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GIS-BASED ANALYSIS OF URBAN LAND-USE CHANGES
— A Case Study of Haizhu District of Guangzhou City, China

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ABSTRACT: This paper describes a GIS-based spatial analysis method that combines qualitative analysis and quantitative analysis to characterize land-use patterns and predict the trend of future land-use changes in Haizhu District of Guangzhou City, China. Spatial technique is introduced to manage land-use data and derive information of land-use changes. Through the case study for the selected area, it is demonstrated that the method and technique introduced in the paper can be effectively utilized for the analysis of urban land-use changes. Based upon this analysis, the paper also provides discussions and recommendation on urban land-use planning, urban planning and land management. Both land-use maps of Haizhu District of Guangzhou in 1995 and 1997 and the remote sensing images of 1999 are utilized in the current research. It is convenient to get various statistic data and to combine attribute data with spatial data so as to analyze land-use changes in a geographic context, which is especially suitable for the need of urban construction department, urban management department and urban planning department.

KEY WORDS: GIS; land-use; spatial analysis; overlay analysis

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1 INTRODUCTION

Major characteristics of urbanization include: urban construction is continuously spreading, the demand for urban land use is rapidly swelling, and a lot of agricultural land is converting into non-agricultural land. When these characteristics are reflected in urban system, the developing speeds of big cities and super cities are quickening (CHEN, 1999). Based on the condition of market, land resource bears three types of values which are respectively social value, economic value and ecological value. The external expressive form of the interaction of these different values is that the amount of population, economy and land use increases in a given geographic area. Serious problems addressed on sustainable urban development include how to properly make use of limited land resources, how to balance actual land use capacities and theoretic capacities, how to scientifically appraise the benefit of urban land use and how to improve the capacity of urban land use (CHEN and PETER, 2000). A simple survey of land use changes in general is not adequate for a thorough understanding of the conditions and factors of various types of urban land-use changes. Instead detailed analysis of urban land-use patterns, changes of these patterns, and underlying conditions as well as development directions will be necessary (ZHANG *et al.*, 2001). Using GIS, it is convenient to make various statistic data be spatialized and to combine attribute data with spatial data so as to analyze land-use changes in a geographic context, which is especially suitable for the need of urban construction department, urban management department and urban planning department. In a GIS environment, various data of land use and remote sensing images can be effectively manipulated and analyzed, which can form a critical basis for

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land-use studies, particularly in deriving dynamic land use patterns and synthesizing land-use changes (CHEN and PETER, 2000).

2 RESEARCH METHOD

2. 1 The Selection of GIS Tools

A commercial GIS system, GeoMedia4. 0 from Intergraph, has been selected to manage spatial data and to provide the needed analysis for the current research. The reason for this selection is that the software provides advanced spatial database technology to allow effective integration and analysis of attribute data and spatial data. With the software, data in different format can be easily converted and integrated. Spatial data and attribute data of the same spatial features can be combined after these data are imported into the system. Through overlay analysis, it can combine different categories of spatial and attribute information (e. g. land-use maps and socio-economic data in different times) in the same geographical space, which forms a key ability in the analysis of urban land use.

2. 2 The Selection of Study Area

This research selects Haizhu District in Guangzhou City as the study area. There are two major reasons for this choice: 1) Haizhu District is surrounded by the Zhujiang River. Therefore, the study area can be conveniently defined. The selection of such a study area also allows a natural delineation of the research region and can eliminate the influence of unnecessary factors for the analysis. 2) Haizhu District represents a transition zone between city and countryside. With continuous urbanization, land-use changes frequently in this district. Because of that, it can serve as a very good testing case for land-use change studies. Haizhu District includes Haizhu Island, Gongzhou Island in the east and three Yahuansha oases encircled by water. The whole area is 94. 25km^2. It is a relatively new region with a fast developing speed.

2. 3 Database Development

The database used for this study consists of two parts, which are respectively basic information database and special subject information database. Land-use maps are the core of the basic database. The basic database also includes urban cadastral maps, land-use planning maps and large-scale relief maps. Special subject information database contains two types of information. One is land management information, which covers land construction and land development, the other is statistic information of society and economy, which is related to socio-economic conditions and land quality. The land use represented on the land-use maps can be divided into eight first-grade sub-classes based upon the national classification standard of land use (YAO and SHUAI , 1995) . But there are only 28 secondary-grade sub-classes in this district because there are only 28 among 47 secondary-grade sub-classes. The detailed classification is indicated in Table 1.

Table 1 Classified system of land use in Haizhu District

First grade types	Secondary grade types
Cultivated land	Irrigated paddy field, irrigated field, dry land, vegetable plot
Garden land	Orchard, other garden plots
Woodland	Forest land, shrubbery land, pre-forested land, nursery land
Grassland	Artificial grassland
Residential and industrial and mining area	Cities and towns, rural residential area, independent industrial and mineral land, special land
Transportation land	Highways, rural roads, ports and docks
Water area	River surface, pond surface, ditch, shallow-tidal-flat area
Unused land	Barren land, sand land, grassless land, raised path through fields, beach land, others

2. 4 Technical Approach

The spatial variation and changes of land-use patterns over time is the focus of the analysis. This analysis is accomplished mainly through using of GeoMidia4. 0. To achieve the research objective, GIS functions are either used separately or bundled to form sophisticated analytical capabilities. The general procedure is listed in Fig. 1.

3 CASE ANALYSIS

In the research, land-use maps and satellite images in three time periods (1995, 1997, 1999) are utilized