STUDY ON LAND USE SUITABILITY ASSESSMENT OF URBAN-RURAL PLANNING BASED ON REMOTE SENSING—A CASE STUDY OF LIANGPING IN CHONGQING

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ABSTRACT:

Land use suitability assessment is an important fundamental work in urban-rural planning. Be restricted by technology and means, qualitative analysis methods be wider used in evaluating land use suitability in most districts of China. This method can't impersonally and Quantitatively indicate the difference in land use suitability, and make urban-rural planning more subjectively because the influences on land use suitability are in many aspects and the impacts on objective evaluation are different. It is necessary to explore a land of urban-rural planning quantitative evaluation method to provide a reliable basis for the in-depth analysis of urban-rural planning and improve the persuasiveness of the decision-making and objectivity and science of the urban-rural planning. The rapid development of remote sensing technology and gradually maturing of GIS technology applications provides the foundation for urban-rural planning from the qualitative analysis to quantitative analysis.The core technology of the urban-rural planning is land use suitability comprehensive evaluation. Land use suitability assessment is the progress in which on basis of relevant natural, economic, social and technical data, using GIS, RS and other methods we do an individual assessment for every impact factor on the protection and development, and then make a comprehensive congruence analysis to the factor by the most optimal allocation principles and finally derive the rational allocation program of various elements and resources. Through the evaluation method, we can clearly determine the space relationship of "strict protection - appropriate protection - general use - optimal use - key development" in different policy conditions, so as to provide a solid theoretical foundation and serviceable content for urban-rural planning.The use of remote sensing technology, GIS technology in land suitability evaluation is a new technology and a new method in urban-rural planning. This thesis takes use of remote sensing and GIS technology to study urban-rural planning land suitability comprehensive evaluation. Taking Liangping of Chingqing for example, we acquire Liangping land use information through land use interpretation of 2006 TM image and the natural limiting factor, the factor of economic construction, ecologically sensitive factor, ecological protection factor which affect land suitability evaluation through GIS analysis. The natural limiting factor includes terrain factor and landscapes factor; the factor of economic construction includes town factor and traffic factor; the ecological protection factor includes basic farmland protection factor, nature reserve and scenic area factor and drinking water source protection factor. These factors are acquired from remote sensing technologies and GIS analysis.Through remote sensing image interpretation results, residential area is be extracted. On basis of the characteristics of population distribution, using the natural impact factors (terrain) and socio-economic impact factors (Towns scale, the distance from the town, the distance from the main network traffic), the population on the grid is discreted by spatial analysis functions of GIS. Through analyzing the various factors which impact on land suitability and the distribution of population, we determine the weight of the various factors which impact on the development of urban-rural, evaluate the land use suitability to determine the direction of urban-rural. These provide the scientific basis for planning.

1. INTRODUCTION

As an important fundamental work in urban-rural planning, land use suitability assessment provides important reference for planning, planning management, planning implementation and planning evaluation. Whether at home or abroad, many scholars and planning workers have made in-depth study and explore at the approaches of land suitability assessment, especially in the use of GIS technology. In general, the current study focuses on taking GIS as evaluation tools, but does not make in-depth research at the aspect of data source. On the basis of previous studies, this paper sums up experiences, uses remote sensing technology to broaden Data acquisition channels and applies GIS-based Spatial Analysis method to land suitability assessment of Liangping in Chongqing.

2. DESCRIPTION OF THE STUDY AREA AND DATA

Liangping county is located in the northeast of Chongqing, east longitude 107 ° 24'-108 ° 05 ', north latitude 30 ° 25'-30 ° 53', east close to Wanzhou, west nearby Dazhu county of Sichuan province, south adjacence to Zhongxian county and Dianjiang county, north close to Dazhou county and Kaijiang county of Sichuan province. The county covers an area of more than 1890 square kilometers. Liangping shows a natural landscape of "Three Hills-Five Mountains, Two Slots-One Dam, Hills Undulate, Six Rivers Flow".

As an important data acquisition means, remote sensing plays a vital role in land use suitability asseccment. Road traffic, land use, basic farmland, urban distribution, ecological elements are all obtained from the TM remote sensing images in September, 2007. In addition, DEM, water, natural ecological protection areas and other planning and basic geographic information are also adopted.

3. TECHNOLOGY AND METHODOLOGY

The main factors for affecting urban land use suitability assessment include the natural limiting factor (terrain factor and landscape factor), the factor of economic construction (town factor and traffic factor), ecologically sensitive factor (ecological factor), and ecological protection factor (basic farmland protection factor, nature reserve and scenic area factor and drinking water source protection factor).

Firstly, using object-oriented information classification technology construction land, water, woodland, grassland, unused land, arable land and fired land, and other indicators are extracted from TM remote sensing image, and on the basis of these indicators relevant factors can be accessed through based-on GIS factor analysis. Secondly, it is to extract terrain factor from DEM and other basic geographic information. Thirdly, it is to extract nature reserve and scenic area factor, drinking water source protection factor, and other factors from planning and basic geographic information. Finally, it is to incorporate the evaluation model to comprehensive foregoing various factors for land use suitability assessment (see Fig. 1).

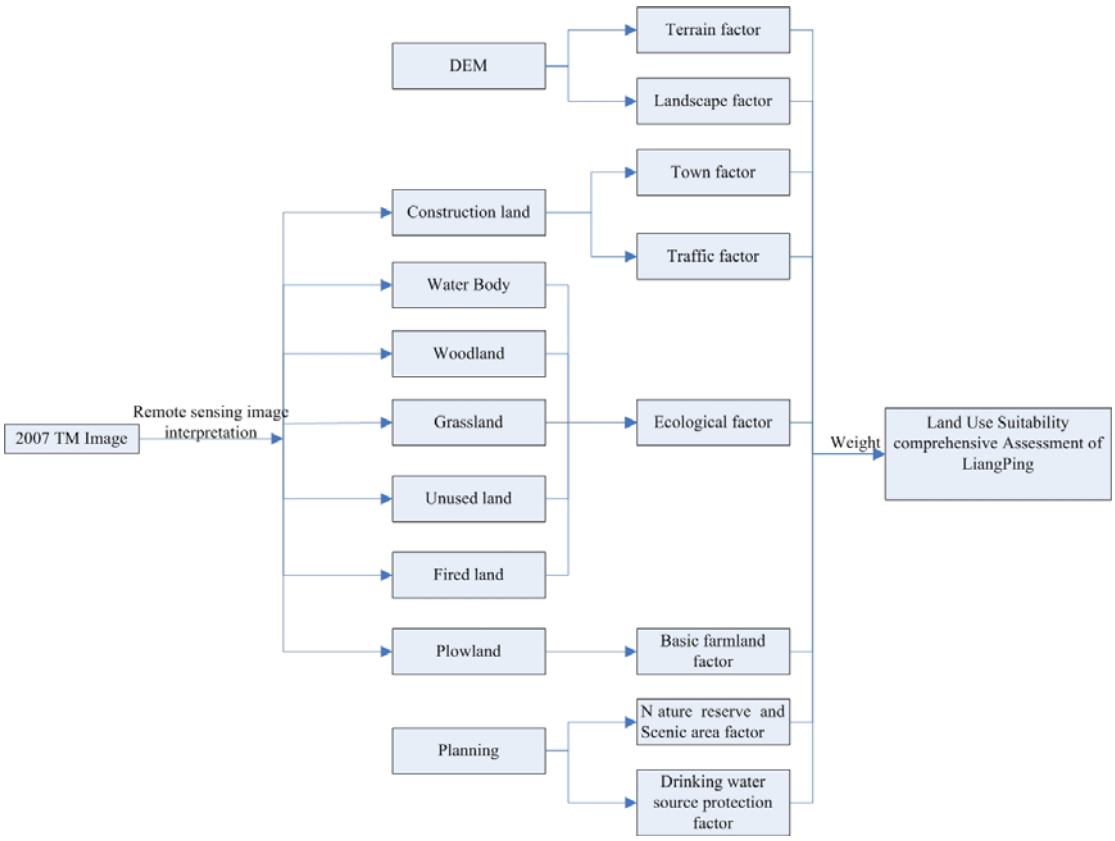

Figure. 1 land use suitability assessment flow chart of Liangping

3.1 Land use interpretation

Land use is the main basis for urban-rural planning; the distribution of various land-use types gives considerable constraints to urban and rural planning. In the land use suitability assessment of Liangping, we have applied an object-oriented information classification technology to the classification of TM images in 2007(see Fig. 2).

According to Liangping land use classification, we can see that the Mingyue mountain and Huanan mountain are main forest cover of Liangping; Dongshan national forest parks and other state-level and county-level scenic spots are mainly concentrated in the area of Mingyue mountain and South Mountain Huashan Mountain; arable land is more concentrated in the center, east and west. Every land use styles are illustrated in Table 3.

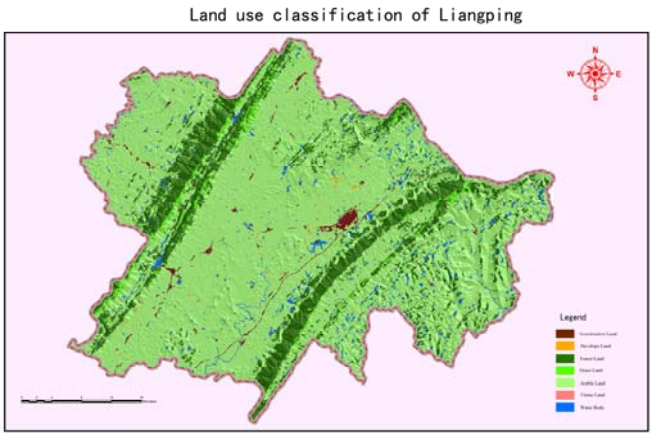

Figure. 2 land use classification of Liangping

classification	area（square kilometers）	percentage of total area
arable land	1486.9	78.2%
Woodland	304.9	16%
grassland	36.7	1.9%
construction land	21.2	1.2%
Development land	2.8	0.1%
water	47.5	2.5%
unused land	0.3	0.02%

Table 3 Statistics of land use classification in Liangping

3.2 Terrain factor

Liangping county is located in the northeast of Chongqing, which belongs to highland, both with mountains, hills and dams, mainly with hills. Its average elevation is 450 meters. In the county, there are nearly north-south, steep, Linear anticline low hills (Mingyue Hill, Nanhua Mountain), which performs that the distance from foot to peak is between 470 and 1200. It determines that the altitude of the land-use for urban-rural development and construction is most between 200 meters and 470 meters. Liangping County is separated by Mingyue Hill and Nanhua Mountain to three segments: west, center, east. The west is relatively flat, the altitude of which is from 200 meters to 470 meters; in the east there are steep slopes, undulating terrain so that the terrain is more complex. In the region of Mingyue Hill, Nanhua Mountain, surrounded by a geological collapse zone, there are more disaster-prone and more fragile so that it is not suitable for development land.

classification	Extent	score
unlimited region in terrain	surface elevation between 196 and 300 meters	10
weak limited region in terrain	surface elevation between 300 and 350 meters	8
general limited region in terrain	surface elevation between 350 and 400 meters	5
strong limited region in terrain	surface elevation between 400 and 500 meters	3
stronger limited region in terrain	surface elevation more than 500 meters or less than 196 meters	1

Table 2 terrain factor classification table in land suitability assessment of Liangping

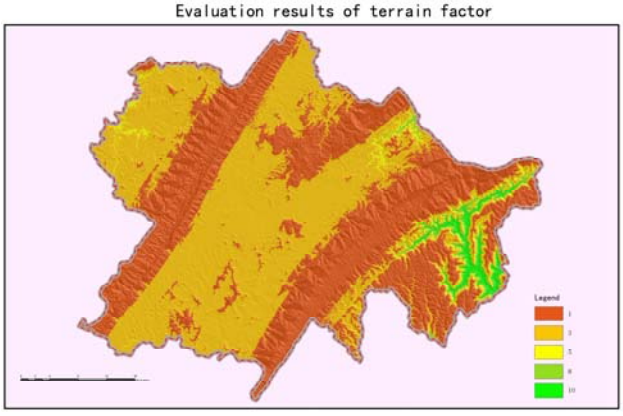

Figure. 3 evaluation results of terrain factor

Terrain factor is graded by Terrain factor classification table in Table 2. Analysis results are illustrated in Fig. 3.

3.3 Landscape factor

Surface slope is one of the most important elements for impacting urban and rural development and construction, which not only affects the spatial structure within the city layout, but also to the economic investment and engineering measures. Landscape is graded by Landscape factor classification table in Table 3.

classification	Extent	score
unlimited region in Landscape	surface scope less than 5 degrees	10
weak limited region in Landscape	surface scope between 5 and 10 degrees	8
general limited region in Landscape	surface scope between 10 and 15 degrees	5
strong limited region in Landscape	surface scope between 15 and 25 degrees	3
stronger limited region in Landscape	surface scope more than 25 degrees	1

Table 3 Landscape factor classification table in land suitability assessment of Liangping

From the analysis results in figure 4, in Liangping County the region for slope less than 5 degrees are mainly lied on both sides of the Mingyue hill, located in the centeral and western Liangping, in which central terrain is more gentle, and ground broken is smaller. The region for slope between 6 and 10 degrees is situated in the centeral and western Liangping. The region for slope above 25 degrees is mainly distributed in the Mingyue hill, Huashan and other mountain areas, mainly covered by forest and vegetation, in which the scope value is higher, ecosystem is more fragile and is prone to all kinds of geological disasters.

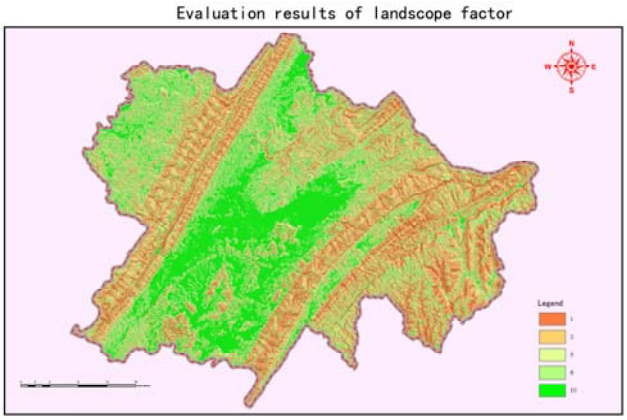

Figure. 4 evaluation results of landscope factor

3.4 Town factor

Towns are main space gathering region of socio-economic elements, the location, size and grade of which play a decisive role on the distribution of future population and the space layouts of rural-urban development. Town factor is graded by Town factor classification table in Table 4. Analysis results are

illustrated in Fig. 5.

classification	Extent	score
optimal region in town dependence	regional sites within 1.2 km from the central city, within 0.7 km from first-class town, within 300 m from second-class town	10
excellent region in town dependence	regional sites between 1.2 and 2.0 km from the central city, between 0.7 and 1.2 km from first-class town, between 300 and 500 m from second-class town	8
better region in town dependence	regional sites between 2.0 and 3.0 km from the central city, between 1.2 and 1.5 km from first-class town, between 500 and 700 m from second-class town	5
general region in town dependence	regional sites between 3.0 and4.0 km from the central city, between 1.5 and 1.8 km from first-class town, between 700 and 1000 m from second-class town	3
poor region in town dependence	regional sites more than 4.0 km from the central city, more than 1.8 km from first-class town, more than 1000 m from second-class town	1

Table 4 town factor classification table in land suitability assessment of Liangping

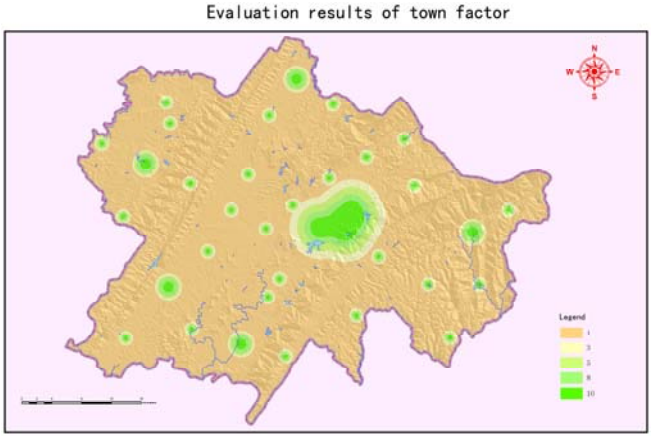

Figure. 5 evaluation results of town factor

Liangping County consists of 30 townships, according to the analysis of town dependence factor, the central city of Liangping County has the greatest impact on the development of the surrounding cities and towns and the affected range is widest. Five central towns: Xinsheng, Yuanyi, Pingjin, Yunlong, fulu, perform a circular distribution around in the central city of Liangping County, and form a spatial distribution pattern of central cities and central towns, characterizing with points along with areas and uniform distribution. This pattern can effectively promote the development of the surrounding townships through space radiation effects of central cities and central towns.

3.5 Traffic Factor

Transport network has a strong guiding role in the urban and rural development, in accordance with the general experience of urban geography, towns, population and related elements of the productivity gather into the open traffic elements (except railways and highways). Based on the results of remote sensing image interpretation,traffic factor is graded by traffic factor classification table in Table 5. Analysis results are illustrated in Fig. 6.

classification	Extent	score
optimal region in traffic location	regional sites within 500 m from main highway	10
excellent region in traffic location	regional sites within between 500 and 1000 m from main highway	8
better region in traffic location	regional sites within between 1000 and 1500 m from main highway	5
general region in traffic location	regional sites within between 1500 and 2000 m from main highway	3
poor region in traffic location	regional sites within more than 2000 m from main highway	1

Table 5 traffic factor classification table in land suitability assessment of Liangping

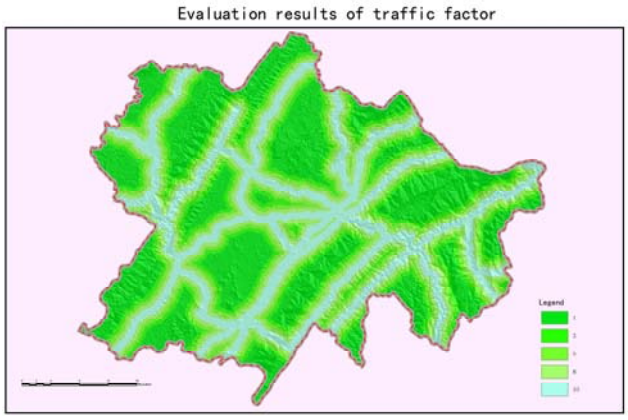

Figure. 6 evaluation results of traffic factor

In Liang Ping the road transport system interleaves Vertically and horizontally, including the Liangping segment of Yuyi highway. State road 318 crosses provincial road 102 and 202, which North-South link with state road 318. Highway, state road and provincial road form a highway network of Liangping county. both sides of the highway are radiation belt of development of cities and towns, which have different influences on the development of cities and towns according to different levels of road and the distance from the highway.

3.6 Ecologically Sensitive Factor

Basic ecological protection factor is water system, wetlands, forest green and natural ecological protection zones and other

regional, and simultaneously nature reserves, scenic spots, key heritage conservation areas are ecologically sensitive areas, at which must be taken seriously in urban and rural planning and construction. According to ecological factor classification table in Table 6, ecologically sensitive factor is extracted from the relevant information of land use interpretation. Analysis results are illustrated in Fig. 7.

classification	Extent	score
not ecologically sensitive region	unused land (grassland, saline-alkali soil, etc.)	10
ecologically generally sensitive region	other land	7
ecologically moderately sensitive region	woodland and garden with continuous area <10 hectares; pond surface and etlands with continuous area of <5 hectares; aquaculture area with continuous area <10 hectares.	5
ecologically rather sensitive region	third-class river surface; sparse woodland, shrub, garde with continuous area>10 hectares; pond surface and etlands with continuous area > 5 hectares	3
Ecologically very sensitive region	first and Second-class river surface; trees and evergreen broad-leaved forest with continuous area>10 hectares; pond surface and etlands with continuous area > 5 hectares	1

Table 6 ecological factor classification table in land suitability assessment of Liangping

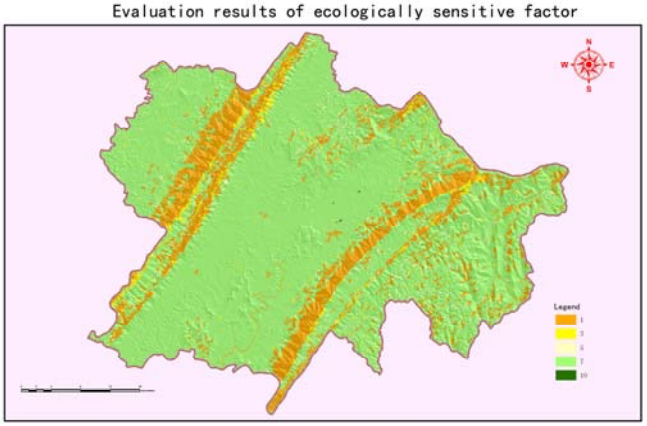

Figure. 7 evaluation results of ecologically sensitive factor

3.7 Basic Farmland Protection Factor

According to the results of land use interpretation, existing arable land area in Liangping County exceeds 1,500 square kilometers of arable land. Basic farmland as part of arable land and as the best arable land must be strong protected. In the land suitability assessment of Liangping County, taking into account the actual situation, the arable land with ground slopes less than 8 degrees and continuous area more than 50 hectares is taken as basic farmland.

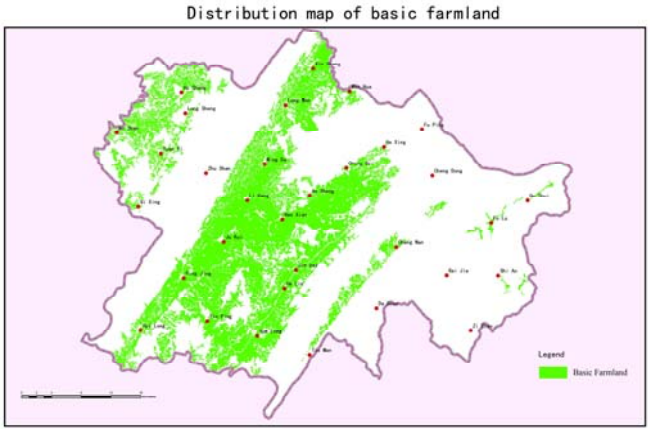

Figure. 11 distribution map of basic farmland

Based on the analysis results, in Liangping county basic farmland is mainly distributed in the central and western regions, with the vast region between Mingyue hill and Nanhua mountain and a small amount of the distribution of basic farmland in the western region. In Liangping county in the area of basic farmland is 57,600 hectares, or 864,000 acres, 30.3 percent of the total area. The sum of current population is 883,100, so that per capita area of basic farmland is 0.98 acres, close to 1 acre.

4. COMPREHENSIVE EVALUATION AND ANALYSIS OF RESULTS

4.1 Evaluation Model

Land suitability comprehensive assessment is to integrate various factors for affecting the various factors, add proper weight, and finally get comprehensive evaluation results of Land suitability. These factors include six flexible factors: terrain factor, landscape factor, town factor, traffic factor, ecologically sensitive factor, basic farmland factor, and two rigid factors: nature reserve and scenic area factor and drinking water source protection factor. The weight between Flexible factors can be adjusted by local situation; rigid factor is to protect the local ecological environment and the safety of drinking water so that it is not randomly adjusted. The weight of each factor see table 7. Weight is mainly determined by expert knowledge and experience accumulation in accordance with the importance of indicators for assignment.

Land suitability comprehensive assessment model is $Si=\sum ViWi$. Vi is the value of single-bound targets set in the formula. Its spatial distribution data can use space overlay data extraction, or assign the value by experts based on Case analog and Expertise, or operate the buffer zone and re-classification the single-bound.

We access the land suitability comprehensive assessment based on various factors different weight under the platform of ArcGIS, the factor which had been calculated.

factor name		Factor description	Weight	Factor type
Natural limited factor	Terrain factor	Ground elevation	0.2	Flexibility
	Landscape factor	Slope, aspect	0.15	
Construction and economic factor	Town factor	Distance from the cities and towns	0.15	Flexibility
	Traffic factor	Distance from the main transport network	0.15	
Ecologically sensitive factor	Ecologicall factor	River and reservoirs; woodland, garden, Grassland unused land (including the beach)	0.2	Flexibility
Ecological protection factor	Basic farmland factor	Basic farmland	0.15	Flexibility
	nature reserve and scenic area factor	Specialized planning nature reserve and scenic area	_	Rigid
	drinking water source protection factor	Reservoir water, specifically designated water source	_	Rigid

Table 7 factor selection table of land suitability comprehensive assessment

Class	The most appropriate development and construction sites	Suitable land for development	Suitable for general development	Appropriate for the protection	Suitable for strict protection
Score range	8-10	6-7	5	3-4	0-2
Final code	1	2	3	4	5

Table 7 The integrate data table of land suitability comprehensive assessment

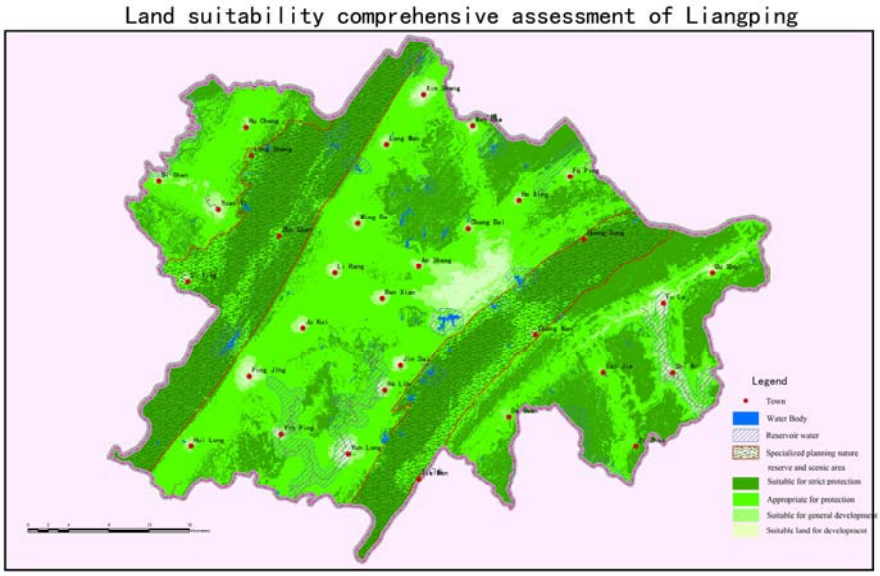

Figure. 12 Land suitability comprehensive assessment of Liangping

Comprehensive two rigid factors which are nature reserve, scenic area and drinking water source protection, we can get the value of land suitability comprehensive assessment for Liangping. It is be determined as appropriate construction sites If the value is more than six.

4.2 Result Analyst

The lands which is suitable for development and construction of Liangping are mainly distributed surrounding the county seat and the center towns according the result analyst, have the following characteristics in space structure. Firstly, surrounding the county seat of Liangping formed hunch land plots which is suitable for development and construction, it is mainly determined by town zone bit and traffic conditions, because the current landuse situation surrounding urban sites is better; Secondly, it is showed greater plaque in the central towns of Liangping county, the main reason is that these region have obvious advantages in traffic and these regions have a better base for development such as PinJing town has advantage in industrial, YuanYi town is the famous ancient town which the population is relative concentration. These

regions are the direction of future development.

The lands which suitable for protecting of Liangping county are mainly districting in Nature Reserve and environmental protection region in ,Mingyue mountain and Nanhua mountain, these regions are distributed in plate situation, these regions are fundamental for cultivating the ecological environment of Liangping and its surrounding regions, play a important role in adjusting surrounding ecological environment , they commitment the enormous pressure to protect the environment and ecology. Basic farmlands are mainly in the central and western regions of Liangping which showing large sectors-connecting distribution. Basic farmlands are important land resources which protect local people's livelihood and promote agricultural production, they are also important guarantee for local people's living and producting. Therefore, to protect the quantity and quality of the basic farmlands are play important role in the harmonious development of society. we should try to guide the population transfer to the appropriate region, in particularly, the county seat and the central town, they are not suitable for large-scale development and construction and large assembly of population, at least maintain its status that is net agricultural production.

5. CONCLUSION

Remote sensing is launched a successful application in urban and rural planning at all levels of Chongqing which is the strongest means to access geographic information for its potential, its technical superiority is superior than traditional methods to make urban and rural planning, and it improves the scientific of urban and rural planning. It provide a better platform for land suitability evaluation of urban and rural planning which combine remote sensing and GIS, this article made evaluation based on the weight analyst, we hope there maybe further evaluation methods in future researches.

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