Evaluation of Available Land Resources Based on Three Types of Space: Town, Agriculture and Ecology

—Taking Panzhou City, Guizhou Province as an Example

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Abstract—The rational use of limited land resources is of great importance to the division of land space and the coordination of man land relationship, strictly implement the ecological function orientation of Karst mountain area, on the basis of scientifically defining three kinds of space: Town, agriculture and ecology, supported by RS and GIS means, combining the three kinds of spatial division results of town, agriculture and ecology, the optimal allocation of land resources is realized, using ArcGIS spatial overlay analysis, according to the evaluation model of available land resources and the classification standard of available land resources, the evaluation of the three kinds of space available land resources was carried out. It is beneficial to control and deploy land resources in the three types of space, realize the protection and restoration of the environment, maintain the structure of the ecosystem, and guarantee the ecological security of the region. The results show that, the available land resource is 204.79 km², overall distribution characteristics are more in the South than in the north and the East, more in the west, and lower in the terrain than in the terrain, per capita available resources is only 0.12 acres, the abundance of available land resources can be divided into three levels: rich, medium and relatively deficient, the area of available land resources in each functional space is sorted into ecological space, agricultural space and urban space. There is a certain spatial consistency between the three types of spatial scope and the available land resource evaluation results. The land resources use situation is relatively coordinated, and intensive use and protection should be strengthened.

Keywords—main functional areas; towns, agriculture and ecology; available land resources; GIS and remote sensing

I. INTRODUCTION

Different regions have different features and different natural conditions. The problems of resources, environment, economy, society and population are different, and land use patterns are often different. The regional characteristics of land resources distribution and socio-economic development make land resources in the process of functional zoning In the analysis, we must pay attention to the regional[1]. The poor natural conditions in Karst mountains and the fragile ecological environment lead to the shortage of land resources and the contradiction between man and land, which determines that the land use in Karst areas must be highly efficient and intensive[2]. When evaluating the available land resources, the main functions of the region should be fully considered, the guidance and binding power of space should be emphasized, and the allocation of land resources should be planned accordingly[3]. The division of the three categories of urban, agricultural and ecological space is based on the requirements of the "National Development and Reform Commission's Guiding Opinions on Reform and Innovation of Economic and Social Development Planning in Cities and Counties for the Thirteenth Five-year Plan", strictly implementing the functional orientation of cities and counties and scientifically dividing . Evaluating the available land resources in the three types of space is conducive to further strengthening the differentiated management and control measures in the three types of urban, agricultural and ecological spaces and effectively integrating development with layout, development and protection.

The available land is an important index in the provincial main functional zoning. With the contradictions of resources, environment, population and socio-economic development becoming increasingly prominent, the contradiction between supply and demand of land also tends to be fierce[4]. The predatory exploitation of land in the Karst region has caused serious damage to resources and undermined the structure and function of resources, environment and ecosystems[5]. Government departments and academia have conducted extensive research on land resource assessment. At present, it mainly includes two aspects of evaluation research: land suitability evaluation[6-9] and land resource sustainable use evaluation[10-12]. The former evaluation system, evaluation methods and methods have formed a wealth of experience in all aspects, and the latter from the index system and evaluation methods of the theoretical framework has made numerous achievements, but mostly small space for one or several of the appropriate land Way of research. In general, there is still not much research on the multi-objective and quantitative study on

the complex Karst mountainous areas in the evaluation of available land resources using 3S technology.

Nowadays, as the era of data information has entered, with the development of big data technology, computers can easily access and process valid data through the Internet, Internet of Things and sensors. The remote sensing-based survey method has the characteristics of large-area synchronous observation, timeliness, high data comprehensiveness and economy. The research uses the 3S technology to synthesize various elements and uses the spatial analysis method to scientifically and objectively evaluate the available land in the Karst mountains The spatial distribution, the quantitative characteristics and the classification of resources are compared. The comparative analysis of the available land resources abundance in the three types of space is made to clarify the rules and causes of the available land resources in each functional area. In the context of the booming development of "big data" , Relying on the quantitative real operation index system is conducive to the implementation of the national main functional zone strategy to promote multi-disciplinary integration. In order to strengthen the environmental protection and management of the main functional zones in the country, realize the allocation of optimized space resources in the Karst mountainous areas and regulate the spatial development order Provide scientific basis and decision support.

II. RESEARCH AREA OVERVIEW

Located in the west of Guizhou Province and southwestern Liupanshui City, Panzhou is located in the junction of Yunnan, Guizhou and Guangxi. It is known as the Throat of Yunnan and Guizhou and the Fortress of Chuanqian and is the west gate of Guizhou. Between 104 °17'46"-104°57'46" longitude and 25°19'36 "-26°17'36" north latitude, with Pu'an County in the east, Xingyi City in the south, Fuyuan County, Yunnan Province, Xuanwei City, north Shuicheng County. Throughout the territory of 107 km long from north to south, east-west width of 66 km, land area of 4056 square kilometers, accounting for 40.9% of the total area of Liupanshui, accounting for 2.3% of the total area of Guizhou Province. Is located in the Yunnan-Guizhou Plateau to the Guizhou-Guizhou Plateau excessive slope parts, is the South and North Pan River and its tributaries of the watershed. The terrain is high in the northwest, low in the southeast and uplift in the middle. Stratum rocks to limestone, dolomite, dolomitic limestone-based. The subtropical zone has a subtropical climate with an annual average temperature of 15.2°C. The maximum temperature in previous years is 31.2°C and the minimum temperature is 11.2°C. The annual average frost-free period is 271 days and the sunshine duration is 1593 hours. The average annual rainfall is 1390 mm. The territory of the water system development, more rivers, are Pearl River system. It is rich in natural resources and owns 23 kinds of deposits of coal, iron, copper and aluminum. Among them, the coal reserves are 9,758,000,000 tons, accounting for 14.5% of the total reserves of the province, accounting for over 50% of the reserves of the city. The territory of Panzhihua Liang and Ginkgo Nature Reserve, Panzhou ancient ginkgo scenic spots,Dadong ancient human cultural sites and other tourist resources.

III. RESEARCH METHODS

A. Data Source and Pretreatment

According to the main function orientation of Panzhou City, using the standard unified geospatial basic data and geographical census results, using ArcGIS and ENVI software platform to prepare the spatial planning basemap, delineating the scope of the negative list of space development, and integrating the results of the evaluation and the status quo Surface subdivision, through image interpretation verification, field verification and coordination, and ultimately determine the spatial distribution of urban, agricultural and ecological boundaries and the specific boundaries. The research data mainly include l: l0000 regional topographic maps. In 2016, the ALOS remote sensing image data come from the geospatial data cloud (http://www.gscloud.cn/). The population-related data mainly come from all counties and cities in 2016 "Statistical Yearbook "and" Statistical Bulletin of National Economic and Social Development." Through the interpretation of remote sensing images, combined with field surveys and sample site monitoring, derived derived data of land use types, development suitability, current status of surface subareas in Panzhou City. Using digital topographic map, land use status map and administrative map and other maps, after spatial processing and spatial superposition, the data extraction and spatial analysis are performed according to the calculation formula, and the abundance of available land resources is graded according to the grading standards.

B. Three Types of Space Delineation

Panzhou City, agriculture and ecology of the three types of space division mainly by field surveys, satellite mapping, GIS spatial analysis and database construction and other technologies, based on the first National Geographic census data and mapping results delineated. Determine the technical process include: scientific research and demarcation of program identification, field research, data integration, data processing, preparation of spatial planning basemap, comprehensive index analysis, space development evaluation, three types of space planning, field verification, space Coordination and convergence, statistical summary, expert demonstration, three types of space to confirm, cartographic building, the results of preparation. According to the evaluation results and considering the needs of urban construction, agricultural production and ecological protection, we should classify the urban, agricultural and ecological areas scientifically.

C. Available Land Resources Calculation Methods and Grading Standards

Evaluation of available land resources and per capita availability of land resources in Panzhou mainly takes into account various factors such as the topography, geomorphology, geology, water areas and the spatial distribution of various types of protected areas and the current status of land use distribution [14-18] , The land use status map and the administrative district map, etc., and the data are extracted and spatially analyzed according to the calculation formula after using the spatial superposition on the ArcGIS software platform. The abundance is graded according to the

index system in Table II[19]. Calculated indicators and formulas (Equation I-V) are as follows (Table I):

TABLE I. THE CALCULATION INDEX AND METHOD OF AVAILABLE LAND RESOURCES

Index	Calculation method	
[Basic farmland area]	[Arable land area within the suitable area of construction land]×β(Among them, the beta value is taken as the national standard0.80)	(I)
[Existing construction land area]	[Urban land area]+[Land area of rural residential areas]+[Independent industrial and mining land area]+[Transportation land area]+[Special land area]+[Land area for construction of water conservancy facilities]	(II)
[Suitable construction land area]	([Terrain slope]∩[Altitude])-[Water area]-[Forest and grassland area]	(III)
[Available land resources]	[Suitable construction land area]-[Area of existing construction land]-[Basic farmland area]	(IV)
[Area of available land resources per capita]	[Available land resources]/[Permanent population]	(V)

According to the conditions of Panzhou's altitude and topography, the calculation conditions of "(topographic grade ∩ altitude)" in the suitable construction land area are that the altitude under 2000m is less than 2000m and the altitude is greater than 2000m Slope less than 15 °of land.

TABLE II. THE GRADING STANDARD OF AVAILABLE LAND RESOURCES

Grade	Area of available land resources per capita (Mu / person)	Available land resources(km^2)	Score
Abundant	＞2	＞320	4
More abundant	2~0.8	320~150	3
Medium	0.8~0.3	150~100	2
Lack of	0.3~0.1	100~50	1
Lack	＜0.1	＜50	0

Available land resource evaluation function (Equation VI):

$$f_{\text{Available Land Resources}} = X_{\text{Available Land Resources Per Capita}} \begin{cases} 4 & 2 < X_{\text{Available Land Resources Per Capita}} \\ 3 & 0.8 \leq X_{\text{Available Land Resources Per Capita}} \leq 2 \\ 2 & 0.3 \leq X_{\text{Available Land Resources Per Capita}} \leq 0.8 \\ 1 & 0.1 \leq X_{\text{Available Land Resources Per Capita}} \leq 0.3 \\ 0 & X_{\text{Available Land Resources Per Capita}} \leq 0.1 \end{cases} \quad \text{(VI)}$$

In the formula, $f_{Available}$ Land Resources is the appraised value of available land resources, $X_{Available}$ Land Resources Per Capita is the appraised value of per capita available resources, and the higher the $f_{Available}$ Land Resources point value, the more abundant the available land resources.

IV. RESULTS AND ANALYSIS

A. Panzhou Three Spatial Distribution

Based on the evaluation results of the development suitability of Panzhou City and the status quo of surface subareas, we use the GIS technology to consider the needs of urban construction, agricultural production and ecological protection in an integrated manner and scientifically classify the urban, agricultural and ecological spaces. The area of urban development of Panzhou City is designated to be approximately 396.32km^2, accounting for 9.77% of the total land area of the whole Municipality. The scope of agricultural production in Panzhou City is about 1606.07 square kilometers, accounting for 39.60% of the total land area of the city. Panzhou Ecological space of about 2053.61km^2, accounting for about 50.63% of the city's land area. The rationality of belonging to the three categories of space has been affirmed by the Bureau of Development and Reform of Panzhou City.
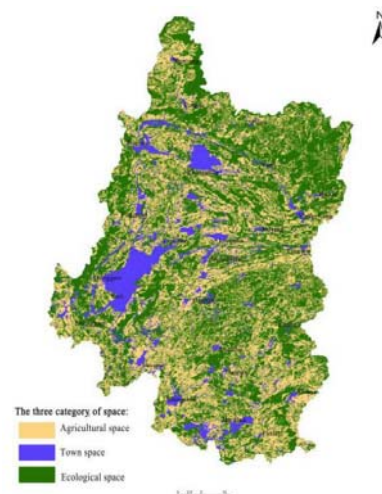

FIGURE I. THE THREE TYPES OF SPATIAL DISTRIBUTION MAP OF TOWN, AGRICULTURE AND ECOLOGY IN THE STATE

B. Panzhou Available Land Resources Evaluation

According to the average value of available land resources in Panzhou City and the trend characteristics of descending from small to small, it is divided into three types: rich, medium and scarce (Figure V). The general distribution of available land resources in Panzhou is The southern part is more than the northern part, the eastern part is more than the western part, and the topography is lower than the topography (Figure IV).

TABLE III.   THE EVALUATION RESULTS OF AVAILABLE LAND RESOURCES

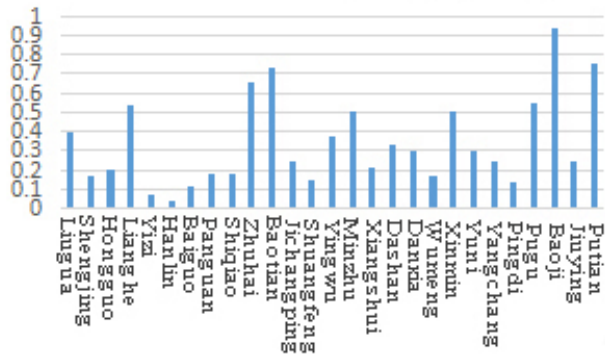| Town name	Area of available Land Resources(km^2)	Percentage of total area of townships(%)	Area of available land resources per capita(Mu / person)
Liuguan Street	7.39	6.08%	0.4
Shengjing Street	5.35	3.31%	0.17
Hongguo Street	2.94	2.74%	0.2
Lianghe Street	15.8	9.35%	0.54
Yizi Street	2.27	3.65%	0.07
Hanlin Street	1.16	2.46%	0.04
Baiguo Town	6.72	3.26%	0.11
Panguan Town	7.88	4.46%	0.18
Shiqiao Town	7.66	3.97%	0.18
Zhuhai Town	18	7.29%	0.66
Baotian Town	16.81	7.77%	0.73
Jichangping Town	14.58	5.58%	0.25
Shuangfeng Town	5.84	3.95%	0.15
Yingwu Town	6.44	3.93%	0.38
Minzhu Town	8.99	6.57%	0.5
Xiangshui Town	3.53	3.99%	0.21
Dashan Town	11.64	5.51%	0.33
Danxia Town	11.82	6.53%	0.3
Wumeng Town	2.04	1.98%	0.17
Xinmin Town	10.57	7.92%	0.51
Yuni Yi Nationality Township	5.31	2.93%	0.3
Yangchang Bouyei&Bai Nationality Township	4.27	3.47%	0.25
Pingdi Yi Nationality Township	3.24	2.05%	0.14
Pugu Yi&Miao Nationality Township	7.81	5.24%	0.55
Baoji Miao&Yi Nationality Township	7.58	4.93%	0.94
Jiuying Bai&Yi Nationality Township	2.92	2.92%	0.25
Putian Hui Nationality Township	6.23	7.76%	0.75

The results of evaluation (Table I and Figure II) show that the available land resources in Panzhou are 204.79 km^2, accounting for only 5.05% of the total land area. Of which: the largest available land resources are Zhuhai, Baotian and Lianghe streets, covering an area of 18.00 km^2, 16.81km^2 and 15.80 km^2, respectively; the largest percentage of the total area of townships is Lianghe Street, 9.35%, Xinmin Town, accounting for 7.92% of township area and Baotian Town, accounting for 7.77% of township area. The towns of Hongguo Street and Yizhong Street have a larger development area and a relatively small area of available land resources of 2.94km^2 and 2.27km^2, respectively. Due to the topographical features of Wumeng Township, which are steep and steep, Land resources area is only 2.04km^2.
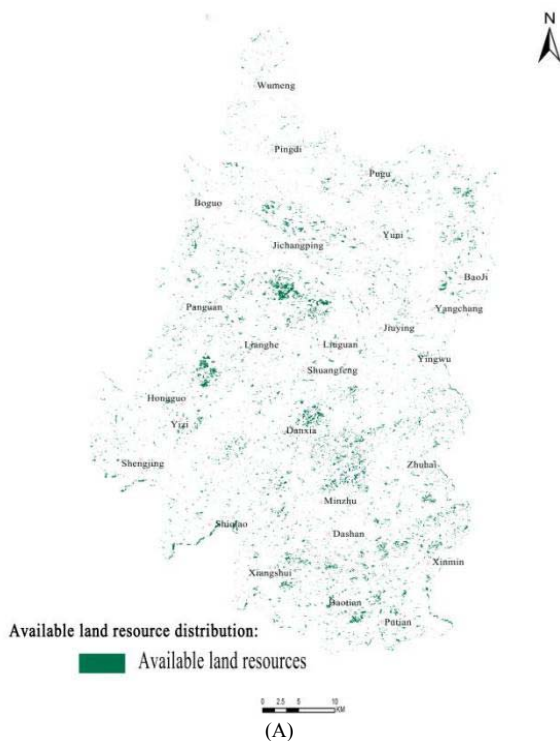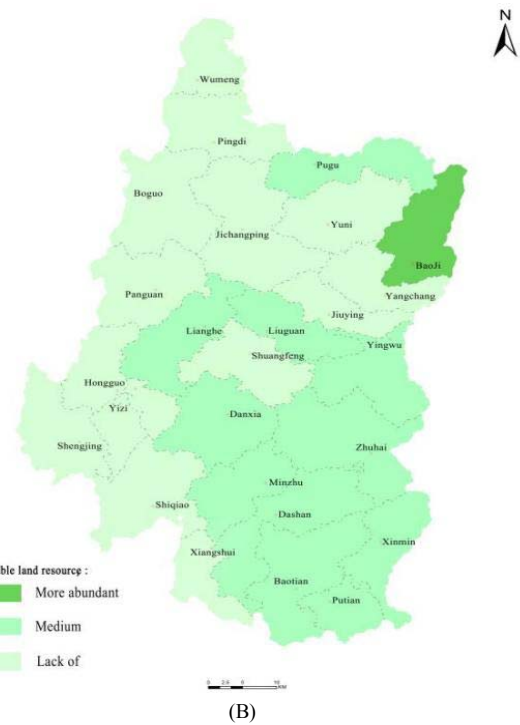

Available land resource area (km²)

(A)
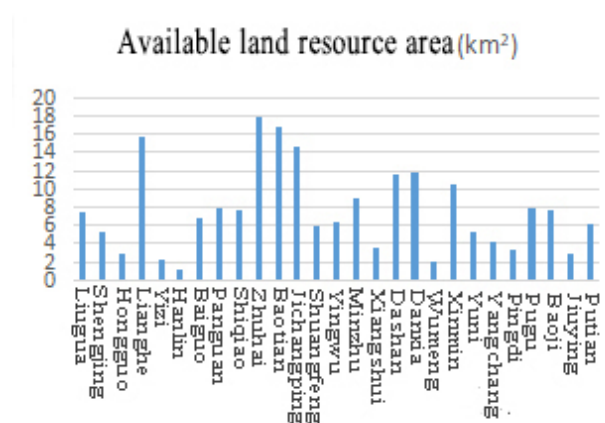
FIGURE II. (A)THE AVAILABLE LAND RESOURCES AREA (B)THE PER CAPITA AVAILABLE LAND RESOURCE AREA

On the basis of available land resources, the per capita available land resources of each township were evaluated. The per capita available land resources were scarce, with a per capita population of 0.12 mu. There is a shortage of available land per capita for Panxian Shengjing Street, Hongguo Street, Yizhijie Street, Hanlin Street, Boguo Town, Pan Guan Town and Shiqiao Town; and Liuguan Street, Lianghe Street, Zhuhai Town, Baotian Town, There are medium available land resources available for each of the townships of Yingwu, Democracy, Dashan, Danxia, Xinmin, Mud Yi, Mugu and Putian in Baogu (Figure II).

FIGURE III. (A)THE AVAILABLE LAND RESOURCES DISTRIBUTION (B)THE ABUNDANCE CLASSIFICATION OF AVAILABLE LAND RESOURCES

The availability of land resources in Panzhou is mainly divided into three categories: lack of, medium and rich. Among them, the more abundant available land resources are 7.58km^2, the middle-grade area is 121.51km^2, and the less-developed area is 75.70km^2. After evaluating the abundance of available resources in each township of Panzhou City, it can be seen that there is a shortage of available land resources in 14 townships and towns where the north industry is prominent with relatively high elevation and the downtown area of the old city. However, Relatively good, the development is relatively slow, the tourism industry is more developed in southern Panzhou and has Pupuniangshan National Wetland Park, ecological protection is better in Panzhou in northern Pugu Miao and other 11 townships may be The use of land resources is moderate in grade; only the land available to a township of the Yi Nationality Township of Baoji Miao and Yi nationality, which has better forest coverage, is more abundant.

The spatial distribution pattern of per capita availability of land resources in Panzhou is the result of a long-term synergy of regional development history, geographical features, population aggregation process and socio-economic development. The lack of available land resources per capita in Wumeng Mountain Plateau is caused by the alpine environment. In Pannan and the eastern region, per capita availability of land resources is relatively short of natural conditions and relatively sparsely populated. The development history is rather short. Minority nationalities The reason why more land is available in most parts of Pannan and West is generally lacking in that the geography and environment conditions in these areas are superior, the population density is high, the history of development and construction is earlier,

and the economic development Level and urbanization, a higher degree of industrialization.

C. Assessment of Available Land Resources in Three Kinds of Space

Spatial overlay analysis of the results of three kinds of spatial division of urban land, agriculture and ecology in Panzhou was made, the abundance of available land resources in urban space, agricultural space and ecological space were extracted, and the distribution of available land resources Area analysis, the results obtained are shown in Table IV.

TABLE IV. THE THREE TYPES OF SPACE AVAILABLE LAND RESOURCES AREA

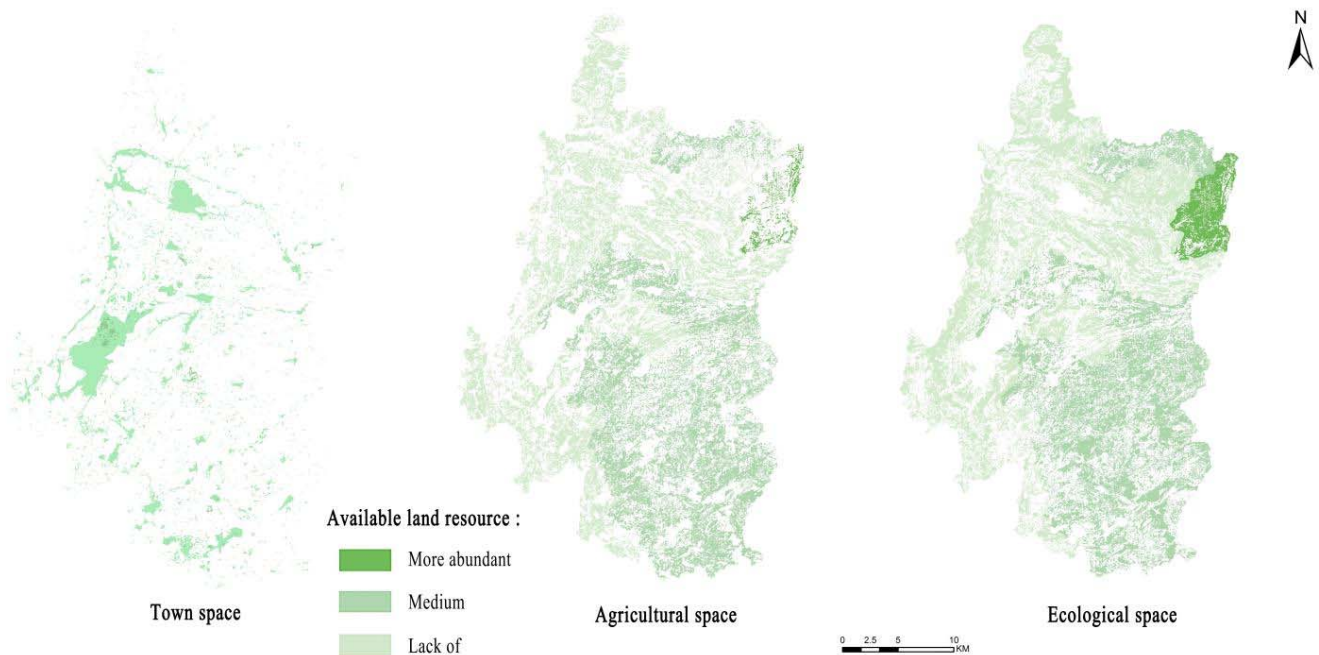|	Available land resource area(km²)	Abundance of available land resources(km²)					
		More abundant	*Proportion (%)*	*Medium*	*Proportion (%)*	*Lack of*	*Proportion (%)*
Town space	27.73	0.13	0.47%	16.03	57.81%	11.57	41.72%
Agricultural space	78.62	1.9	2.42%	46.97	59.74%	29.75	37.84%
Ecological space	98.44	5.55	5.64%	58.51	59.44%	34.38	34.92%

FIGURE IV. THE ABUNDANCE DISTRIBUTION OF THREE KINDS OF SPACE AVAILABLE LAND RESOURCES

According to Table IV, the available land resources of each functional space are sorted according to the overall situation in Panzhou's three types of space, which are: ecological space (98.44km²)>agricultural space (78.62km²)> urban space (27.73km²). From the proportion of available land resource abundance, it can be seen that among the three types of space, middle-grade available land resources have reached more than 50%, indicating that the utilization of land resources in Panzhou is still in a relatively coordinated state, followed by Lack of hierarchy and richer levels also require intensified intensive land use. Without protection, the balance of ecological and regional development will be undermined.

The available land resources for urban space is 27.73km², of which the richer is 0.13km², the medium is 16.03km², and the less developed is 11.57km². The development and regulation of urban space need to change the economic mode, strictly control the project access conditions, strengthen the comprehensive management of water pollution and air

pollution, promote the integration of the industrial and urban areas, increase the population concentration, improve the living environment, make good use of the developed land resources, In the protection of ecological environment based on promoting and supporting economic and green development.

The available space for agricultural space is 78.62km², of which the richer is 5.55km², the middle class is 58.51km² and the less developed is 29.75km². Panzhou is a typical county in the mountainous area. The distribution of arable land is fragmented. Most of the cultivated land is distributed on both banks of the river and mixed with woodland and grassland. There is no dam land above a thousand mu. Cultivated land is mostly terraced and sloping farmlands, mainly distributed in slope land above 15°. The overall quality of cultivated land is poor, the soil is barren, the content of organic matter is low, and the available cultivated land reserve resources are insufficiently surveyed. The basic farmland needs to be protected and the layout of agricultural production is optimized

Structure, strengthen the land remediation and water conservancy facilities, improve the comprehensive agricultural production capacity, to avoid the waste of cultivated land resources.

The available resources for ecological space are 98.44km^2, of which the more abundant is 1.9km^2, the middle is 46.97km^2, and the less developed is 34.38km^2. Although the area of available resources in ecological space is the largest, it is necessary to strictly control various development activities, minimize the interference with natural ecosystems, control the intensity of development, reduce the space occupied by rural residential areas, and guide the orderly transfer of residents to other development areas, Free up more space for the virtuous cycle of ecosystems.

Comparing the three types of spatial scales and the evaluation results of available land resources, we found that the spatial distribution of the three types of urban areas is consistent in spatial distribution, that is, the spatial distribution of urban and rural areas in Panxian County is basically the same as the lack of available land resources, and the agricultural space and land- Lack of two levels more than the same, but the consistency of the other two space is not strong, more abundant ecological level range of land resources available for more.

V. CONCLUSION AND DISCUSSION

The evaluation of regionalized land resources provides a guarantee for the implementation of regional planning. The research suits the background of big data development, uses the method of data statistical analysis, gives full play to the advantages of 3S technology in spatial analysis, data calculation and thematic map production. Agriculture, Ecology three types of space available for evaluation of land resources. At present, the available land resources in Panzhou is 204.79 km^2, with less per capita available resources, only 0.12 mu. Most townships with development value have scarce land resources and there is a sharp contradiction between supply and demand. They need to make good use of the developed Of the land resources, and improve the value of the land. The sorts of the available land resources of the three types of space are as follows: ecological space (98.44km^2), agricultural space (78.62km^2), urban space (27.73km^2), urban and agricultural and ecological space There is some spatial consistency between the range and available land resources evaluation results.

With the deepening and extensive use of big data technology, the relevant elements of the ecological civilization construction in the main functional areas of the country can be transformed into data information and become the object of dataization. In the future, we will use big data thinking and tools in the analysis of land and resources in the territorial area. We will make use of the cloud platform and big data tools in combination with the 3S technology to carry out scientific studies on the surface of the earth to quickly determine the scope of monitoring, Surface changes in the continuous detection and analysis of timely and accurate detection of crux of the main functional areas within the proposed use of land resources control indicators to form a zoning control, index control, policy control, to prevent duplication of waste caused by regional construction, And pointedly put forward to adapt to the industrial development direction and development and protection strategy within each functional division, which is conducive to the relevant departments to make timely and systematic response and decision-making in a timely manner. In order to build an environment-friendly land use model and realize the environment of the ecologically fragile region Protection and sustainable economic development to provide a scientific basis.

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