LAND USE CHANGE OF SANJIANG PLAIN--THE MIDDLE REACH OF THE AMUR RIVER*BASIN IN CHINA AFTER 2000 YEAR

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1. STUDY AREA AND DATA

1.1 Basic Situation of Study Area

Sanjiang Plain, located in the middle reach of Amur River* and belongs to the Heilongjiang Province of Northeast China as a low floodplain, was formed by the Heilongjiang River, Songhuajiang River and Wusulijiang River. It include five regions—Hegang,Jiamushi,Shuangyashan,Qitaihe and Jixi Cities.Our study was conducted within a 10.89×10 km^2 region(45°01’05”N ～ 48°27’56”N ， 130°13’10”E ～ 135°05’26”E),which accounts for 22% of land area of Heilongjing Province. Its topography is high in the southwest and low in the northeast and is characterized by broad alluvial plains and low terraces formed by the river, as well as a wider development of the floodplain marsh and swamp meadow, The climate in this area belongs to the temperate humid or sub-humid continental monsoon climate, with a mean annual precipitation of 500-650 mm .Average temperature is –18°C in January and 21-22°C in July. Most of the rivers in the area have the characteristics of the wetland river: the slight gradient and large channel curve coefficient, generally between1.5 - 3.0. Vegetation types are mainly swamp meadow and marsh vegetation of Changbai flora. There are five main soil types: meadow soil,brown soil,lessive, swamp soil and black soil. The natural fertility of the soil is high. In the past 50 years, the land use / cover of study area has been changed dramatically ,which produced a series of environmental problems.But it has been grasped exactly for long time series land-use change of long time series in the Sanjiang Plain . Especially there has been the lack of quantitative research on the process of wetland reclamation and its environmental effects.

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* It’s named Heilongjiang River in China

1.2 Data

The Sanjiang Plain land-use database was divided into two periods: 2005 and 2000. Because data sources of different periods are different, they were treated in different ways: the data sources of 2005 were the CBERS images with a resolution of 23 m, accompanied by a Landsat ETM scene; the data

Sources of 2000 were Landsat TM satellite images with a resolution of 30 m. Land use / cover data were obtained as follows: 1:100000 topographic maps were scanned into the computer and were projected. l: 100000 topographic maps were the master data sources, the Landsat TM (ETM) data of 2000 were registered by l: 100000 topographic maps. In the GIS environment, according to image color, texture and other characteristics of different land cover types, corresponding interpretation marks of remote sensing were established. According to man-machine interactive interpretation, checking for mistakes, modification and splicing, land use / cover data of 2000 were obtained. Remote sensing images of 2000 were geo-referenced and they rectified the CBERS images of 2005 respectively. The rectification was less than 2 pixels. In the GIS software ArcView, the dynamic map spots of the adjacent two periods for various land use types were extracted, and land-use dynamic data of different periods were obtained. At the same time, land use / cover present data of 2005 were obtained. Total factor 1:100 000 topographic maps were taken as a data source. Data processing platform were ENVI 4.0, ArcView 3.2. and ArcGIS 9.0.

According to the characteristics of the study area and analytical precision, refering to "Land-use Survey Technical Regulations" and "China's Resources and Environmental Remote Sensing Survey and Macro-dynamics Study", land-use types of study area were merged and were divided into 7 types to be analsysed statistically. These 7 types of land use were cropland, woodland, grassland, water body, Urban and rural industrial and mining land, unused land and wetland. Meanwhile, wetland includes marshes, beaches and other natural wetlands and excludes artificial wetlands. Corpland includes dry land and paddy field. During the course of land use information extraction through the use of topographic maps and remote sensing images, the land use maps data of different time periods, various sources were applied (such as topographic maps of different periods, the Sanjiang Plain vegetation maps, land-use planning maps, investigative land resources maps of various counties and cities, swamp maps, etc.), which were supplementary reference to improve the interpretation accuracy. Because there are some land type boundaries were not very clear in the topographic maps, and because data were from different sources. There existed mismatches to some extent between the data accuracy and spatial interpretation data of MSS and TM images.

2. THE CHANGE OF LAND USE AFTER 2000 YEAR

Change in the total area of different types gave expression to change in the number of land use types. Through the analysis of land use / cover change in the total amount of the type. We can grasp the general trend of land-use change and structural variations. In this paper we gathered statistics (Table 1) of land use graphics data (Figure 1)of the two periods respectively.

During the period of 2000-2005, the area increase of corpland in Sanjiang Plain was still relatively large. Area growth rate increased from 48.16% to 51.17%. Wetland and woodland reduced. Wetland decreased from 112206 hm^2 to 958 716 hm^2. It showed that the Sanjiang Plain wetland reduced rapidly; the forest area declined further. Area percentage decreased rapidly from 33.22% to 31.63%. In five years time, the area decreased 162048 hm^2. The statistical analysized result of forest land reclassify showed: during this period the decrease of forest area was mainly because the land near the sides of the road, residential land, woodland and bush land near farmland were used for cultivated. Field trips in 2006 testified further about our findings. Grassland and water area changed less. Residential land and the build-up land area continued to decline. In the 5-year period the total area reduced 10926hm^2. The average annual reduction was 2185hm^2. In the study, we only gathered planar statistics data. Linear features such as roads did not compile statistics. So the conclusion did not consider the case of road construction.

Tab．1 Land use changes in Sanjiang Plain after 2000 year

Year			Farmland	Forest	Grassland	River & lakes	Settlement	Unused land	Wetland
2000	area	(hm^2)	5240891	3604376	420625	282199	222359	1433	1122066
	(%)		48.16	33.12	3.86	2.59	2.01	0.01	10.31
2005	area	(hm^2)	5568845	3442328	419992	280201	211433	1806	958716
	(%)		51.17	31.63	3.86	2.57	1.94	0.02	8.81

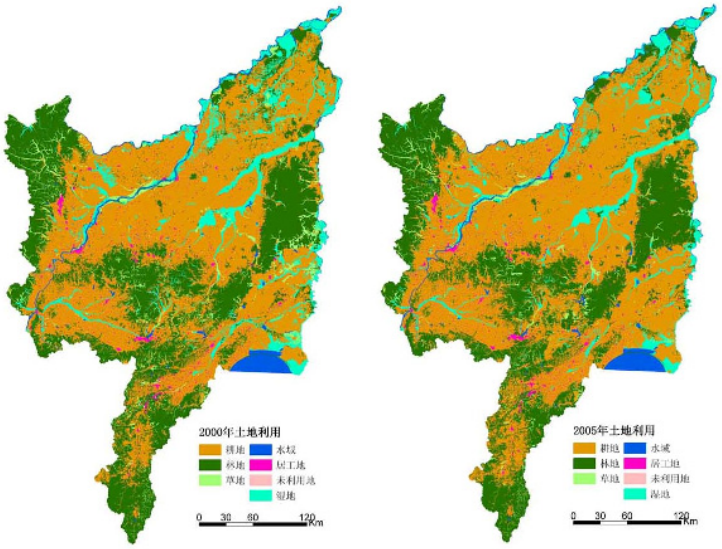

Figure 1, land use graphics data of the 2000 and 2005 year

Land use degree mainly reflects the influence degree of human factors in land system. The land system itself is a complex natural and social complex. Any time, the land use is a comprehensive result of natural and social factors. In the study, we took 5 km × 5 km grid as the statistical unit to calculate the spatial distribution of the Sanjiang Plain land-use pattern.

3. DRIVING FORCES ANALYSIS OF SANJIANG PLAIN LAND USE CHANGES

Land use / cover change reflects the interaction between man and nature relationship. The problems of the change impact and driving mechanism are research key issues of land use / cover change. In different regions, land use / cover change factors were different and the maindriving factors are different. Various factors promote or cancel each other. Driving forces and land use /cover change has a temporal and spatial relationship. Sanjiang Plain belongs to the state grain production base. It can be cultivated both in non-irrigated agriculture and in a good water conditions. It is located in the temperate humid and semi-humid continental climate zone. Under the constraints in various factors, patterns and intensity of land use changes significantly.

3.1 Regional Land Use and the relationship between population growth

Since the founding of new China, with economic development and developing and constructing the borderland of national attention, a large number of peasants, People's Liberation Army officers and soldiers who were demobilized and educated young people moved to the area. The population grew rapidly. In 1949, the population in the study area was only 1.399 million people. The average population density was 12.84 persons km^2: By 2005 the region's population has increased to 8.732 million people. The average population density was up to 80.35 km^2. The populations were 6.24 times as many as 1949. Meanwhile in Heilongjiang Province and the Northeast region, the population grew 2.71 times and 1.79 times respectively. It could be seen from this that in the study area's population growth rate was significantly higher than in Heilongjiang Province and the northeast region. According to the Statistical Yearbook of Heilongjiang Province and Sanjiang Plain-owned Bureau of Reclamation statistics, it was obtained that how the total population of all cities and counties in the Sanjiang Plain and the agricultural population in a few study periods changed. Then we analyzed the basic trends of land use situations.

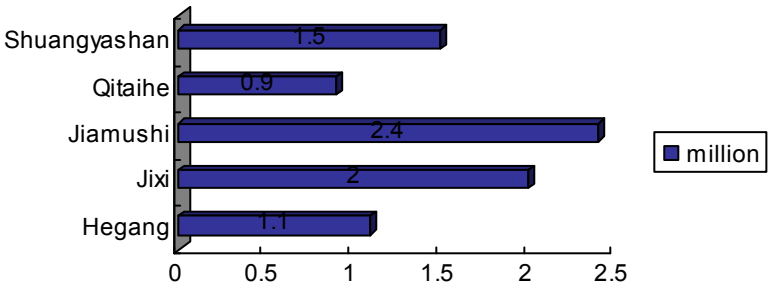

Figure 2, The population of the five regions in 2005 year

3.2 county corpland area changes and population growth

Through county corpland changes and population growth trends in the study periods,it can be seen that county land changes and population trends had good correlation in Sanjing Plain. In the early period of P. R. C., corpland and population grew slowly, and in the period from 1955 to 1960, population and corpland grew rapidly. According to the country's

economic development trend, China's economy was in a rapid development stage. And Sanjiang Plain Land Reclamation activities were at a stage of rapid development; between 1966 and 1976, there was a decline phase of corpland, while the population had been on the rise, it was period of the Cultural Revolution in China. Agricultural production was severely damaged, while the population continued to grow. The area of cropland had shown a rapid increase from the reform and opening up to 1995 in the state. From the statistical data analysis, the Sanjiang Plain area of cropland decreased slightly in 1995-2005. But the results of remote sensing interpretation showed that the Sanjiang Plain of results was still in growth stage, which caused them to be in-depth research.

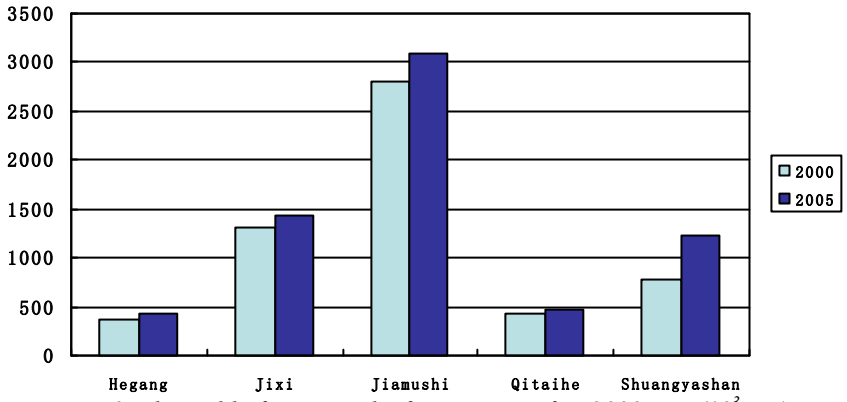

Figure 3, The yield of grain in the five regions after 2000 year(10^3Ton)

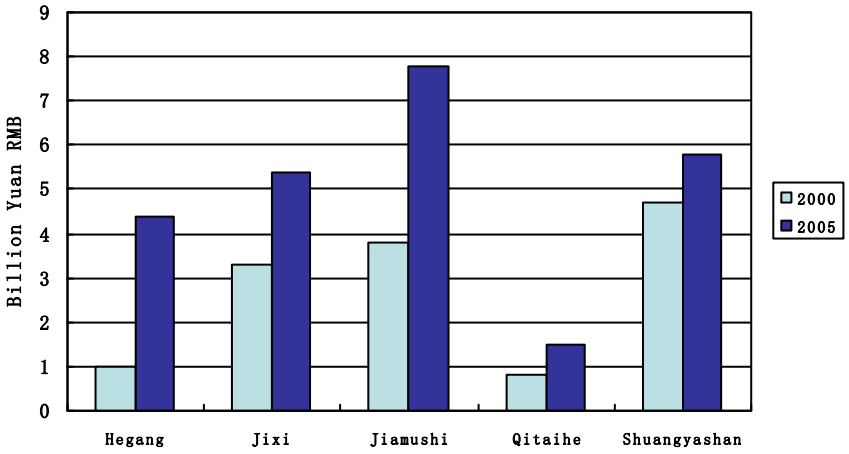

Figure 4, The Gross Agriculture Product in the five regions after 2000 year

CONCLUSION

Land use change was connected with topography and slope in Sanjiang Plain. Where there topography was low and slope was flat, land use change was more dramatic. And the changes started first in these geomorphological units: With the shortage of available development resources, land-use change began in farmland where its topography and slope should not be cleared relatively rapidly changing. Sanjiang Plain land-use change were closely linked with geomorphic and soil conditions. Overall changes trends were similar to topography, slope of land use change. Land-use changed greatly first in a relatively good

topography or soil conditions position. With the rapid decline in arable resources, topography, soil conditions are relatively poor landscape unit also began to change dramatically.

This paper analyzed the relationship between arable land and population growth in the Sanjiang Plain and with national agricultural policy. The results showed that a direct manifestation of land-use change in Sanjing Plain was the rapid expansion of cultivated area. Then it caused a sharp reduction in wetland area. Woodland retreat, grassland was almost replaced by farmland. All this showed that the most direct factor of land-use changes was the agricultural land reclamation. Agriculture reclamation on the one hand led to the national demand for food, the other hand, it is because of the influx of migrants, which made population increased raplidly. Population growth is the most direct and the most important factor on the increase in cultivated area in Sanjiang Plain. Through the interact analysis in typical county, city population and land area .The results showed that there were significant differences in the relationship between population and cultivated land with the different natural conditions, different history of the development and population growth in different ways. But land-use change model was basically the same in the vast majority of cities and counties in the Sanjiang Plain.

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