Study on land use change and driving force in Chengdu-Chongqing urban agglomeration

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Abstract. The study of land use change and its driving forces at urban agglomeration scale is one of the most urgent issues to be studied.Based on GlobeLand30 data set of 2000, 2010 and 2020, this paper uses ArcGIS and other software to calculate and process land use change in Chengdu-Chongqing urban agglomeration and its driving forces through dynamic attitude and transfer matrix.The results showed that :(1) the land use change in chengdu-chongqing urban agglomeration was significant from 2000 to 2020, and the area of construction land continued to increase and the change rate was fast, while the area of cropland and grassland decreased.(2) The main drivers are population growth, socio-economic development and policy factors.The results provide references for the allocation of land resources and sustainable land use in this region.

Keywords: Land use change, Driving force, Transfer matrix, Chengyu city group.

1 Introduction

Land use research has gradually become one of the hot spots in the field of global environmental change. As the main spatial carrier of human beings [1] and one of the important non-renewable resources, land plays a decisive role in maintaining and improving regional ecological balance [2]. As urbanization drives social and economic development, land use patterns and structures also change constantly, which negatively affects the structure and function of the ecosystem, and induces a series of ecological security problems such as excessive population density and loss of cultivated land [3]. Research on regional land use change and its driving forces can provide guidance and reference for regional land planning and social and economic construction. Chengdu-chongqing urban agglomeration is one of the national difference planning focus on the development of urban agglomeration, and the development of the western region, the middle and lower reaches of the Yangtze river ecological security barrier [1], with the rapid development of Chinese society, the accelerating process of urbanization and industrialization, people growing demand for land, grasslands and relevant policy, land use structure imbalance, the prominent contradiction between human and land. The unreasonable land use in Chengdu-Chongqing urban agglomeration threatens the ecological

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security of the region. It is of great significance to explore the change of land use in Chengdu-Chongqing urban agglomeration and analyze the driving forces of its change, so as to provide a theoretical basis for optimizing land structure and scientifically allocating land in Chengdu-Chongqing urban agglomeration, and then promote the sustainable development of land use and ecology in other similar areas.At present, there are few studies on the analysis of land use change and driving force of Chengdu-Chongqing urban agglomeration. Fachao LIANG et al. [4] conducted landscape ecological risk assessment and proposed control strategies. Wei ZHAO et al. [5] studied the construction of ecological security pattern in this region. Huizhong DONG et al. [1] explored the sensitivity of its ecosystem service value. Therefore, this study selects Chengdu-Chongqing urban agglomeration as the research area, and uses Globeland30 2000, 2010 and 2020 data sets to comprehensively analyze the land cover distribution, land use type change and its driving forces in this area.

2 Overview of the study area

The geographical location of the study area is 27° 39 '~33° 3'N, 101° 56' ~110° 11'E, with a total area of $19.38\times10^4 km^2$, a total population of 986.69×10^5, and a total GDP of 1.56×10^4 billion yuan [6]. According to Chengdu-Chongqing Urban Agglomeration Development Plan, the study area is determined to include 15 cities in Sichuan province, including Chengdu, Dazhou, Deyang, Guang 'an, Leshan, Luzhou, Meishan, Mianyang, Nanchong, Neijiang, Suining, Ya 'an, Yibin, Ziyang, Zigong and Chongqing (Figure 1).

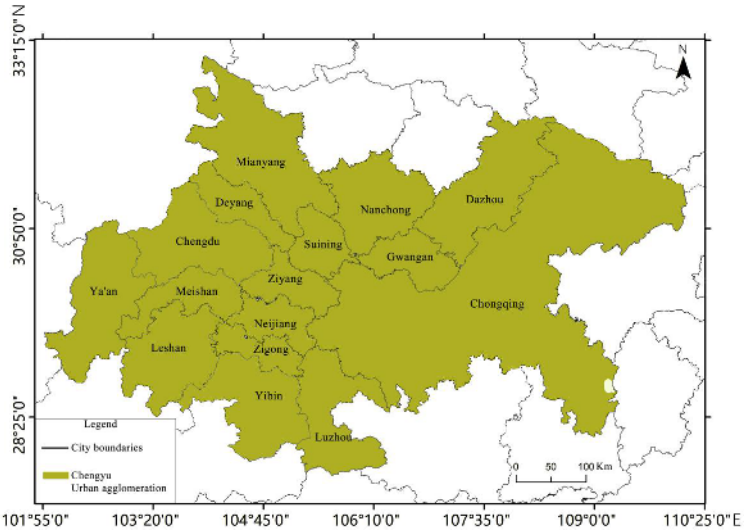

Fig. 1. The geographical location of the study area is indicated.

3 Data sources and research methods

3.1 The data source

Developed based on the data from the world's two phase of 30 m resolution GlobeLand30 surface coverage data products, given by a third party global accuracy of test results was 83%, the land use types classified as cultivated land, forest, grassland, shrub land, wetland, water body, tundra, artificial surface, bare land, glaciers and permanent snow, waters,

countless according to area,Is an important scientific data in the study of land cover today.In this study, data sets of Globeland30 2000, 2010 and 2020 were used to extract data within the research scope in ArcGIS software. Combined with the actual situation of Chengdu-Chongqing urban agglomeration [7], land types were reclassified into five land types: grassland, woodland, cultivated land, water area, unused land and construction land.

3.2 The research methods

3.2.1 Land use dynamic change analysis method.

Dynamic attitude of land use.Dynamic attitude of land use shows the change of land use type and its trend in a quantitative way in a certain period of time, and its size reflects the stability and intensity of change of a certain land use type [8].The calculation formula of dynamic land use attitude is [9] :

$$D_i = \frac{S_a - S_b}{S_b} \times \frac{1}{T} \times 100\% \quad (1)$$

where D_i represents dynamic attitude of a certain land use type per unit time;T is the year of change;S_a represents the area of the initial study area, and S_b represents the area of the late study area.

(1) Land use transfer matrix.The land use transfer matrix not only reflects the area transformation among different land types, but also reflects the change characteristics of different land types in different time periods [10].It can describe the structural characteristics and change process of regional land use in detail and comprehensively.By analyzing the land use transfer matrix of Chengdu-Chongqing urban agglomeration from 2000 to 2020, this study reveals the characteristics and changes of land use pattern in the past 20 years.Its calculation formula is as follows [11] :

$$S_{ij} = \begin{bmatrix} S_{11} & S_{21} & \cdots & S_{1n} \\ S_{21} & S_{22} & \cdots & S_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ S_{n1} & S_{n2} & \cdots & S_{nn} \end{bmatrix} \quad (2)$$

where S represents the area, i, j(1,2,3...n) land use types at the beginning and end of the study period;S_{ij} represents the area of land use type i converted into land use type j in this period.

3.2.2 Driving force analysis

Based on the researches of scholars [12,13], the factors driving land use change can be divided into natural factors and social and economic factors.However, in a short period of time, natural factors are relatively stable, while human factors change relatively fast, so social and economic factors are the main reason driving land use change.Therefore, this study uses qualitative methods to analyze the driving forces of land use change.

4 Results and analysis

4.1 Analysis of land use change

4.1.1 Analysis of spatial distribution of land use

The spatial distribution pattern of land use in chengdu-Chongqing urban agglomeration from 2000 to 2020 is shown in Figure 2.Cultivated land is the most important type of land use, which is widely distributed in chengdu-Chongqing urban agglomeration.Woodland and grassland are mainly distributed in mountainous and hilly areas at the edge of Chengdu-Chongqing urban agglomeration.The construction land is distributed widely, mainly in the areas extending outward from the core of Chengdu and Chongqing.The spatial distribution of construction land changed most obviously, showing an increasing trend year by year.On the whole, the change of land use spatial distribution in Chengdu-Chongqing urban agglomeration is obvious.

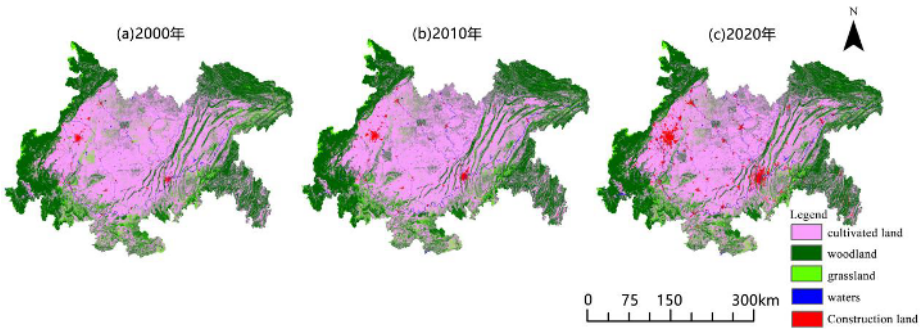

Fig. 2. Spatial distribution of land use in Chengdu-Chongqing urban agglomeration from 2000 to 2020.

4.1.2 Analysis of land use area change

The proportions and changes of land use types in Chengdu-Chongqing urban agglomeration from 2000 to 2020 are shown in Table 1.It can be seen that arable land and forest land are the main types of land use, accounting for more than 90% of the total.Arable land accounts for about 50% of the total area, with the highest proportion reaching 53.79% in 2010.Water area is the smallest, accounting for an average of about 1.3% of the total area.During the study period, all kinds of land use types changed, and cultivated land changed the most.The area of forest land, water area and construction land increased, while the area of grassland and arable land decreased.Construction land is changing the fastest.Table 1 Land use change in Chengdu-Chongqing urban agglomeration from 2000 to 2020.

Table 1. Land use change in Chengdu-Chongqing urban agglomeration from 2000 to 2020.

type	2000		2010		2020		2000-2020	2000-2020
	area/km^2	The proportion/%	area/km^2	The proportion/%	area/km^2	The proportion/%	Increasing reduction/km^2	Dynamic attitude/%
grassland	20700045	7.69	17144632	6.37	16635069	6.25	-4064976	-1.17
woodland	98188759	36.49	100983910	37.53	99738690	37.47	1549931	0.07

cultivated land	144490210	53.69	144734540	53.79	137635290	51.70	-6854920	-0.24
waters	3251016	1.21	3163232	1.18	4019520	1.51	768504	0.92
Construction land	2459880	0.91	3045511	1.13	8144792	3.06	5684912	3.35

4.1.3 Analysis of land use transfer change

ArcGIS software was used to calculate the land use transfer matrix of Chengdu-Chongqing urban agglomeration from 2000 to 2020 (Table 2). It can be seen that the transfer between land use types was obvious in the study period, and there were certain differences in the change of land use transfer of chengdu-Chongqing urban agglomeration at different stages.(1) From 2000 to 2010, grassland, cultivated land and forest land were the main land use transfer types, and grassland and cultivated land were mainly changed to forest land;(2) From 2010 to 2020, the change of cultivated land transfer is the most obvious, mainly to forest and construction land, which is speculated to be affected by urban expansion and the policy of returning farmland to forest and grassland;(3) From 2000 to 2020, the transfer of cultivated land and grassland was the most obvious, and the transfer of cultivated land, grassland and construction land were the three main directions.The area of farmland transferred to construction land was the largest, 4900.31km2, accounting for 66.92% of the total area of construction land transferred to construction land.The area transfer of forestland and grassland is also obvious, mainly for construction land.It can be seen that the construction land of chengdu-Chongqing urban agglomeration is constantly expanding.

Table 2. Land use transfer matrix of Chengdu-Chongqing Urban agglomeration from 2000 to 2020.

year	type	type(km^2)				
		grassland	cultivated land	Construction land	woodland	waters
2000—2010	grassland	10079.73	1407.06	12.24	3701.52	215.01
	cultivated land	1846.62	124181.10	306.99	3258.09	711.27
	Construction land	172.35	681.75	1857.24	10.08	21.60
	woodland	6213.42	3278.43	11.52	81221.58	125.10
	waters	278.91	515.07	22.50	186.30	1847.61
2010—2020	grassland	6415.34	3793.25	34.23	4793.79	90.10
	cultivated land	3738.44	108941.06	304.86	11470.29	728.87
	Construction land	196.18	4497.76	2320.13	282.42	96.70
	woodland	4778.15	11734.06	33.64	73825.98	182.13
	waters	238.44	1291.22	50.14	304.75	1741.30
2000—2020	grassland	6309.86	3708.93	32.80	4805.39	117.87
	cultivated land	4702.28	107181.05	394.92	10611.67	958.98
	Construction land	366.34	4900.31	1675.81	262.06	118.53
	woodland	6613.27	11498.45	34.84	71228.02	178.01
	waters	352.74	1343.72	53.27	330.02	1508.04

4.2 Driving force analysis of land use change

4.2.1 Policy factors

The land use change of Chengdu-Chongqing urban agglomeration from 2000 to 2020 is closely related to national and local policies.The "Chengdu-Chongqing Economic Zone Regional Planning" issued by the state in 2011 shows that it will focus on promoting regional integration development;To build China into an important economic center in the western region by 2015;By 2020, it will become one of the regions with the strongest comprehensive strength in China.In 2016, the Executive meeting of The State Council approved the Chengdu-Chongqing Urban Agglomeration Development Plan. According to the plan, urban agglomeration will become an important strategic support for China's economic development, cultivate and develop chengdu-Chongqing urban agglomeration, and help build regional development into an important growth pole.With the acceleration of urbanization and agricultural modernization, people's demand for land resources expands and the phenomenon of cultivated land reclamation exists, which leads to the decrease of cultivated land area, which will inevitably lead to the transformation of land use patterns in the region.

4.2.2 Socioeconomic factors

Social and economic development is the reason for the change of land use structure [14].According to "Sichuan Statistical Yearbook", "Chongqing Statistical Yearbook" and relevant statistical bulletin of national economic and social development, the economic aggregate of Chengdu-Chongqing urban agglomeration showed a trend of continuous increase from 2000 to 2020.Among them, the total GDP of Chengdu-Chongqing urban agglomeration increased from 2.5 trillion yuan in 2010 to 5.6 trillion yuan in 2017, more than doubling in just 8 years, and its growth rate remains the first in China [15].Economic development will promote the reconfiguration of traditional industrial structure, resulting in the change of land use type.Economic growth has accelerated the urbanization process, and vigorous infrastructure construction has driven the increase of construction land, reducing the area of arable land, grassland and forest.From 2007 to 2016, the proportion of agricultural output value in Chengdu-Chongqing urban agglomeration decreased from 15.28% to 9.49%.The proportion of labor force dropped from 45.87% to 33.4%, but the average GDP growth rate reached 14.69% in the same period [16], indicating that the industrial layout and structure of urban agglomeration were optimized, the overall income level of residents was improved, and the population engaged in agricultural production activities decreased, driving the decrease of cultivated land.

4.2.3 Demographic factors

From 2000 to 2020, the social economy of Chengdu-Chongqing region has been developing continuously, the population scale has been expanding, and it has presented the characteristics of "large dispersion and small aggregation" in space.The development of the western region and the transformation and upgrading of the industrial structure have attracted more floating people.Meanwhile, the reform of the household registration system has provided more opportunities to settle down in cities.The increasing concentration of population promotes the adjustment of industrial structure and urban expansion;Increase the demand of urban construction land, and then lead to the change of regional land use structure.

5 Conclusion

Based on the 30m spatial resolution Global land cover dataset (GlobeLand30), this study uses geographic information system (GIS) technology to extract and process the data in the study area.The characteristics and driving forces of land use change in Chengdu-Chongqing urban agglomeration from 2000 to 2020 were analyzed. The results show that:

With the socio-economic development and population growth, land use in Chengdu-Chongqing urban agglomeration showed significant changes, with the increase of construction land area and the decrease of cultivated land, grassland and other land areas being the most obvious.

Cultivated land, forest land and grassland were the main land use types in chengdu-Chongqing urban agglomeration, and the area of construction land increased the most, and its proportion increased by 2.87%.The area of cultivated land decreased the most, accounting for a cumulative decrease of 1.98%, which was mainly converted to construction land, forest land and grassland.Construction land area increased the fastest, and its dynamic attitude was 3.35%.Grassland decreased the fastest, with a dynamic attitude of -1.17%.The absolute value of dynamic attitude of forest land, cultivated land and water area is less than 1%, indicating that the land use change rate is not obvious.

The results of driving force analysis show that policy, social economy and population are driving the change of land use types in chengdu-Chongqing urban agglomeration.Policy dominates the direction of land use change;Social and economic development and population increase will change the way of land use and affect the formulation of regional policies.Therefore, scientific land use planning has very important significance.To sum up, it is suggested that chengdu-Chongqing urban agglomeration should pay attention to the balance between city and ecology in the process of urbanization, formulate regional land use policies on the basis of protecting the ecological environment, and optimize the regional land use structure.

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