Research Article

Evaluation of Land Safety Degree of the Tourist Area Based on the Land Comprehensive Bearing Capacity

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Abstract: The regional land safety evaluation indicator system is built based on the land comprehensive bearing capacity in the study and the primary and secondary relationship of the land safety obstacle factors of Mengshan tourist area and influence degree of various obstacle factors on land safety are determined, so as to provide reference for sustainable utilization of land in Mengshan tourist area. The results indicate that: (i) The land comprehensive bearing capacity of Mengshan tourist area is at the safety state. Where, the social bearing capacity is at the weak safety state, which is the most critical factor influencing the land bearing capacity of Mengshan tourist area. (ii) The traveling and living ratio, the output values of the secondary industry and the tertiary industry of the unit construction land and the land utilization intensity are the key factors influencing the regional safety level.

Keywords: Land comprehensive bearing capacity, land safety evaluation, mengshan tourist area

INTRODUCTION

With rapid development of the tourism industry in recent years, the bearing capacity of some tourist attractions has been close to or exceeded the critical level, which endangers tourist safety, disturbs living of local residents, causes shortage of resources and deterioration in ecological environment in the tourist area and even threatens sustainable development of the tourist attraction. It is the only way to realize "triple win" of tourists, residents and local tourism to find out the land comprehensive bearing state of the tourist area and clarify the regional land safety level. At present, there are more researches on evaluation of land bearing capacity (Cao Yue-e et al., 2008; Li and Liu, 2014) and the evolution tendency from the land population bearing capacity to land comprehensive bearing capacity and from single indicator to comprehensive indicator system is shown (Cui and Liu, 1998). In summary, most current researches are emphasized on analyzing the relation between the number of visitors in the tourist area and the land bearing capacity and there are fewer researches on systematic analysis of bearing state in three aspects of environment, economy and society (Qian et al., 2009; Liu et al., 2009; Huang et al., 2013). There are more analyses on the current situation of land bearing capacity in the tourist area, with relatively insufficient researches on the regional land safety level and limiting factors from the land bearing capacity and it is difficult to provide specific measures for promoting the regional land safety.

Mengshan tourist area crosses four counties of Pingyi, Mengyin, Feixian and Yi'nan and consists of four scenery spots of Guimeng, Yunmeng, Tianmeng and Caimeng. From 2005 to 2013, the number of tourists in Mengshan tourist area was increased from 638 thousand person-times to 2.02 million person-times and the tourism income was increased from 271 million Yuan to 712 million Yuan. However, it is the important problem concerned and to be proven whether rapid development of tourism has damaged the natural environment of the tourist area and influenced normal living of local residents. Therefore, we construct the indicator system of the land comprehensive bearing capacity for systematic analysis of the land safety level in the area from the angle of bearing capacity, so as to provide basis for further development of the tourist area.

RESEARCH METHOD

Indicator system and weight: In combination of development characteristics of Mengshan tourist area, through expert suggestions and screening and in accordance with correlation analysis results, the regional land resource safety evaluation indicator system based on the land comprehensive bearing capacity is established, the extreme-value method is
Table 1: Land bearing capacity evaluation indicator and weight

<table>
<thead>
<tr>
<th>Criteria layer and weight</th>
<th>Indicator layer and weight</th>
<th>Indicator meaning</th>
<th>Indicator type</th>
<th>Target value</th>
<th>Standardization value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural bearing capacity 0.347</td>
<td>Land utilization rate/0.184</td>
<td>Land area utilized/total land area</td>
<td>100%</td>
<td>0.91</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Land utilization structure index /0.249</td>
<td>Complete degree of regional land</td>
<td>1</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Agricultural acreage per capita/0.188</td>
<td>Regional agricultural acreage/total population</td>
<td>0.053–0.085</td>
<td>0.81</td>
<td>0.053–0.085</td>
</tr>
<tr>
<td></td>
<td>Cultivated land pressure index/0.201</td>
<td>Minimum agricultural acreage per capita / actual agricultural acreage per capita</td>
<td>1</td>
<td>0.75</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Forest land per capita/0.178</td>
<td>Regional wooded area/total land area</td>
<td>0.178</td>
<td>0.99</td>
<td>0.1784</td>
</tr>
<tr>
<td>Economical bearing capacity 0.335</td>
<td>GDP per capita/0.209</td>
<td>GDP value/total population</td>
<td>10.1</td>
<td>0.42</td>
<td>10.1</td>
</tr>
<tr>
<td></td>
<td>GDP annual growth rate/0.199</td>
<td>GDP of current year/GDP of last year</td>
<td>13%</td>
<td>0.86</td>
<td>13%</td>
</tr>
<tr>
<td></td>
<td>Proportion of the tertiary industry/0.208</td>
<td>Increased value of the tertiary industry/GDP</td>
<td>55%</td>
<td>0.86</td>
<td>55%</td>
</tr>
<tr>
<td></td>
<td>Output value of the secondary industry and the tertiary industry of unit construction land/0.205</td>
<td>Increased value of the secondary industry and the tertiary industry/construction land area</td>
<td>332.93</td>
<td>0.31</td>
<td>332.93</td>
</tr>
<tr>
<td></td>
<td>Per capita net income of peasants/0.179</td>
<td>found from the statistical yearbook</td>
<td>1.5</td>
<td>0.66</td>
<td>1.5</td>
</tr>
<tr>
<td>Social bearing capacity 0.318</td>
<td>Population density/0.187</td>
<td>Regional population/total area</td>
<td>358.6</td>
<td>0.68</td>
<td>358.6</td>
</tr>
<tr>
<td></td>
<td>Natural growth rate/0.203</td>
<td>found from the statistical yearbook</td>
<td>5%</td>
<td>0.55</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>Share of grain per capita/0.211</td>
<td>Regional food output/total population</td>
<td>&gt;1000</td>
<td>0.81</td>
<td>&gt;1000</td>
</tr>
<tr>
<td></td>
<td>Traveling and living ratio/0.217</td>
<td>Number of visitors/total population</td>
<td>0.67</td>
<td>0.18</td>
<td>0.67</td>
</tr>
<tr>
<td></td>
<td>Land utilization intensity/0.182</td>
<td>Tourism land area/total land area</td>
<td>0.33</td>
<td>0.21</td>
<td>0.33</td>
</tr>
</tbody>
</table>

1: Gibbs-Mirtin diversification index is adopted in the paper to measure the land utilization structure diversity index; 2: According to related research (Cai et al., 2005), it is obtained that the food consumption level is 300 kg/person and 400 kg/person and the minimum agricultural acreage per capita in the tourist area is 0.064 ha and 0.085 ha.

The additive model is adopted to measure and calculate the land bearing capacity:

\[ B_i = \sum_{j=1}^{n} P_{ij} \times W_{ij} \]  

(1)

wherein,

- \( B_i \) = Comprehensive evaluation value of \( i \)th criteria layer
- \( P_{ij} \) = Standardization value of \( j \)th indicator in \( i \)th criteria layer
- \( W_{ij} \) = Weight of \( j \)th indicator in \( i \)th criteria layer
- \( n \) = Number of indicators in \( j \)th indicator layer

Diagnostic method of limiting factor: The "factor contribution", "indicator deviation degree "and "obstacle degree" (Qu et al., 2014) are introduced in the study, the obstacle degree values of various land safety indicators are calculated and sequenced according to the value and the primary and secondary relationship of the land safety obstacle factors of Mengshan tourist area and influence degree of various obstacle factors on land safety are determined, so as to adjust the land utilization behaviors of the area.

\[ R_{ij} = r_i \times W_{ij} \]

(2)

\[ D_{ij} = 1 - P_{ij} \]

(3)

\[ A_{ij} = \frac{D_{ij}}{\sum_{j=1}^{m} D_{ij} \times \left( D_{ij} \times R_{ij} \right)} \times 100\% \]

(4)

wherein,

- \( R_{ij} \) = Contribution of \( j \)th indicator in \( i \)th criteria layer on the overall objective
- \( r_i \) = Weight of \( i \)th criteria layer
- \( D_{ij} \) = Gap between \( j \)th indicator of \( i \)th criteria layer and the land safety objective (the indicator deviation degree), i.e., the difference between the appraised value of \( j \)th indicator in \( i \)th criteria layer and 100%.
- \( A_{ij} \) = Influence value of \( j \)th indicator of \( i \)th criteria layer on the land comprehensive safety level, which is the objective and results of obstacle diagnosis.
- \( m \) = Number of indicators in \( i \)th criteria layer. The meanings of \( P_{ij} \) and \( W_{ij} \) are same with Formula (1):
RESULTS AND ANALYSIS

Land safety level value determination and analysis: There is a certain relation among the regional bearing value, the land safety level and people's living standards and there is no uniform standard. The land safety levels are divided according to the actual characteristics of Mengshan tourist area, which is more targeted. The GDP per capita of the tourist area in 2012 is 4,300 Yuan, which is at the level of moderately prosperous society. Meanwhile, according to existing research findings of the ideal state of regional natural, economic and social bearing capacity (Huang et al., 2010; Liu et al., 2014), the land resource safety bearing capacity in the tourist area is divided into five levels (Table 2).

The bearing capacity index of the land natural system is 0.84 and the natural system is at the safety state, which indicates that the natural resource conditions of Mengshan tourist area are superior. The tourism project development does not cause significant impact on the ecological environment and there is still a certain development space. The land development strategy can be adopted in accordance with local conditions, the foreign investment is accelerated, the resource development force is strengthened, the integrated development capability of the industry is cultivated, construction of supporting facilities of tourism is perfected and the rapid development of social economy at the land safety state is searched.

The land economical bearing capacity index is 0.62 and the economic system is at relative safety state. During construction of the tourism development pattern of "Damengshan", relying on the exceptionally gifted natural conditions, the health pension industry is cultivated and three pension and health industry bases of Mingguang Temple, Mengyang Valley and Dawa are established and the surrounding apartments for the elderly and health properties of Mengshan are developed. With development of "leisure agriculture, sightseeing agriculture and ecological agriculture" as the main line, the high-efficient ecological agriculture is vigorously expanded.

The social bearing capacity of the land is 0.49 and it is at the weak safety state, which indicates that the social factor is the most critical factor influencing the land bearing capacity of Mengshan tourist area at present, which has large binding force on future development. It is known from the land utilization intensity indicators that the tourism land area of Mengshan tourist area is too small, but the resident land area is too large. The land of rural residents per capita is 226 m², which is far more than the upper limit specified in Standard for Planning of Town (GB50188-2007). It can be known from further analysis that the tourism land area accounts for 1/3 of the resident land area in Yunnan. However, the proportion of tourism land area in resident land area is less than 1/10 in Mengshan tourist area. There is a large gap, which also indicates that it has large potential. Overall, the land comprehensive bearing capacity index of Mengshan tourist area is 0.66 and the land comprehensive bearing capacity is at relative safety state, which is consistent with the actual situation.

Analysis of limiting factors of land bearing capacity: It can be known from Table 3 that the main limiting factors of land safety include the traveling and living ratio, output value of the secondary industry and the tertiary industry of unit construction land and land utilization intensity.

The traveling and living ratio and the land utilization intensity are the optimum value factors, but do not reach the optimum value, which indicates that the number of visitors and tourist land in the tourist area are within the affordable range.

The output value of the secondary industry and the tertiary industry of the unit construction land is ranked at the second place, which indicates that the intensification utilization degree of construction land in the area is relatively low. Mengshan tourist area is at the key stage of transformation from extensive

<table>
<thead>
<tr>
<th>Indicator layer</th>
<th>Sequence</th>
<th>Obstacle degree</th>
<th>Indicator layer</th>
<th>Sequence</th>
<th>Obstacle degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traveling and living ratio</td>
<td>1</td>
<td>14.48</td>
<td>Cultivated land pressure index</td>
<td>9</td>
<td>5.18</td>
</tr>
<tr>
<td>Output value of the secondary industry and the tertiary industry of unit construction land</td>
<td>2</td>
<td>14.11</td>
<td>Agricultural acreage per capita</td>
<td>10</td>
<td>3.69</td>
</tr>
<tr>
<td>Land utilization intensity</td>
<td>3</td>
<td>13.51</td>
<td>Grain per capita</td>
<td>11</td>
<td>3.67</td>
</tr>
<tr>
<td>GDP per capita</td>
<td>4</td>
<td>11.94</td>
<td>Proportion of the tertiary industry</td>
<td>12</td>
<td>2.80</td>
</tr>
<tr>
<td>Natural growth rate of population</td>
<td>5</td>
<td>8.54</td>
<td>GDP annual growth rate</td>
<td>13</td>
<td>2.64</td>
</tr>
<tr>
<td>Land utilization structure index</td>
<td>6</td>
<td>6.22</td>
<td>Land utilization rate</td>
<td>14</td>
<td>1.54</td>
</tr>
<tr>
<td>Per capita net income of peasants</td>
<td>7</td>
<td>5.94</td>
<td>Forest land per capita</td>
<td>15</td>
<td>0.10</td>
</tr>
<tr>
<td>Population density</td>
<td>8</td>
<td>5.63</td>
<td></td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
economy to intensive economy. The village land area in
the tourist area accounts for 68.25% of the total area of
construction land. Therefore, it is very important for
promoting intensive land use and improving land safety
level to conduct intensive utilization of village land.

CONCLUSION AND DISCUSSION

The land comprehensive bearing capacity of
Mengshan tourist area is 0.66, the land safety degree
belongs to relative safety state and people are at the
well-off level. There is still a certain development space
in the research area and one shall also notice that the
social bearing capacity has been close to the unsafe
level.

There are the problems of low tourism
development degree and poor intensive land use degree
in Mengshan tourist area and the important factors
limiting land safety of Mengshan tourist area include
the traveling and living ratio, output value of the
secondary industry and the tertiary industry of the unit
construction land and the land utilization intensity. It is
suggested to clarify the land function positioning,
optimize the land utilization structure and layout and
realize ecological protection, peasant income increase
and good economic development in the tourist area.

Subject to restrictions of data access, the dynamic
characteristics of the land comprehensive bearing
capacity of Mengshan tourist area are not revealed in
the research, which is the important direction for future
improvement.

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