GIS Based Construction Land Layout in Ecological Area

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Abstract

This paper explores the rational construction land layout in Qi river ecological area of Hebi city so as to provide references for the construction land layout in other similar domestic area. We take the geographical information system software (ARCGIS) and statistical software (SPSS) as technical support. We adopt qualitative analysis with quantitative calculation, data analysis with graphical analysis as research methods. The paper evaluates the suitability and the ecological sensitivity of the construction land in Qi River ecological area, then overlays the evaluation results by ARCGIS software, finally gets the layout of construction land in the ecological area. Conclusions are that: Rational layout of construction land in ecological relates area not only to the suitability evaluation but also to the sensitivity evaluation; there are strong correlations among ecological sensitivity and water system, land cover type, elevation, special value.

Keywords: *Ecological Area, Construction Land, Rational Layout, ARCGIS.*

1. Introduction

Healthy and stable ecological environment is the premise of survival and development of human society, and the layout of the construction land is an important regional economic foundation. Hebi is a both resource and tourist city. At present, the city is in the accelerated development period of industrialization, urbanization and modernization. Due to coal mining, environmental, pollution of Hebi spread from the point to the whole. The resource destruction is becoming more and more serious, which is a serious threat to the sustainable development of social economy. Therefore, the study on reasonable layout of construction land in Hebi ecological area has a strong practical significance to the rational utilization of ecological natural resources, human resources and tourism resources.

2. Research Methodologies

Taking the sustainable development and recycling economy theory as the guide, construction land of ecological area is evaluated under the suitability assessment and the sensitivity assessment. Then we overlay the two evaluation results by ARCGIS software to obtain the construction land layout of ecological area [1, 2].

3. Data sources

The research data is cited in Hebi official data, including the statistical yearbook of Hebi from 2000 to 2010, agricultural economics report of villages and towns of Hebi from 2000 to 2010, statistics of natural disaster of Hebi, land use maps of Hebi in 2009(1:1million), topographic maps of Hebi(1:5 million), traffic map of Hebi in 2011. We use the analysis, experiment and investigation method to obtain the data which is unable to access directly.

4. Empirical analyses

4.1 Construction land analysis of ecological area

Qi River ecological area is established in 2007, approved by Hebi People's Government, with total area of 37 square kilometers and population about 16000 people; Qi River flows from northwest to southeast, about 18 kilometers length, and the water quality is better. According to the land use map of ecological area of Qi River, we get the current land use situation: mountain and forest land is large, and the forest coverage is high; the town and rural residential land are relatively dispersive, local population density is less; there are some land use types, for example, traffic land, industrial and mining land, tourism land.

Ecological problems are summed up in the following aspects: the infrastructure was weak, and the existing road grade is in poor quality; construction land was dispersive and low using efficiency; municipal infrastructure corridor across the ecological area and the area was divided into pieces, with a high degree of landscape fragmentation; unauthorized reclamation and construction in the ecological region did big harm to the wetland resource of Qi River.

4.2 Suitability evaluation of construction land layout in the ecological area

According to the condition and features of Qi River ecological zone and some recognized indicators of construction land suitability evaluation. We built the construction land suitability evaluation system from 5 aspects (containing 15 impact factors): the engineering geological conditions, terrain conditions, geographical conditions, natural disasters and fundamental condition [3, 4, 5, 6]. Analytic hierarchy process was used to determine the index weight of construction land suitability in Qi River ecological area.

After using this method to calculate the weight of each influencing factor, we use the expert scoring method to amend the weight.

Table 1: Index weight of influence factor of suitable assessment system

Influence factor	***Weight***	***Specific factor***	***Weight***	***Index Weight***
Terrain conditions	0.150	Slope	0.200	0.030
		Aspect	0.150	0.023
		Elevation	0.350	0.053
		Topography types	0.300	0.045
Engineering geological conditions	0.100	Components of the earth's surface	0.300	0.030
		Bearing capacity of foundation (t/m^2)	0.250	0.025
		Depth of Groundwater	0.350	0.035
		Water and soil erosion	0.100	0.010
Geographical conditions	0.450	Hebi city circle radiation zone(Km)	0.200	0.090
		Radiation of ecological area and nearby towns (m)	0.450	0.203
		Traffic location(m)	0.350	0.158
Natural disaster	0.050	Flood buffer and water ecological isolation zone	0.400	0.020
		Geological stability	0.600	0.030
Fundamental condition	0.250	Land utilization	0.700	0.175
		Communicati-on, electric and water conditions	0.300	0.075

Using ARCTOOLBOX Union and Buffer functions for data spatial analysis in ARCMAP, we get the map of impact factors.

According to the respective weight of each topography factor in the graph based on slope, aspect, elevation and topography types, we overlay four maps to obtain influence graph of topography factors.

Construction land suitability assessment graph is obtained by the ARCGIS software according to the weight of each factor corresponding to the overall goal in the influence graph of topography factors, flood buffer and water ecological isolation area factor, traffic location

factor, land utilization factor, ecological area and nearby towns' radiation factor. By the construction land suitability assessment graph of Qi River ecological area, the appropriate and suitable area for construction was obtained. Number 1 to 5 in figure 1 represents suitable degree of ecological area from low to high.

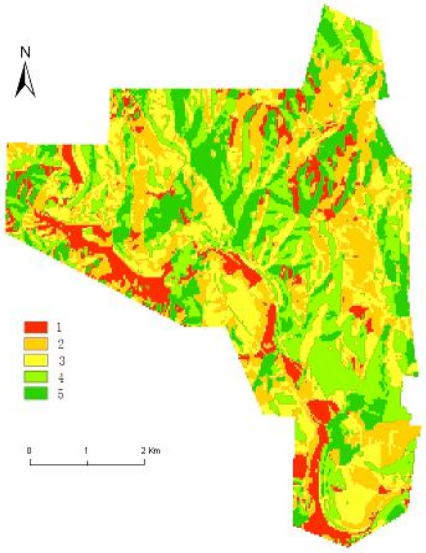

Fig.1 Suitability evaluation of construction land graph

4.3 Ecological sensitivity assessment of construction land

On the analysis of current situation of Qi River ecological area in Hebi, We built the construction land ecological sensitivity assessment system from5 aspects: elevation, slope, water, land and vegetation, special value factor [7, 8, 9, 10, 11].

The Delphi method is used to determine the sensitivity value of the internal components of single factor, and the assessment standards is divided into five levels,respectively"1, 2, 3, 4, 5". "1" represents non-sensitive index, its index is corresponding to regional non-sensitive area; "2" represents low sensitivity, its index is corresponding to the area for the low sensitive area; "3" represents middle sensitive, its index is corresponding to the area of the middle sensitive area; "4" represents sensitive, its index is corresponding to the area of sensitive area; "5" represents high sensitive, its index is corresponding to the region of high sensitive area. The higher ecological sensitivity of the area there is, the fewer suits for the construction land layout, and vice versa.

Table 2：Specific assignment of ecological sensitivity evaluation standard

Factor	*Classification*	*Index*
Elevation	90—120	1
	120—150	2
	150—180	3
	180—210	4
	210—495	5
Slope	0° —5°	1
	5° —10°	2
	10° —15°	3
	15° —20°	4
	＞20°	5
Water	200 meters outside of the river buffer	1
	150—200 meters outside of the river buffer	2
	100—150 meters outside of the river buffer	3
	50—100meters outside of the river buffer	4
	50 meters of water around	5
Land and vegetation	Current construction land	1
	Farmland	2
	Woodland	3
	Natural scenery protection areas, rivers and wetlands	5
Special value	Tai chi natural scenic area	5
	Qi River coast and core wetland area	5
	Jinshan Temple Scenic Area, Luo Guanzhong Literature Research Institute	5

In the ecological sensitivity assessment of Qi River in Hebi, the analytic hierarchy process method is used again to determine the weight of influence factor. After calculating the each weight of influence factor, the expert scoring method is used to amend the weight, finally we get the index weight of impact factor of ecological sensitivity assessment system. (as the table below).

Table3：Index weight of impact factor of ecological sensitivity evaluation system

Factor	*Water*	*Elevation*	*Slope*	*Land cover types*	*Special value*
Weight	0.3	0.20	0.10	0.2	0.2

Again using ARCTOOLBOX Union and Buffer functions for data spatial analysis in ARCMAP, the thematic map of impact factors was obtained.

According to the respective weight of each topography factor in the factor graph based on water factor, special value factor, elevation factor, slope factor, land cover types factor and topography types, four maps were superimposed to obtain ecological sensitivity factors influence graph. Number 1 to 5 in figure 2 represents sensitive degree of ecological area from low to high.

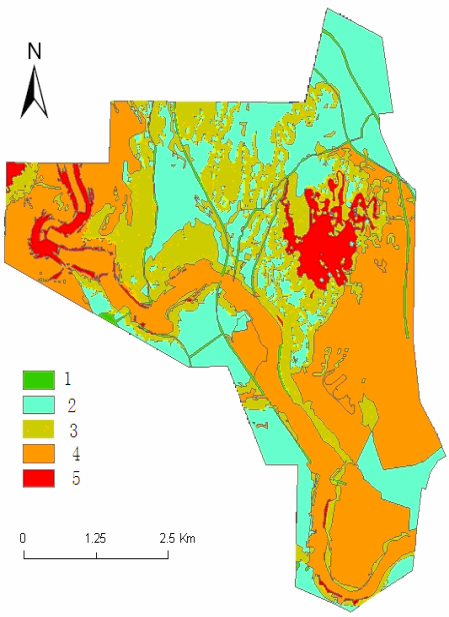

Fig.2 Ecological sensitivity evaluation graph

4.4 Comprehensive assessment of the construction land in ecological area

The suitability assessment and ecological sensitivity assessment graph is superimposed by ARCGIS software, and then comprehensive assessment of construction land in the ecological area is obtained. We get the comprehensive map of ecological sensitivity and suitability assessment by the weights of suitability and ecological sensitivity assessments are accounted for 0.3 and 0.7 (by the expert consulting results). Number 1 to 5 in figure 3 represents suitable degree of ecological area - from low to high.

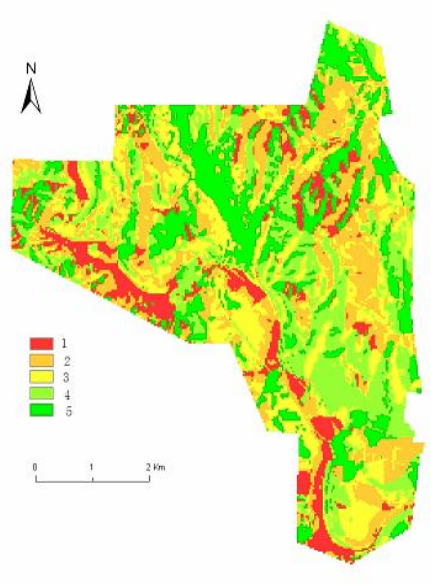

Fig. 3. The comprehensive map of ecological sensitivity and suitability assessment of construction land

Number 1 to 5 in figure 3 represents suitable degree of ecological area from low to high. Number 4 and 5 represents very appropriate and suitable area, mainly for the existing urban construction land, including the original rural residential, industrial and mining land distribution. These areas can withstand a certain degree of human interference, but are easy suffer from soil erosion and other natural disasters, with slower ecological restoration. Unsuitable areas for the construction land are the areas with fragile ecological environment and which are vulnerable to human disturbance. If the land is used improper, it can result ecosystem instability. The unsuitable areas for construction are mainly about 50 meters vertically away from the river, and some areas which are being ecological restoration construction now. The rest areas are middle unsuitable for construction, mainly for woodland distribution areas which are have large slope.

5. Suggestion of the reasonable layout of Qi River construction land in ecological area

5.1 Suggestion for urban construction land

The original urban construction land in ecological area is very suitable, so we can expand the scale and improve the urban population density and land utilization to make eco-town township form a centralized sheet pattern area based on the original building scale.

5.2 Suggestion for rural settlements

We should merge the existing rural settlements, move them to the four suitable settlements gradually, and reduce the current scale and improve the land use intensity. We should respect ecological resources and pay equal attention to the protection and development in the village construction, so as to build the rural ecological community, which is of green environmental protection with leisure and tourism.

5.3 Suggestion for the independent industrial and mining land

We can continue to arrange the independent industrial and mining land in situ site, and take control of the area scale. For those industrial and mining enterprises, which did serious damage to the ecological environment, should be closed, then take measures to reconstruct the ecological restoration immediately and accelerate the construction of water conservation forest.

5.4 Suggestion for traffic land

Considering the results of the construction land suitability assessment, skeleton of road system in ecological area planning should be cooperated with the urban space development. The improper original road construction should be adjusted. The road in the ecological area should avoid crossing the sensitive area; secondary road should set traffic road for walk, bicycles and other traffic tools.

5.5 Suggestion for waters and water conservancy facilities

The area along Qi River is not suitable for construction land, so it should be defined strictly protected areas. We should establish banning digging, mining, lumbering, grazing, reclamation areas and phosphorus prohibition area. The contaminative and poisonous industries should be banned in the area .But some constructions which are mainly for the purpose of water resources protection and wetland development should be arranged along the Qi River ecological protection buffer area, such as wetland science base, scientific research and observation point.

5.6 Suggestion for scenic spots and special use land

Unsuitable areas should be prohibited the construction activity. We should carry out the strict measures of protecting biological species, ecological environment and natural landscape to ensure the whole regional ecological safety. The land in core area is limited to scientific research and observation using. The land out of the core area is proper to develop the tourism and health with the main content of the accommodation, medical and other industries to improve the economic value of land.

6. Conclusion

The layout and assessment of construction land in ecological area is a comprehensive, highly relevant research topic. The following conclusions have been obtained through this study.

Study on the reasonable layout of construction land in ecological area should relate not only to the ecological sensitivity but also to the ecological suitability assessment of construction land. So we can characterize the suitable layout of the construction land fully and arrange the construction land reasonably.

Ecological sensitivity is great influenced by water system, land cover types, elevation and special value. Study on the ecological sensitivity assessment has shown that the weight of water system, land cover type, elevation and special value are higher. Therefore, their influences on ecological sensitivity are greater. We should strengthen the development and protection on these factors reasonably in order to promote the sustainable development of Qi River ecological area.

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