent with the government's administrative work and the main interests of nature reserves, and relevant departments need to coordinate the interests of each main body. Following analysis, the protection levels of zones is determined, of which there are four. The situation of each level is shown in Fig. 4 below. This level is widely distributed in the western and eastern regions of a province.

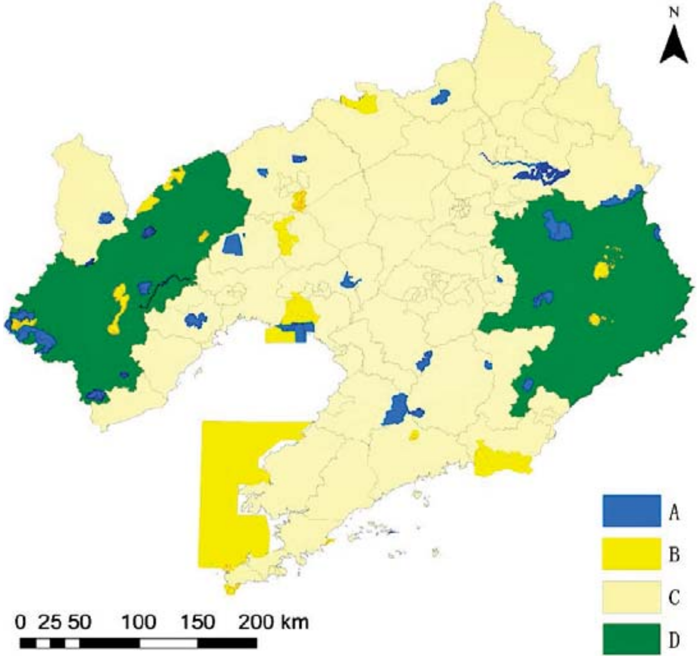

Figure 4 Administrative distribution of priority areas for biodiversity conservation in a province.

Table 5 Area statistics of functional districts in priority areas for biodiversity conservation in a certain province (class III area statistics of cultivated land).

Category	Priority areas for biodiversity conservation in Western Liaoning		Priority areas for biodiversity conservation in Eastern Liaoning		Provincial priority area	
	Area (hectare)	Proportion (%)	Area (hectare)	Proportion (%)	Area (hectare)	Proportion (%)
Type I	302350	15.75%	279609	12.80%	581958	14.18%
Type II	801818	41.77%	1525000.878	69.81%	2326819	56.69%
Type III	815497.724	42.48%	379845.502	17.39%	1195343.226	29.13%
Total	1919665	100%	2184455	100%	4104120	100%

4. CONCLUSION

To ensure the continuation of biodiversity, it is essential to monitor and safeguard the ecological environment. In China, biodiversity can be maintained and developed by studying the quality of ecological environments and establishing an evaluation standard system to determine the status of these environments [20]. Relevant data can be derived from soil analysis maps, climate analysis maps of the monitored area, and professional statistical data reports [21]. GIS technology can more intuitively incorporate graphics in databases, enabling detailed and graphically-presented information to be accessed quickly. This not only facilitates the storage and extraction of biological resource data, but also makes China's management of biodiversity more humane [22]. This paper investigates the biodiversity conservation work in a province, and provides suggestions for a province's future biodiversity conservation work through specific calculations and analysis. In this paper, the remote sensing image and GIS system technology are combined, and based on this, a series of analysis and investigation methods are adopted, such as the literature research method, the field survey method and the landscape interval index method, etc. Biodiversity research and analysis. By studying the dynamic evolution process of the greening pattern in this area, based on the ecological fragility, the evolution law of urban vegetation in the greening area after being destroyed by the outside world is explained.

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REFERENCES

1. J. Amin, M. Sharif, M. Raza, M. Yasmin Detection of brain tumor based on features fusion and machine learning. J Ambient Intell Hum Comput 19(4) (2018), 1092–1125.
2. M. Angulakshmi and GG. Lakshmi Priya Brain tumour segmentation from MRI using superpixels based spectral clustering. J King Saud Univ Comput Inf Sci 10(9) (2018), 2445–2513.

3. R. Bharathi and D. Satish Improving MRI brain tumor classification and segmentation based on comparison technique. Int J Emerg Technol Comput Sci Electron (IJETCSE) 13(1) (2015), 560–569.
4. VY. Borole, SS. Nimbhore, DSS. Kawthekar Image processing techniques for brain tumor detection: a review. Int J Emerg Trends Technology Comput Sci (IJETTCS) 4(5) (2015), 28–32.
5. A. Chanchlani, M. Chaudhari, BY. Shewale, A. Jha Tumor detection in brain MRI using clustering and segmentation algorithm. Imperial J Interdiscip Res 3(5) (2017), 2122–2127.
6. G. Kaur and J. Rani MRI brain tumor segmentation methods—a review. Infinite Study 6(3) (2016), 760–764.
7. N. Kumaran and R. Bhavani MRI image retrieval using Gabor wavelet based texture features. Int J Adv Res Sci Technol 2(1) (2013), 2320–1126.
8. Y-H. Liu, M. Muftah, T. Das, Li. Bai, K. Robson, D. Auer Classification of MR tumor images based on Gabor wavelet analysis. J Med Biol Eng 32(1) (2012), 22–28.
9. GS. Mahajan and KS. Bhagat Survey on medical image segmentation using enhanced K-means and kernelized fuzzy C-means. Int J Adv Eng Technol 6(6) (2014), 2531–2536.
10. MAM. Malviya and AS. Joshi Review on automatic brain tumor detection based on Gabor wavelet. Int J Eng 3(1) (2014), 53–56.
11. R. Manikandan, GS. Monolisa, K. Saranya A cluster based segmentation of magnetic resonance images for brain tumor detection. Middle-East J Sci Res 14(5) (2013), 669–672.
12. G. Mohan and MM. Subashini MRI based medical image analysis: survey on brain tumor grade classification. Biomed Signal Process Control 39(3) (2018), 139–161.
13. F. Moslehi and A. Haeri An evolutionary computation-based approach for feature selection. J Ambient Intell Hum Comput 19(6) (2019), 1590–1624.

.

14. N. Nabizadeh and M. Kubat Brain tumors detection and segmentation in MR images: Gabor wavelet vs. statistical features. Comput Electr Eng 45(6) (2015), 286–301.
15. E. Noureen and K. Hassan Brain tumor detection using histogram thresholding to get the threshold point. IOSR J Electr Electron Eng 9(5) (2014), 14–19.
16. J. Patel and K. Doshi A study of segmentation methods for detection of tumor in brain MRI. Adv Electron Electric Eng 4(3) (2014), 279–284.
17. B. Potdukhe and SA. Nagtode Application of wavelet transform for brain tumour detection. Int J Innov Res Comput Commun Eng 4(3) (2016), 3025–3030.
18. NSM. Raja, S. Fernandes, N. Dey, SC. Satapathy, V. Rajinikanth Contrast enhanced medical MRI evaluation using Tsallis entropy and region growing segmentation. J Ambient Intell Hum Comput 18(8) (2018), 689–702.
19. RA. Ruchita, D. Suresh, S. Salankar A review on brain MRI image segmentation clustering algorithm. IOSR J Electron Commun Eng (IOSR-JECE) 11(1) (2016), 80–84.
20. N. Sauwen, M. Acou, S. Van Cauter, DM. Sima, J. Veraart, U. Frederik Maes, EA. Himmelreich, S. Van Huffel Comparison of unsupervised classification methods for brain tumor segmentation using multi-parametric MRI. Neuroimage Clin 12(4) (2016), 753–764.
21. A. Selvapandian and K. Manivannan Performance analysis of meningioma brain tumor classifications based on gradient boosting classifier. Proc Int J Imaging Syst Technol 28(8) (2018), 1–7.
22. M. Sharif, U. Tanvir, EU. Munir, MA. Khan, M. Yasmin Brain tumor segmentation and classification by improved binomial thresholding and multi-features selection. J Ambient Intell Hum Comput 75(3) (2018), 1075–1083.