A Pilot Study on the Evaluation of Land Resource Carrying Capacity Supported by the Results of National Geographic Census

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Abstract: The traditional methods of carrying capacity evaluation of land resources are mainly based on quantitative indexes and lack of spatial distribution differences. In this paper, the application of a geared to the needs of space development and utilization of land resources carrying capacity evaluation technology, through the comprehensive consideration of overlapping county development affect significantly and significant factors, using the step of the algorithm is suitable for the measuring idea of county land area and spatial distribution, and then compared with the existing state of development analysis, to study the carrying capacity of land resources in Diebu county. The results show that the carrying capacity of land resources in Diebu County is not overloaded, and the current situation of land construction and development basically conforms to the actual situation of the county. This method adds spatial distribution evaluation to the carrying capacity of land resources, and solves the problem that the traditional method is based on quantitative evaluation and lacks positioning evaluation, which is difficult to effectively reflect the state of development and utilization of the carrying capacity of land resources.

1. Introduction

Land resources are the basic resources for human survival and development. In recent decades, with the rapid development of urbanization and industrialization, the scale of cities has been expanding, and the construction space has expanded rapidly. Land resources are particularly important [1]. Study on land carrying capacity is important for ensuring sustained regional economic development, land use planning and reasonable [2-3].To implement the overall requirements for comprehensively deepening reforms , establish a monitoring and early warning mechanism for resource and environmental carrying capacity [4].In September 2016 , the "carrying capacity of resources and environment monitoring and warning technology methods (Trial)" (hereinafter referred to as "technical methods") published methods for the study of the requirements to county-level administrative units, separately land evaluation and seas evaluation. The focus on land evaluation basis for evaluation and special evaluation of expansion related evaluation, where land resources evaluation, water resources evaluation , environmental assessment and ecological assessment is the basis of the evaluation of the content, including special evaluation urbanized areas evaluated , the main producing areas of agricultural products evaluated And evaluation of key ecological functional areas. According to the requirements of the “Technical Methods”, Gansu Province selected Diebu County as a pilot to carry out the above work. Diebu located in the eastern edge of the Tibetan Plateau, an over continental climate and oceanic climate transition zone, belonging to the Longnan and Gannan Dong mountain open in the provincial

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Department of restrictions in the main functional areas prone areas [6]. At the same time, Diebu County is also a pilot county for spatial planning research selected by the Development and Reform Commission of Gansu Province. Therefore, it has a good research basis as a pilot.

In terms of land resource evaluation methods, domestic and foreign scholars have used a variety of methods. Chen Fangmiao focuses on the supply of ecological resources for land resources to assess the carrying capacity of land resources [7], and conduct research in Yunnan Province as an example. Jiang Qiuxiang use the particle-optimized projection pursuit model to solve the problem of poor objectivity of index weight assignment in the evaluation of land resource carrying capacity [8], and effectively avoid the subjective arbitrariness of index weighting. Lv Xiaojian, When Liang and Ma Aihui and so on the basis of selecting different indicators [9-11], AHP respectively on Ningguo, Wuhan Hanyang Lake and Xinjiang 's land carrying capacity evaluation. Zhu Xiaojuan use the human relationship grain -based, building land resources carrying index (LCCI) model [12], time and space from 2 evaluate the quantitative scales 1985-2010 spatiotemporal pattern of land carrying capacity in Gansu Province. Huang Guoyong uses the system dynamics model to analyze the land resource carrying capacity of Gannan Tibetan Autonomous Prefecture [13]. The above research methods are mainly based on quantitative research, lacking spatial difference evaluation, and cannot evaluate the spatial distribution difference of land resources.

2. Overview of the Study Area

Diebu County is located at the junction of Ganchuan, south of Gannan Tibetan Autonomous Prefecture, in the alpine valley of the upper reaches of the Bailong River. The county jurisdiction over 11 towns, 52 village committees, 233 village groups, the total population of 5.36 million, altitude 1600 - 4800m , an average altitude of 2400m . The total land area of the county is 5108 square kilometers, of which the natural grassland area is 1568.53 square kilometers, accounting for the total land area 30.7%; the forest area is 3007.00 square kilometers, accounting for 58.9% of the total land area, and the forest coverage rate is as high as 60%.

3. Data Source

3.1 Thematic Data

Unexpected geological disaster data collected from Diebu County Land Bureau "Diebu geological disasters detailed investigation report" relevant information; permanent basic farmland data from the Bureau of Land Diebu permanent basic farmland demarcated achievement data; ecological protection red line The data comes from the Gansu Environmental Science Design and Research Institute, including the Red Line of the Prohibition Zone and the Red Line of the Science Assessment Zone.

3.2 Spatial Data

The spatial data mainly includes DEM data in the national conditions census results, vector data of county-level, township administrative divisions, roads, as well as cultivated land, garden land, woodland, house construction, grassland, transportation facilities, desert and bare ground, the surface coverage data of the object type. The above data are derived from the geographical situation of census data.

4. Evaluation Methods and Pilot Evaluation Results

4.1 Element Screening

On the basis of comprehensive consideration of factors such as agricultural land protection, geological safety, ecological land use and terrain slope, combined with the actual topography and data collection of Diebu County, select permanent basic farmland, ecological protection red line, difficult to use land, natural grassland and woodland. Eight general agricultural land, slope and sudden geological disasters affect the construction and construction of land. At the same time, permanent basic farmland, ecological protection red line, hard-to-use land, natural grassland and forest land are divided into strong restrictive factors; general agricultural land, slope and sudden geological disaster are divided into strong limiting factors.

4.2 Construction Development Restrictive Evaluation

4.2.1 Factor assigned

Screening out the elements of the above consultation with relevant industry experts, by expert scoring method to its assignment, which strongly limiting factor to implement one-vote veto, its assigned 0 and 1; strong limiting factor elements by restriction level assign a value from 0 to 100 (Table 3 -1).

Tab. 3-1 The factors and marking table of land resource carrying capacity evaluation in Diebu county

Factor type	Element	classification	Suitability assignment
Strong restriction factor	Permanent basic farmland	Permanent basic farmland	0
		other	1
	Ecological protection red line	Ecological protection red line	0
		other	1
	Difficult to use land	Permanent glaciers, Gobi deserts, etc.	0
		other	1
	Natural grass	Natural grass	0
		other	1
	woodland	woodland	0
		other	1
Strong restriction factor	General agricultural land	Artificial grass	40
		arable land	50
		Garden	80
		other	100
	slope	15 ° or more	40
		8-15 °	60
		2-8 °	80
		0-2 °	100
	Sudden geological disaster	High-prone area	40
		Zhongyifa District	60
		Low prone area	80

4.2.2 Land development construction suitability evaluation

(1) Constraint factor method comprehensive score

Suitability scores calculated using the land construction limit coefficient for the composite score, calculated as formulas 3-1.

$$F = \prod_{i=1}^{m} F_i \cdot \sum_{j=1}^{n} w_c f_c \quad \text{(Eq.1)}$$

Formulas Eq.1, F is suitability score, i is a strong limiting factor numbers, c is a stronger limiting factor number, m is a strong limiting factor of the number, n is the number of stronger limiting factor of number. F_i is the value of i factor, f_c is the value of c factor, w_c is the weights of heavy elements of k.

(2) Determination of the weight of strong restriction factor elements

The weight of the stronger limiting factor element, that is the value of w_c (see Table 3-2) . It is obtained by the Analytic Hierarchy Process (AHP), and the general agricultural land, slope and sudden geological disasters are scored according to the land use conditions of Diebu County. The judgment matrix is constructed, and the feature weight is determined by the consistency check.

Tab. 3-2 The table of weights of relatively strong limiting factors

Element	Element weight
General agricultural land	0.12618
slope	0.19472
Sudden geological disaster	0.67911

4.2.3 Cluster analysis four levels

The formula 3-1 is calculated and the resulting value to the actual situation of Diebu, by the method of cluster analysis to develop construction suitability for four divided corresponding quantitative a scale of 63~86, 42~63, 21~42 and 0 to 21, the corresponding is suitable, basically suitable, basically unsuitable and unsuitable areas, wherein the higher the score, the higher the suitability of land construction and development .The distribution range 3-1 as shown,

Tab. 3-3 Land construction development suitability division result table

Cluster analysis four-level division result	Area(km^2)	Proportion of total area(%)
suitable	10.59	0.225
Basically suitable	58.17	1.234
Less suitable	18.04	0.383
Not suitable	4622.17	98.158

As can be seen from figure 3-1, Diebu County has a suitable and basically suitable land area, with an area of 68.76km^2, accounting for 1.459% of the total area of the county , and is mainly concentrated in the vicinity of the main stream of the Bailong River area , the rest are scattered in the county area.

The rest are less suitable and unsuitable land areas, and more than 98% are unsuitable land. This is consistent with the geological features of the Duan County in the alpine valley area, with Dieshan in the north and Minshan in the south.

4.3 Evaluation of Development Level of Current Construction

The evaluation of development level of current construction is mainly reflected in the evaluation of the relationship between the current construction land and the appropriate land, so as to measure the degree of development.

$$P = X/(X \cup F) \quad (2)$$

X means the area of construction land status area, F refers to an area of land development suitability evaluation Construction of suitable base and a suitable area of the region and, $X \cup F$ refers to the area of the space and set two, thereby calculating the area, P means The degree of development of the regional status quo, the calculated degree of development of the regional status is a value between 0 and 1. Calculated by Diebu status quo County extent of construction and development $P= 0.223$.

4.4 Development Degree Threshold Calculation

4.4.1 Spatial aggregation

In this paper, the raster data neighborhood statistical method in ArcGIS is used to calculate the suitable spatial agglomeration index. The calculation steps are as follows: assign the appropriate space (suitable and basic suitable area) to 1 and the unsuitable space to 0 (essentially inappropriate and not Appropriate spatial region), then calculate the sum of the raster adjacent raster values for each score of 1, and the arithmetic mean is the appropriate spatial agglomeration index.

4.4.2 Main function positioning

The binding Diebu function positioning body case , it is determined Diebu suitable for the construction of a threshold level of development, and different threshold adjusted according to the degree of aggregation and space main functional areas, Table 2-1 .

Tab. 2-3 The measurement table of benchmark threshold

Benchmark threshold calculation	
Suitable space aggregation	The aggregation index is greater than 7 ; the baseline threshold is up 0.1
Suitable space aggregation	The aggregation index is greater than 3 or less than 7 ; the baseline threshold remains the same
Suitable space concentration is low	The aggregation index is less than 3 ; the baseline threshold is lowered by 0.1.
Focus	Key development float 0.05
Ecology & Agriculture	The main agricultural production area is lowered by 0.05 ; the key ecological function area is lowered by 0.15.

4.4.3 Benchmark threshold determination

According to the calculation, the spatial agglomeration index of Diebu County is 0.131. As can be seen from Table 2-3, the appropriate spatial agglomeration is low, and the benchmark threshold is lowered by 0.1. According to the positioning of Qinba Biodiversity Ecological Function Zone , the key ecological function zone of Diebu County, the threshold of suitable construction development degree is lowered by 0.15 , and $T = -0.235$ is obtained .

4.5 Pressure Index Measurement and Status Judgment

4.5.1 Pressure index measurement

The final result of the evaluation of land resource carrying capacity is determined by the land resource pressure index, and its calculation formula is as follows:

$$D = (P - T)/T \quad (3)$$

D is the land resource pressure index, P is the development level of the current situation and T is the threshold for the appropriate construction development level . The land resource pressure index D= - 1.948 is obtained by the above formula.

4.5.2 Judging the status of land resources

According to the different values of land resource pressure index, the evaluation results of land resource carrying capacity are divided into three types: land resource pressure, medium pressure and low pressure. The analysis from the evaluation results shows that the land resource pressure index is in a state of smaller state, the lower the degree of deviation between the current construction and development level and the appropriate construction and development degree, the surface construction and development pattern and the land resource conditions tend to be coordinated. When D≥ 0, the land resources greater pressure; when the D range -0.3 ~ 0, the land resource pressure medium force; when D≤ -0.3, the pressure is small land resources (Table 2-2). Evaluation the table 2-2 can be drawn Diebu land resources County “pressure is small”.

Tab. 2-4 The grading table of land resource pressure evaluation

Land resource index	**D≤-0.3**	**-0.3<D<0**	**D≥0**
Land resource pressure	low pressure	Medium pressure	high pressure

5. Causes Analysis and Policy Pre-research

5.1 Cause Analysis

As a result of the county's land use is mainly to major natural grassland and woodland-based, small population, as of 2017 year-end, the county resident population of 5.4 million people. Moreover, the county is mainly based on tourism and agriculture and animal husbandry, with low industrialization and beautiful environment. It shows that the characteristics and spatial distribution of various land types in the county are basically in line with the requirements of natural, ecological system requirements, social needs and economic development of the planning area , basically follow the production rules of land resources, exert their unlimited potential, and realize the coordination of human and land resources.

5.2 Policy Pre-research

5.2.1 Rational development and efficient use of land resources

The land resources of Diebu County are currently in a state of reasonable development and utilization, but they should not only pay attention to the current state, but should continue to maintain the rational and efficient development and utilization of land resources.

5.2.2 Maintaining the rational use of land

In order to maintain the sustainable development of land resources in Diebu County and the rational use of land, the policy of returning farmland to forests and grasslands should be further

implemented, especially in high-altitude areas that are not suitable for crop growth, and slopes that are easy to lose soil in alpine valleys. It is also necessary to strictly implement the policy of returning farmland to forests and grasslands.

6. Conclusions

Based on the results of the survey of geographical conditions, this paper uses the large-scale basic mapping data and thematic data to combine the GIS technology and the analytic hierarchy process to evaluate the land resource carrying capacity of Diebu County. The research results show that the research is more in line with the actual situation of Diebu County, indicating that this evaluation method is scientific and feasible, and has certain reference value for the evaluation of land resource carrying capacity in other counties and districts of Gansu Province. But whether this method is suitable for larger -scale provincial or municipal area of evaluation of land carrying capacity , further research is done.

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