The Spatial-temporal Changes of the Land use/cover in the Dongting lake Area of Central China during the Last Decade

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Abstract: Based on the Chinese resource and environment database, and using the Landsat TM and ETM data acquired in 1990 and 2000 respectively, the spatial-temporal characteristics of land use/cover changes in the Dongting lake area of central China was analyzed. The result showed that cultivated land decreased by 0.57% of total cultivated land. Built-up land and water area expanded, with an increase of 8.97% and 0.43% respectively. 94 percent of the cropland decreased was changed into water (mostly to fishpond) and built-up areas. Land-use changed most quickly in cities, and the slowest in the north and east of the study area.

Keywords: Land use/cover change, Dongting lake area, Remote sensing

1. Introduction

Changes of land cover and land use are of the most importance among human alteration of the Earth's land surface [1]. The research on the land use/cover change is one of the frontiers and the hot spots in the globe change research. With the rapid development of the technologies of remote sensing and GIS, mapping and monitoring land use and land cover develops rapidly and becomes more systematic, objective, rapid and correct [2,3].

Dongting Lake area lies at the south of Jingjiang River, the middle Yangtze River (Fig.1), and the lake is the second fresh water one in China. The rapid growth of population and economics as well as the natural deposition and the reclamation in history made the area one of typical cases of the regional study of the land use/cover change in China. Before the mid-1980s many researches had addressed on the reclamation, the deposition of silt, land use and the flood disaster in the region. After the mid-1980s, the change of land use/cover in the area has been seldom studied explicitly.

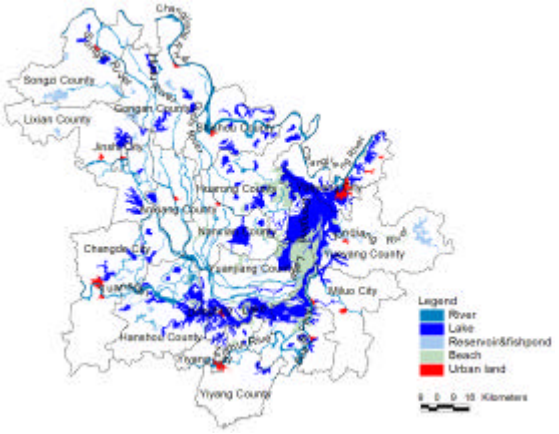

Fig.1. The sketch map of the Dongting Lake area

2. Data and methods

1) Data

The spatial data of land use change in our paper came from the national resource and environment database [4].Moreover, Landsat TM or ETM data, which were captured in 1990 and 2000 respectively, were used for extracting the land use change information while topographic map、regional thematic research data and maps were consulted.

2) Methods

Based on integration of remote sensing and GIS and used the knowledge of specialists and the data of fieldwork, the interpretation of image, after the images selected is geometric corrected, was conducted on the monitor of computer. Firstly, in this paper, a two-level classification system was applied. There are six types in the first-level, which were farmland, woodland, grassland, water body, built-up land and unused land. In the second-level of the classification, there are 19 types. As example, the cultivated land is divided into paddy field and dry land. Secondly, geometrically registration between images and base map of land use in the China resources and environment database was conducted. The last step is to detect the land use change, to draw out the change patches, and to establish the database on land use/cover dynamic.

3.The spatial-temporal characteristics of the land use/cover change

1) The change of land use/cover

The results indicated that areas of farmland and woodland decreased, and of water area、grassland、built-up area and non-used land increased, during the period from 1990 to 2000. Among the land use types that areas decreased, the cultivated land decreased most, the amount of the area decreased is up to 8984 ha, the proportion in the total area declined from 55.51% to 55.19%(Table 1), and the decreased rate was 0.57% of the total farmland during the 10 years. In the sub-classification of cultivated land, the area of paddy field decreased 5826 ha, and the dry land area shrank by nearly 1/2 of the paddy field. The area of woodland decreased 925ha.In detail, the areas of forest and shrub increased a little, but the total increased area was far less than the total decreased area of sparse wood and other woodland. Among the land use types that areas increased, the area of built-up area increased most, up to 7473 ha, and the proportion increased by 0.26%. Compared to 1990, its increased rate was 8.97%. The urban land and industrial land expanded more than 3800 ha and 2800 ha respectively. Rural residential land increased a little, and the part of the reason is that some pitches can't be extracted and counted duo to the too small size. Another land use type whose area increased remarkably was water area, with an increase of 1586ha, about 0.06% of the overall area, and the increased rate got to 0.43%. In more detail, there increased 2600 ha area of beaches along lakes and rivers, and did some lakes area. But the area of reservoirs, fishponds, and other ponds decreased 779 ha. The increase of the area of grass and non-used land was very small, only 642 ha and 208 ha respectively.

Table 1. Change of land use/cover structure in the study area (%)

	1990	2000	1990-2000
Farmland	55.51	55.19	-0.31
Woodland	20.36	20.33	-0.03
Grassland	0.92	0.94	0.02
Water body	17.68	17.74	0.06
Built-up land	2.82	3.08	0.26
Unused land	2.72	2.72	0.01

2) The conversion of land use/cover

As shown in table 2, there were 6652ha and 5534ha (sum up to 94 percent) area of the decreased cultivated lands was changed into water and built-up areas respectively. Though there was 3658ha water area changed to cultivated land, and made up to the loss of the cultivated land partly, the main conversion was from cropland to lake、fishpond and residential . The area of forest decreased was mainly converted to built-up land, and most of remains were transformed to farmland. For sub-class, there was 568ha forest changed to industrial and mining land, and 312ha to urban land. The most of the water area increased was changed from paddy field. From 1990 to 2000, there was 6652ha cropland changed to water area totally, most to fishery pond. Besides, the

rest of increased area of water body came from grassland and unused land, hardly from forest. So it also showed that the reclamation was curbed effectively in the lake area. The expansion of every kind of built-up land was very obvious, too. The increase area came from different land classes. 74%(5534ha) of increased area came from cultivated land, while 21% from forest. 67% of cultivated land loss was from paddy field. None of built-up land changed to others.

Table 2 Conversion of land use/cover in the Dongting lake area from 1990 to 2000 (ha)

	fl	wl	gl	wb	bl	ul
fl	----	773	0	6652	5534	59
wl	353	----	46	22	1561	0
gl	23	205	----	282	102	0
wb	3658	60	1208	----	256	352
bl	0	0	0	0	----	0
ul	0	19	0	164	20	----

In table 2, the element fl refers to farmland, wl to woodland, gl to grassland, wb to water body, bl to built-up land and ul to unused land.

3) The regional differentiation of land use/cover

In order to comprehensively reveal the regional differentiation of land use/cover change, the degree, defined as Liu Jiyuan [3], for every county and city were calculated. It revealed that with well economic condition and more population, Shishou City, Yueyang City and Jinshi City, had the high dynamic degree of more than 20, suggesting the greatest changes of land use/cover in the region. Obviously it was the social and economic forces that driven the land use changes in these cities. Gongan county with higher dynamic degree of 16.97 is located in the west of Dongting Lake area, which indicated that the west of the Lake area is still the influenced strongly by human activity. The land use changed rate was smallest in Yueyang County, Huarong County, Miluo County, Xiangyin County and Nanxian County, which distributed near the east and southeast of the Dongting Lake area. The amounts of dynamic degree for all these counties are less than 5. Due to the slowly growth of economics and population in the 5 counties and to lower sediment deposition in the east and southeast of the Dongting Lake area, the land use/cover changes in these counties were not as fast as in other areas.

4.Conclusions and discussion

Integration of geo-analysis of satellite image and GIS methods is one of the best ways to explicitly monitor the spatial-temporal changes of land use/cover. Using this method, in this paper, the database of the land use/cover dynamic change from 1990 to 2000 was built up rapidly. The result shows that cultivated land area decreased 0.5%, built-up land increased 8.9%, and water body increased 0.43%. 94 percent of the decreased cultivated lands were changed into water (mostly to fishpond) and built-up areas. The reclamation was curbed effectively in the lake area. Shishou City, Yueyang City and Jinshi City were the area where the land use changed rapidly. All of them are city-level districts, and have well economic condition and more population. The slowest changed area existed in the counties near to east and southeast of the lake area.

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References

[1] Eric F.Lambin, B.L.Turner, Helmut J. Geist, et al.,2001. The cause of land-use and land-cover change: moving beyond the myths. Global Environmental Change, 11: 261-269.

[2] D.S.Alves, 2002. Spatial-time dynamics of deforestation in Brazilian, Amazônia. International Journal of Remote Sensing, 23(14): 2903-2908.

[3] Liu Jiyuan, Buheaosier, 2000. Study on spatial-temporal feature of modern land-use change in China: Using remote sensing techniques. Quaternary Sciences.20(3): 229-239. (in Chinese)

[4] Liu Jiyuan, Liu Mingliang, et al.,2002.The land use and land cover change database and its relative studies in China. Journal of Geographical Sciences. 12(3):275-282.