International Journal of Intelligent Information and Management Science
ISSN: 2307-0692, Volume 7, Issue 3, June, 2018

Analysis of Spatial Patterns of Urbanization Supported by GIS Technology

Dong Ouyang,Yuan Zhong, Xiaoting Yang
Hualan Design & Consulting Group, Nanning, 530011, China

Abstract: At present, the research on the spatial pattern of urbanization is based on the application of GIS technology to the urban and rural developments. At the same time, the methods of big data statistics are adopted. However, there are problems in the analysis of the spatial pattern of some cities and towns. In response to these problems, based on the analysis and comparison of the current practice of applying GIS in the spatial analysis of urbanization , by adopting data analysis and other technologies, with the existing urban information and in-depth study of urban development methods, how to improve the analysis of urban spatial pattern characteristics supported by GIS technology is discussed. The conclusion of the experiment is obtained through the analysis of the results of the existing five surveys. The results show that GIS technology is an effective technique of analyzing characteristics of urban spatial patterns.

Keywords: GIS; Spatial analysis; Urbanization; Vertical analysis; Horizontal analysis

1. Introduction

GIS is the abbreviation of Geographic Information System. It is an application technology system for spatial data input, storage, retrieval, calculation, display, update and comprehensive analysis supported by computer software and hardware. After three generations of software improvements, an information system platform with powerful capabilities of data processing and spatial analysis has been formed. As an important part of GIS model and modeling, it has been widely adopted in research. The following content mainly proposes the introduction of some basic elements of GIS model and modeling, and provides basic information for subsequent research.

2. Analysis of Spatial Pattern of the Pearl River Delta with GIS Technology

At present, China is in the acceleration stage of urbanization, and the change of the patterns of villages and towns across the country is tremendous [1].Monitoring and researching urban expansion provides the support fordecision-making of urban development, which is an important means to ensure regional sustainable development. Panyu District is in the central Guangzhou. The impacts of the development of Panyu are significant to Guangzhou. The rationality of the patterns of villages and towns in Panyu District is influenced by a series of natural and social factors, for example, the industrial development and transportation system. This paper employs the remote sensing technology to obtain the spatial changes of the villages and towns in Panyu District in the past two decades, and applies GIS technology to analyze the laws and causes under the changes. It is noted that urbanization has extremely significant impacts on the current changes in urban and rural land use patterns in the Pearl River Delta.

The Pearl River Delta region is at the forefront of China's reform and development. Panyu District is where the channel leading the Pearl River to the ocean in the Pearl River Basin as it locates in the Pearl River Estuary and the geographic center of the Greater Pearl River Delta. Moreover, it is the hub connecting the Zhujiang Port urban agglomeration and the only access to the ocean in Guangzhou. The spatial pattern of the settlements in the villages and towns is deeply affected by the urbanization process, and the urban expansion in this area is extremely rapid [2]. Under the pressure of economic development, it is of great significance to strictly monitor the urban expansion and prevent the rapid expansion of large-scale urban space into a stumbling block for regional sustainable development. By establishing a buffer zone and overlaying the construction information of three land parcels, it can be analyzed that the area of construction land in the rehabilitation area was reduced from 1990 to 2008. In the 1990s and 2000s, the northeast of the resurrection area is still a residential area. According to the image on the Google Earth, it can be seen that in 2008, the northeast of the resurrection area has been changed to industrial land, which is the reason of the decrease in the area of construction land in the resurrection area. The results of the analysis of the five sets of survey data are shown in Table 1.

Table 1. Map Information of Sampling Analysis

Project	Design1	Design2	Design 3	Design 4	Design 5
Coverage probability	5	4	3	2	7
Space cardi-nality	3.75	8.64	5.42	1.26	3.66
Prepaid cost	0.25	0.71	0.49	0.22	0.58
Butt rate	0.27	0.18	0.16	0.21	0.13
Consultation frequency	22.98	56.78	35.25	6698	22.98
Characteristic change	89.66	56.54	75.56	39.78	89.66

3. The Vertical Analysis of Spatial Pattern of Urbanization in Guangdong Supported by GIS Technology

This paper uses remote sensing technology to supervise and classify the three phases of TM data to obtain information of the spatial pattern of the villages and towns in Panyu District in the past two decades. On the ArcGIS platform of ESRI, combined with the traffic data of Panyu District and the economic information of the past 20 years, the spatial analysis technology of GIS is used to find out the regularity and reasons of the spatial pattern changes of villages and towns in Panyu District. It provides an important reference index for the relevant departments of government to adjust the spatial patterns of villages and towns in Panyu District, as well as the technical and theoretical support[3].This study used the Guangzhou area images of Landsat TM and ETM, which were TM data for October 1990 and December 2008 and ETM data for September 2000. Meanwhile, the Guangzhou traffic map was used to determine the spatial location of the settlements in various villages and towns in Panyu District. The traffic data of roads and rivers in Panyu District and the annual economic data of Panyu District were used to analyze the regularity and causes of the changes in the villages and towns.

The general idea of the study is to take preprocess and supervise the image to extract the construction land parcels in Panyu District, and to use the spatial analysis function combined with the traffic, yearbook and other data to analyze the causes and laws of the spatial pattern changes of the villages and towns in Panyu District in the past 20 years[4].The increase of the area of construction land for villages and settlements includes three situations: It increases without changing the center of gravity of villages and towns; the area of village settlements increases and its center of gravity shifts to other directions; two adjacent village settlements merge into one area due to the expansion of the area. The results of analysis are shown in Table 2.

Table 2. Map Information of Sampling Analysis

Project	Design1	Design 2	Design 3	Design 4	Design 5
Coverage probability	83	72	64	59	76
Space car-dinality	58	34	28	90	45
Prepaid cost	22.98	56.78	35.25	38.56	56.54
Butt rate	89.66	56.54	75.56	35.45	45.45
Consultation frequency	54.35	45.45	38.56	38.56	56.54

The area of construction land for villages is increased without changing the center of gravity of villages and towns. By establishing a buffer zone, overlaying and analyzing the construction land information of the three phases, it is found that there are six areas with an increased area without changing the center of gravity of the original villages and towns. They are: Hengjiang area, Pingshan area, Yuangang area, Hualong area. Combined with the traffic data, it can be seen that traffic condition is the most important reason for the increase of construction land in the Pingshan area [5].In addition to traffic conditions affecting the construction land in the two regions, it can be seen from the Panyu Statistical Yearbook that the increases of the per capita living area and population are also the reasons of the changes.

The center of gravity of villages and towns is offset and the area is increased [6]. By establishing a buffer zone, overlaying and analyzing the construction land information of the three phases, it is found that there are three areas where the center of gravity of the villages and towns is offset, they are: Guoling area, Shangni Village area, and Hexing area. Combined with the traffic data, it can be seen that the traffic condition is the cause of the shift of the center of gravity of the Guoling area and the increase of the construction land area. The center of gravity is offset in the direction of the road.

The settlements of adjacent villages and towns merged into one large area due to the increase in area [7].By establishing a buffer zone and overlaying the building land information of the three phases, it can be analyzed that the Xiecun Zhongcun area is merged into one area because the respective areas are increased. The results of the analysis of the five sets of survey data are shown in Table 3.

Table 3. Map information of sampling analysis

Project	Design1	Design 2	Design 3	Design 4	Design 5
Coverage probability	56.78	35.25	6698	80.34	56.54
Space cardinality	56.54	75.56	39.78	22.98	45.45
Prepaid cost	45.45	38.56	27.76	89.66	55.98
Butt rate	55.98	78.35	36.78	54.35	56.54
Consultation frequency	39.78	22.98	56.78	35.25	45.45
Characteristic change	0.27	0.18	0.16	0.21	55.98

4. Horizontal Analysis of Spatial Pattern of Urbanization in Guangxi Supported by GIS Technology

(1)Since the 1980s, the worldwide influence of globalization has been deepened. In this “identical trend” process, the city as the main carrier to promote, undertake and reflect the influence of globalization presents a trend of “one thousand cities”.As a result, it not only violates the principle of coordinated regional development, but also greatly weakens the competitiveness of the city itself.Guangxi has a unique geographical position and has become a typical cultural area since the integration of ancient and multi-ethnic cultures. However, in the process of urbanization, Guangxi's traditional national culture is also enshrined by the strong logic of modernization. The original ethnic group settlements and the urban human landscape have been damaged to various degrees. The urban form has become more and more similar, and the personality has gradually faded, which has affected the competitiveness of Guangxi's cities to some extent.Therefore, how to inherit and carry forward the excellent traditional culture of Guangxi in the process of urbanization, and to demonstrate the charm of Guangxi culture and enhance the competitiveness of Guangxi's cities, has become an urgent problem to be solved.

(2)Urban competitiveness refers to a city that competes with other cities in the context of economic globalization and regional integration. In the process of resource element exchange, it contends and even surpasses actual or potential competitors to obtain lasting competitive advantage. And then the system synergy of city value can be achieved. A competitive city should be a city full of charm. City charm is an accelerator that promotes the rapid development of the city and is the soul of modern cities. The charm of a city comes from urban culture and urban spirit. The sustainable development of a city and the traditional culture of the nation play an invaluable role in promoting it, which is the spiritual pillar of a nation. In the process of urban evolution, the traditional culture of the nation is recorded by the traces of matter, forming the cultural “skeleton” of the city.It alsoplays an irreplaceable role in shaping, demonstrating and maintaining the spirit of the city. Different cities have different urban cultures. In turn, they express their spiritual characteristics. Thesecharacteristics are the soul of urban development and important parts of urban competitiveness.At the same time, culture is the spiritual driving force and intellectual support for social production and development, and it plays an important role in enhancing comprehensive competitiveness and promoting economic and social development.

(3)In the past, Guangxi was a typical province of the frontier, ethnic, poverty, and plateau mountainous areas. The economic development was limited by many factors, and the resources of all parties were far from being comparable to the developed coastal areas.However, the rich cultural heritage of Guangxi is more than that in the coastal economically developed areas. Taking this as an opportunity, Guangxi's cultural undertakings and cultural industries have sprung up everywhere, becoming a cultural and economic phenomenon worthy of attention. Some experts and scholars have summarized it as “Guangxi cultural phenomenon”, because culture is not only developing and growing in Guangxi, but it also has become a "new economy", and it has produced a strong "backwardness" to the Guangxi economy.The "Guangxi Cultural Phenomenon" gives people a profound revelation: in a region with less developed economy, culture as a new economic force can take the lead in achieving breakthroughs. In fact, it is a microcosm of the "new cultural economy" in the west. In China Western Development, a new concept of "new cultural resources" should be established. The development of cultural resources should take precedence over the development of natural resources such as forests, minerals and water.

(4)Regarding to the current uncoordinated cultural and economic development, Guangxi’s main task is promoting the interaction of economy and culture in economic and social development in recent years.Recognizing the dialectical relationship between economy and culture from the ideology, understanding the importance of cultural constructionfrom along term perspective and from the urgency of realizing the new leap of the people and the prosperity of the country, the historical culture, national culture and new modern culture are combined to build an image of Guangxiin a new era.The construction of "Cultural Guangxi" is the macro-decision proposed by the Sixth Plenary Session of the Eighth Plenary Session of the Party Committee of the Autonomous Region as one of the important contents of building a harmonious Guangxi. It is the strategic deployment of implementing the proposal of the Fifth Plenary Session of the 16th CPC Central Committee and achieving the new leap of enriching the people and the country. It is an urgent need to

practice the important thinking of the "Three Represents" and meet the growing spiritual and cultural needs of the people; it is an inevitable requirement for implementing the scientific development concept and building a harmonious society; it is an important way to cultivate new economic growth points and stimulate economic growth. The construction of "Cultural Guangxi" is conducive to promoting the adjustment of economic structure and the transformation of growth mode, facilitating the coordinated development of economy and society, helping to improve the overall strengths and comprehensive competitiveness of Guangxi, speeding up the pace of enriching the people, and building a well-off society, which has strategic significance. The characteristics of the town are the overlay of natural characteristics, environmental characteristics, morphological characteristics, architectural features, industrial characteristics, cultural characteristics, landscape features, etc., which are the differences in urban individuality between cities and towns, especially the differences between the urban material form and the "potential position".

(5)In the process of urban construction in Guangxi, only by further emphasizing the "cultural Guangxi" and the shaping of local urban characteristics can the government consolidates the integration of various urban resources in Guangxi. Therefore, the power, vitality and core competitiveness of urban development are generated to promote the sustainable development of the city. At present, this causal effect has already appeared in several towns and cities in Guangxi. With the implementations of the strategy of developing the western region and the establishment of the China-ASEAN Free Trade Area, the location and role of Nanning, the capital of Guangxi, is becoming more and more significant, and its cultural image is becoming more and more important. Based on the sustainable development of the city, Nanning has created the characteristics of "China Greentown" and the city brand, and achieved practical results in the construction of human settlements: In 2000, UN-Habitat awarded Nanning the title "Good example of improving living environment in Dubai"; in 2002, Nanning won the first "China Habitat Environment Award"; in 2007, Nanning won the "UN Habitat Award ."

(6)The nesting and leaching project in urban environment and infrastructure construction has created excellent conditions for the overall leap of Nanning, providing a hardware foundation for important "events" such as the International Folk Song Festival and China-ASEAN Expo. Grasping all kinds of favorable conditions, the development of Nanning has shown a leap-forward situation. In the past master plan of Guangxi, urban landscape planning as a special plan has received attentions, but it is generally in a state of dispensable planning "edge" for the lack of systematic and theoretical summary. Today, as urban landscapes are increasingly valued, some towns have begun to actively shape urban features in the form of "urban characteristics", but such "research" often has no legal effect. For example, "Research on the Characteristics of Urban Features in Laibin City", although the research has been evaluated by experts and won unanimous praise, there is no planning approval, which brings certain difficulties to the implementation and control of urban style. Therefore, regardless of whether we plan the city in the form of "research" or "special planning" in the future, we should turn it into a legally effective plan to ensure the control and implementation of scientific and rational urban features through the general rules, or through local administrative regulations. The results of the analysis of the five sets of survey data are shown in Table 4.

Table 4. Map Information of Sampling Analysis

Project	Design 1	Design 2	Design3	Design4	Design5
Coverage probability	83	72	64	59	76
Space cardinality	58	34	28	90	45
Prepaid cost	22.98	56.78	35.25	38.56	56.54
Butt rate	89.66	56.54	75.56	35.45	45.45
Consultation frequency	54.35	45.45	38.56	38.56	56.54

5. Acknowledgment

Using the spatial autocorrelation index and the average growth index to determine the overall characteristics and hotspots of the new urbanization pattern evolution, adopting the spatial variogram to reveal the spatial variation and driving mechanism of the new urbanization pattern evolution, are GIS technologies applied in the urban spatial pattern analysis.

References

[1] Zou Lianzhao. Analysis of urban landscape spatial pattern based on GIS technology [J]. urban construction theoretical research: electronic version, 2018(18):35-40.

[2] Analysis of spatial pattern characteristics of urban green space in Wuhu based on GIS [J]. resource development and market,2017(35):235-236.

[3] Shen Shujuan, Sun Yizhong, Zhao Xiaoqin. Research and expression of urban spatial pattern elements based on GIS[J].,2017(20):00236-00236.

[4] Wang Chang Xin Chang. Analysis model of spatial-temporal structure evolution of urban land use based on GIS technology [D]. Wuhan University, 2016(6):68-69.

[5] Zhou Lan, Ye Bin, Wang Furong, et al. Research on digital restoration of urban historical spatial pattern based on GIS -- Taking Nanjing as an example, [J]. planner,2017(29):73-74.

[6] Li Hong, Jie Yao Wen, Liang Dongxu. Study on the spatial pattern of Lanzhou in Qing Dynasty based on GIS and historical map [J]. mapping and spatial geographic information, 2018(2):57-61.

[7] Ding Xueying, Hong can, Xiong Zi, et al. Analysis of spatial pattern and influencing factors of commercial housing prices in Changsha based on GIS [J]. tropical geography, 2012, 32(4):423-428.

[8] A study on the temporal and spatial variation of urban land use based on GIS technology -- Taking the land use change in Haizhuqu District of Guangzhou as an example [J]. Zhongshan University, 2017(35):235-236.

[9] Di Ying ya. Research on urban social spatial pattern in Yanji based on spatial statistical analysis and GIS [D]. Yanbian University, 2018(35):2358-2362.

[10] Yang Zhandong, Wang Libin. Based on the spatial pattern analysis of GIS urban expansion, [J]. geospatial information, 2011, 09(3):12-14.

[11] Chen Liyan, Fang Yuan. Spatial pattern analysis of cultivated land circulation in Dongguan based on GIS and RS [J]. Journal of Huanggang Normal University 2012, 32(3):37-40.

[12] Song Linqi. Dynamic analysis of spatial pattern of green space in Shenyang based on RS and GIS [J]. theoretical research on Urban Construction: electronic version,2012(29):235-236..

[13] Zhang Qichun. Research on spatial pattern of urban land use based on GIS -- Taking Haizhuqu District, Guangzhou as an example, [D]. Zhongshan University. 2017(35):235-236.

[14] Cai Zhimin GIS supported the study of public open space in Tianhe District, Guangzhou [D]. South China University of Technology, 2016(34):787-879.

[15] Nie Yan, Zhou Yong, Chen Jie. Analysis of the spatial pattern and dynamic prediction of land use based on GIS and GM -- a case of the city of suitable city [J]. Journal of Huazhong Normal University (NATURAL SCIENCE EDITION), 2018(35):46-67.