Analysis and Research on the Temporal and Spatial Changes of Land Use in Zhaozhou County Based on Geo-information TUPU

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Abstract: Geo-information maps use simple language and graphics to express complex geographical phenomena, and provide an effective means for spatial analysis of land use. This article uses Landsat 8 OLI in Zhaozhou County in 2013 and 2020 as the main data source, with the support of RS and GIS technology to process the land use data in Zhaozhou County, conduct spatial analysis and explore its temporal and spatial changes. The results show that: from the current land use map, Zhaozhou County is dominated by cultivated land, from the analysis of the land use change TUPU, we can see that grassland and unused land are increasing, and the mainly transfer map is from cultivated land to unused land and cultivated land →grassland with a transfer area of 354.22km²; the largest new grassland area was from 2013 to 2010, mainly from the transfer of cultivated land, forestland and construction land. Overall, the land use pattern tended to be stable from 2013 to 2020.

0. Introduction
Land use is a complex geometry that interacts with human activities and environmental changes. It can not only record human activities, but also predict future land changes[1-2]. Land use/cover change (LUCC) is one of the core contents of international researchers studying global change[3-4]. Land use change is mainly manifested in the change of "temporal distribution" and "spatial distribution", and the geography information map can effectively express the spatial and temporal changes of land use in the study area through graphics and TUPU[5-7]. It makes up for the unity of the original method, uses graphic language to express and analyze time and space, and finds a new direction for land use research[8]. In recent years, international scholars have used geo-information TUPU to analyze the spatial and temporal changes of land use, and have made many scientific achievements[9-11].

Based on the two phases of remote sensing data in 2013 and 2020 as the data source, the time-series unit land use information TUPU and fluctuation potential TUPU were synthesized, so as to analyze the dynamic change pattern and timely spatial change of land use in Zhaozhou County from 2013 to 2020[12-13], Which can accurately express the land use change in Zhaozhou County, and provide research methods and scientific basis for future research[14-15].

1. Overview of the study area
Zhaozhou County is located in the southwest of Heilongjiang Province, in the north of Songhua River, in the hinterland of Songnen Plain, at 124° 48′12″ E—125° 48′03″, 45° 35′02″ —46° 16′ 08″ N, adjacent to Zhaodong City in the east, Datong District in the west, Zhaoyuan County in the south, and Anda City in the north, backed by Daqing Oilfield, with an area of 2,445 square kilometers and the total population is 467,000. Zhaozhou County has a mid-temperate continental monsoon climate. In...
addition to basic farmland, a large number of saline-alkali land and waste land have not yet been developed and utilized.

2. Data sources and research methods

2.1. Data source and processing
The remote sensing data of this study is from landsat8 OLI images (USGS, https://glovis.usgs.gov/) in 2013 and 2020, using ENVI 5.3 software to complete radiation calibration, atmospheric correction, geometric correction, mosaic and cutting. After processing, the maximum likelihood method was used to complete the classification of remote sensing images, complete the accuracy verification, and meet the needs of land use change data in the study area, so as to obtain the land use research data of Zhaozhou County. The resolution is 30*30m. According to China’s land use classification system, combined with the characteristics of the current land use, the land use types in the study area are divided into six types of land types: forestland, cultivated land, grassland, reservoir, construction land, and unused land and are assigned codes 1-6. With the support of ArcMap 10.2 software, it constructs land use status maps in 2013 and 2020 (see Figure 1).

2.2. Research method

2.2.1. Build TUPU model. First, determine 30 * 30m as the basic map unit, and then import the two-phase data to perform map algebra operation to synthesize land use change map. The specific formula is:

$$W = 10C + D$$

W is the code value of the newly generated map unit; C is the code value of the map unit at the previous time; D is the code value of the map unit at the next time.

Second, sort the map units generated above. TUPU unit is the basic unit of geoscience information TUPU, which expresses the land use change type in the study period. By sorting the map units in this period, we can find the main types of map changes in the study period and understand their land change characteristics.

2.2.2 Land use change ratio. In order to more clearly express the characteristics of the study area during the spatial and temporal evolution, based on a single land-use map unit, the change ratio is introduced as a quantitative index. The calculation formula is as follows:
\[ V_{ij} = \frac{P_{ij}}{\sum_{j=1}^{n} \sum_{i=1}^{n} P_{ij}} \times 100\% \] (2)

In the formula, \( V_{ij} \) is the change ratio, that is, the ratio of the area of a single land-use change map unit to the area of all land-use change map units; \( i, j \) represent the land use types in the initial and final stages; \( n \) is the number of land use types;

3. Results and analysis

3.1. TUPU analysis of land use change from 2013 to 2020

As can be seen from Table 1 and Figure 2, a total of 36 types of land transfer maps have changed from 2013 to 2020, with a total area of 1054.46 km², of which 18 types of maps have the most significant changes, with a transfer area of 1004.39 km², accounting for 95.25 of the total transfer area ratio. First, cultivated land → unused land has the most significant change (code 26), the transfer area is 213.24 km², and the change rate is 20.22%, mainly concentrated in the satellite branch of Yushu Township, Yang Xiaoxuntun of Xinfu Township, and the new road village, etc. Zhaozhou County is a county town dominated by agriculture. From 2013 to 2020, part of the cultivated land has been converted into unused land. This is due to the accelerated economic development and urbanization during the past five years, which has transformed cultivated land into abandoned land. Second, cultivated land → grassland (code 23), the transfer area is 140.98 km², the change rate is 13.37%, mainly distributed in Shuangjing Village of Xingcheng Town, Deming Village of Xinfu Township, Jiusan Village of Shuangfa Township and Chaoyang The town’s Beidashantun and others are partly due to the arable land being abandoned and gradually evolved into grassland. The other part is that the cultivated land is occupied too much and the artificial grassland is constructed. Third, construction land → cultivated land (code 52), the transfer area is 95.07 km², the change rate is 9.02%, the main transfer occurs in Leyuan Village, Xinfu Township, etc. Finally, the change rate of forestland → reservoir is the smallest, accounting for only 1.00%.

| Coding | Types of land use transfer           | Transfer area (km²) | Land use change ratio (%) |
|--------|-------------------------------------|---------------------|--------------------------|
| 26     | Cultivated land to unused land      | 213.24              | 20.22                    |
| 23     | Cultivated land to grassland        | 140.98              | 13.37                    |

Fig 2. TUPU of land use from 2013 to 2020
3.2. Arising and declining TUPU analysis

As can be seen from Figure 3, the area of newly added grassland was the largest from 2013 to 2020, with an additional area of 345.40 km², mainly distributed in Weixing Ranch, No. 3 Mine Station, Min'an Village and Deming Village in Xinfu Township, Xingcheng Town, And grassland is mainly transferred to cultivated land, forest land and residential land, Dongshuangjingtun in Yongle Township and Nangang Township in Tuogu Township; secondly, newly added unused land with an area of 308.37km², mainly distributed in satellites Ranch, No. 3 Field of No. 2 Mine, Zhaojiatun of Yushu Township, Lubatun of Xinfu Township, Zhonghua Village of Yongle Town and Wangjiagang Town of Tuogu Township; the third is cultivated land, with a new area of 260.24km², the situation is basically spread throughout the county, showing a "spreading" distribution, mainly located in Yushu Township, Xinfu Township, Zhaozhou Town and Chaoyanggou Town; finally, the newly added area of forest land is the smallest, 15.62km².

From 2013 to 2020, the largest decline trend is cultivated land, the shrinkage area is 420.76km², accounting for 39.90% of the shrinkage area. The cultivated land is transferred to grassland and unused land, mainly distributed in No. 3 Station of No. 2 Coal Mine, Yaotun Village and Baochan Village of Xinfu Township and the Xingfu Village in Chaoyang Township; then the construction land, the falling area is 242.65km², and the conversion of construction land is mainly converted to cultivated land and grassland, which is concentrated in Zhaozhou Town and Gonghe Village in Chaoyang Township; the third is forest land, with a shrinking area of 176.25km² in Xinxiang Village in Yongle Town, etc; the shrinking area of the reservoir is the smallest, accounting for only 2.60% of the area, distributed in the waters such as the Bayi Reservoir.
4. Conclusion
With the support of RS and GIS technology, this paper uses 2013 and 2020 as the main data source, and uses the geography information map to construct the land use change map and fluctuation map, in order to analyze the 2013-2020 Zhaozhou County land use change Process, the main conclusions are as follows:

(1) From 2013 to 2020, Zhaozhou County is mainly based on cultivated land, indicating that the economic development of Zhaozhou County is still dominated by agriculture. Grassland, unused land and cultivated land are all showing an increasing trend, of which grassland mainly comes from cultivated land, forest land and construction land, unused land comes from cultivated land, cultivated land mainly comes from construction land and unused land, and these land types change in cycles;

(2) From 2013 to 2020, the land use change map is mainly cultivated land → unused land and cultivated land → grassland, accounting for 33.59% of the change rate. The conversion of cultivated land to unused land and grassland shows that Zhaozhou County is not Agriculture-based county towns are currently starting economic development and protection of the ecological environment, with the least conversion of forest land to reservoirs, accounting for only 1.00% of the conversion rate;

(3) From the 2013-2020 fluctuation graph, we can see that grassland showed the largest upward trend, accounting for 32.76% of the newly added area; the cultivated land showed the largest decline trend, accounting for 39.90% of the shrinking area; the forestland and the reservoir were newly added area and shrunken area are the smallest, accounting for only 1.48% and 2.60% of the proportion.

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