

URBAN EXPANSION AND LOSS OF AGRICULTURAL LAND IN THE NORTH OF HOCHIMINH CITY: A GIS AND REMOTE SENSING APPROACH

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ABSTRACT

Hochiminh City is a big one of cities in Vietnam. Before 1945, there were about 400,000 inhabitants living in Hochiminh City. During the last two decades, it became the biggest industrial and commercial center. In accordance with statistics in 2004, its population was about 6 million people. In particular, the North of Hochiminh city, population just made up around 1,2 million people. Agricultural activity is the main income of this area. Within 15 years recently, due to urbanization and emigration from the other provinces the population explosion became serious issue. The conversion of the agriculture land into residential has increased more and more, bringing about changing land-use structure.

This paper describes the GIS and remote sensing capacity in detecting and analyzing the spatial changes as well as quantifying the results to show the urban growth process, impacting the land-use distribution of the North part of Hochiminh city.

1. INTRODUCTION

In recent years, human activities have been recognized as a major force shaping the biosphere. In Vietnam, land use and land cover patterns have undergone a fundamental change due to rapid economic development under its economic reform policies. Urban growth has been speed up and extreme stress to the environment has occurred. This is particularly true in Hochiminh city where agricultural land is disappearing each year, converting to urban or related uses. Furthermore, because of the lack of appropriate land use planning and the measures for sustainable development, rampant urban growth has been creating severe environmental consequences.

Agriculture and rural areas belong to general socio-economic structure of Hochiminh city with advantage of geographical location; exist as a suburban of the big commercial, industrial, scientific city. The city have taken full advantage of location, exploited strength of industry, service, science and technology to serve the development of agriculture and rural areas. Recently years face with requiring city expansion, part of suburban was urbanized. Suburban agriculture has intended in transforming ecological and high-tech agriculture, according with strategy of developing a civilized, modern and environmental sustainable city.

The integration of remote sensing and geographic information systems (GIS) has been widely applied and been recognized as a powerful and effective tool in detecting urban land use and land cover change. Satellite remote sensing collects multispectral, multiresolution and multitemporal data and turns them into information valuable for understanding and monitoring urban land processes and for building urban land cover datasets. GIS technology provides a flexible environment for entering, analyzing and displaying digital data from various sources necessary for urban feature identification, change detection and database development.

2. STUDY AREA AND URBAN DEVELOPMENT

Hochiminh city has a very favorable geographical location in the centre of rich Southern region with many resources, distant about 1,738 km from Hanoi in the direction of South – East. It has the common administrative boundary with Long An, Tay Ninh, Binh Duong, Dong Nai, Baria – Vungtau provinces. Its natural surface area is about 209,502ha, among them 45% of land is agricultural. The land of the city is formed by old and recent alluvions, having poor fertility of soil, not suitable for development of annual crop production (Institute of Economic Research, 2005) (figure 1).

For historical conditions, Hochiminh city is former monocentricity or megacity. Before 1975, activities of economy, finance, culture, education, commerce mainly were concentrated in districts 1, 3 and part of district 5. From 1990 up to now, population has rapidly increased from 4,4 millions to 5,5 millions persons in 2002 (Nguyen Minh Hoa, 2003). In addition, massive emigrant situation from other provinces caused Hochiminh city overloaded. There had a time the city did not controlled unplanned construction and urban expansion encroaching suburban agricultural land.

Confronted with this situation, the improvement, expansion and development of the old urban areas, the urbanization of surrounding areas and new urban construction become indispensable requirement. With the geographical specialty of Hochiminh city, the development of the urban districts towards the North, enlarged to East and West, becomes the advantage for housing construction and civil projects. It is a direction of main urban expansion for recent years.

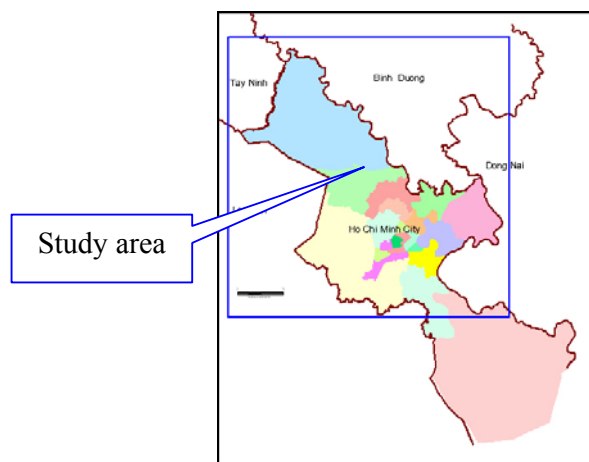


Figure 1. Map of the study area

3. METHODOLOGY

This study based on remotely sensed data (satellite images) combined with fields check and existed maps. Land use / cover patterns for 1989 and 2002 were map by the use of Landsat TM and ETM data (Dates: 16 January 1989 and 13 February 2002). Five land use / cover types are identified and used in this study, including: residential area, agricultural land, grass, bare land and water. As the first step before classification took place the NDVI was calculated and stacked to the spectral images layers as an additional synthetic band. In order to compare the two classification results a Maximum Likelihood Classification was carried out for each image. Then for analyzing the nature, rate and location of urban expansion in compared with loss of agricultural land, an image of residential area was extracted from each original land use / cover image.

The urban expansion image was further overlaid with some geographic reference images to help analyze the patterns of urban expansion, including image of district boundary, major roads. These layers were built in a vector GIS environment and converted into a raster format.

4. RESULTS

As results of urban expansion population explosion is the main reason. Hochiminh city is the biggest industrial, commercial center in Vietnam. The high economic growth and abundant employment opportunities caused influx of labor immigration. Local increase of population plus immigrants made the city become too stuffy. In statistics, the urban population has increased 2 times from 1975 to 2004. The population density in urban districts in 2004 is reported as of 10,313 persons per square kilometers (Statistical Office, 2004). As housing demand and city development, agriculture land is transformed into land for housing, roads and industry.

From the source of Department of Natural Resources and Environment, the main land use structure of Hochiminh City as shown in table 1.

Table 1. Main land use structure of Hochiminh City over years

(Source: Department of Natural Resources and Environment)

Land use / Year	1995	2000	2005	1995 (%)	2000 (%)	2005 (%)
Total (ha)	209,376	209,502	209,554	100	100	100
Built-up land	31,196.34	38,571.07	50,738.27	14.90	18.41	24.21
Agricultural land	100,366.37	97,247.78	89,659.14	47.94	46.42	42.79
Forest	34,657.58	33,472.15	33,857.88	16.55	15.98	16.16
Water	34,153.02	34,011.29	33,035.51	16.31	16.23	15.76
Unused land	9,002.96	6,199.54	2,263.67	4.30	2.96	1.08

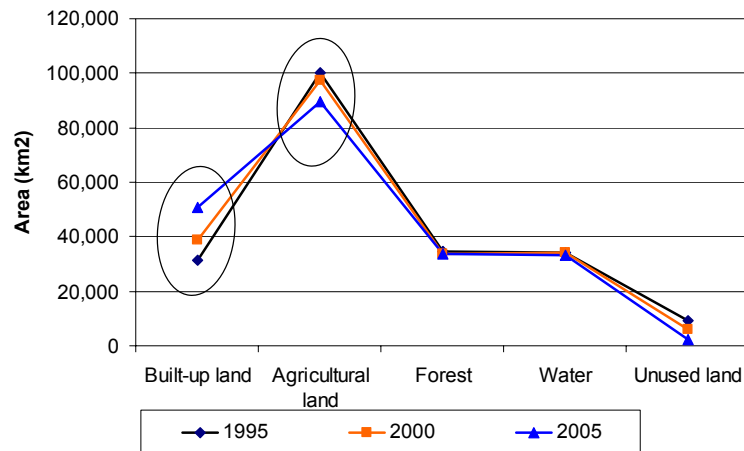


Figure 1. The evident change of built-up land and agricultural land from 1995 to 2005

By the whole city, built-up land increased and agricultural land decreased mainly in the Northern part of the city. As shown in Figure 2 the settlement in this area presented a rapid expansion and concentrated in urban districts and along the main roads in the suburban area, where the agricultural land yielded to property development. Most evidently built-up area appeared in the districts: Go Vap, 12, 2 and Binh Chanh.

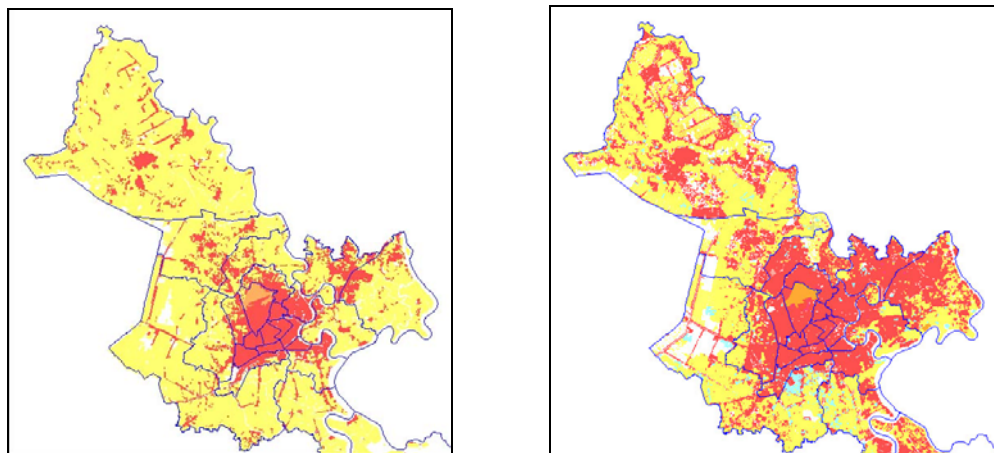


Figure 2. Results of urban expansion in the Northern part of Hochiminh City in 1989 and 2002 from remotely sensed data

In results of remotely sensed interpretation, in 13 years from 1989 to 2002 the disappearance of agricultural land was shown by 14,697 ha, otherwise the land for built-up areas increased to 15,345 ha (including small part of unused land transformed additionally).

5. LOSS OF AGRICULTURAL LAND DUE TO URBAN EXPANSION

Due to uncontrolled rapid urban expansion, loss of agricultural land has changed the aspect of Hochiminh city. The bad alum land, cultivated without benefits, has turned into

developed residential areas, has satisfied housing demand for population explosion. However, this made a face with problem of ecological unbalance and traditional agricultural trade villages. Such as floricultural village Go Vap was disappeared, now a few points of decorative plant trade exist as the reminder of this tradition. Low-lying land areas cultivating wet rice (district 2) were place for balancing the drainage, but construction and concretezation process made flow looking to narrow sewerages, or the altitude raise of new urban areas caused flow into lower old urban areas and instant inundation in the city centre. Besides, when agricultural land changed into urban areas, due to be not synchronous development only a few groups of rich people have good living level, nearly all of farmers who used to be long-lived in their farmland, fall into poor and difficult life. These figures clearly point to the magnitude of the problem.

6. CONCLUSIONS

In this study, an intergrated approach of remote sensing and GIS was developed for evaluation of rapid urban expansion and loss of agricultural land. Results revealed a notable increase in urban land use / cover between 1989 and 2002. Built-up areas has increased in all directions but this is more concentrated to the North, West to East of the city.

Finally, although urban expansion cannot be stopped, with proper management and planning it can be directed in a desirable and sustainable way, protecting fertile agricultural land and ecological areas, creating green belt for the city.

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