CHINESE GEOGRAPHICAL SCIENCE
Volume 13, Number 2, pp. 119 – 123, 2003
Science Press, Beijing, China

LAND RECLAMATION PROCESS IN NORTHEAST CHINA SINCE 1900

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ABSTRACT: Northeast China is an important agricultural region in China. The Northeast Plain is the largest plain in the country and one of the three famous black soil zones in the world. Despite of fertility of the soil, however, large-scale agricultural development mainly took place since 1900. The land exploitation and utilization has been fast and intensive in this region since then and change in the land-cover process has been remarkable. Both national and international researchers on land use and land cover are paying more attention to these processes in this region and their implication for local ecological environment. This article discusses the land reclamation processes and their main driving forces in Northeast China since 1900. According to the research, the 20th century was the most important period for land reclamation in Northeast China. In these years the rate, intensity and quantity of land reclamation have been staggering, and more than 100 000km^2 of land was converted into farmland. This magnitude of land reclamation inland is unique in the world. Research on the land reclamation of Northeast China can provide some data on the effect of human activity on environment. As in many other places in the world, the primary driving force of reclamation in Northeast China was the increasing pressure of population. In the 20th century the population increased from 10×10^6 to 110×10^6 in Northeast China and from 400×10^6 to 1.3×10^9 in China. Population pressure is thus the most important driving force for land reclamation.

KEY WORDS: land reclamation process; Northeast China; 20th century

CLC number: F293.2 Document code: A Article ID: 1002-0063(2003)02-0119-05

Land use/cover change (LUCC) is a focal theme and emerging issue in the study of global environmental change. Human modifications and alterations to the environment cause impacts on the surface of the earth, threaten global sustainability and livelihood systems, and contribute to change in the biogeochemical cycles of the earth, which in turn affect atmospheric levels of greenhouse and other trace gases. Consequently the International Geosphere-Biosphere Program (IGBP) and the International Human Dimensions Program (IHDP) initiated LUCC Program to develop a better understanding of the biophysical and human driving forces of land use/cover change. In 1996 the International Geographical Union (IGU) established a study group on land use/cover change (IGU-LUCC) to conduct research and to contribute to the LUCC Program. Both the IGU-LUCC and LUCC initiatives have identified land use/cover change as a major research topic with regard to global sustainability. Another major objective of IGU-LUCC is to coordinate comparative studies of land use/cover change in different regions, with a view to elucidating the nature and function of driving forces (SINGH *et al.*, 2000).

Research shows that human-induced conversions (e.g. deforestation) and modifications (e.g. changing land use management such as fertilizer use and irrigation practices) of land use have great significance in the functioning of the earth system with impact on the biogeochemical cycles (TURNER *et al.*, 1995). The dynamics of greenhouse gas emissions are to a large extent determined by natural ecosystems. Ecosystem conversion results in the changing of these gas dynamics. Land use changes can also influence water and energy balance, directly affecting climatic conditions. The

Received date: 2002-05-16
Foundation item: Supported by the Key Project of Chinese Academy of Sciences (No. KZCX2-SW-416; KZCX1-SW-19) and the National Natural Science Foundation of China (No. 49871001).
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impact of these land use change becomes globally significant through their accumulative effects.

Apart from affecting environmental sustainability, land use change also has an effect on food security. Conversion of cultivated land to non-farm uses such as housing, factories and infrastructure in combination with a growing population is regarded as a serious threat to future food sufficiency (CHEN and KATES, 1994). In land use change studies, it is essential to link land use change to their driving forces. These driving forces (e.g. population or development), mediated by the socio-economic setting (e.g. marketing economy, resource policy) and influenced by the existing environmental conditions or context, lead to changes in land use through the manipulation of the biophysical conditions of land. Understanding the trends of land use change in relation to the driving forces will provide essential information for land use planning and sustainable management of resources.

1 LAND CONDITION AND RECLAMATION HISTORY BEFORE 1900

There are many mountains, rivers, lakes, as well as a vast plain in Northeast China. The Changbai Mountains, Da Hinggan Mountains and Xiao Hinggan Mountains lie in the east, west and north of Northeast China respectively. In the three biggest forest areas in China, forest resources account for about 27.4% of the China's total. Reserved forests here account for about 31.0% of the total conservation in China, thereby improving the environment and protecting farmland.

Arable land in Northeast China is primarily distributed in the Songliao Plain in the middle and the Sanjiang Plain in the east while grassland in the south. The famous grasslands of Songnen, Horqin and Hulun Buir are the best natural grasslands of China. They, in particular, are world famous for their high quality and output of grass. The total grassland area in this region is about 300 000km^2. The vast grassland and farmland offer mutual benefits among regions and resources. In past centuries, Northeast China was a sparsely populated region with rich, largely untapped land resources. During the Qing Dynasty (1644 – 1911), Northeast China (then called Manchuria) was the birthplace of conquerors. Around 1740, the Emperor of the Qing Dynasty (Qian Long Emperor) proclaimed prohibition of land reclamation and hence this process had been slow from then on.

2 LAND RECLAMATION PROCESS SINCE 1900

2.1 Rate of Land Reclamation

The total land area of Northeast China was about 120×10^6ha and the per capita arable land area about 1ha. Statistically, the arable land was about 20×10^6ha, which accounted for 21.0% of the total arable land in China(1996). According to the investigation of resources and environment based on RS technology by Chinese Academy Sciences in 1996(LIU, 1996), the total arable land of this region was about 30×10^6ha (Table 1) and the per capita land area was 0.15ha, which was about 2 times that (0.08ha) for China as a whole(Table 2). The per capita average farmland in Northeast China was 2 times that of whole China since the 1850s. In Northeast China the reclaimed land increased 7 times from middle of the 19th century to late of the 20th century, but it only increased 32% in the whole China at the same time.

Table 1 The comparison of reclaimed farmland change ($\times 10^3$ha)

Area	1887	1914	1940	1950	1960	1970	1980	1990	1999
Liaoning	2520	3160	4800	4800	4300	4080	3760	3460	3300
Jilin	135	2940	3500	4000	4400	4100	4000	3900	3900
Heilongjiang	7	2140	4050	5700	7000	7700	8700	8800	9000
Northeast China(N)	2662	8240	12350	14500	15700	15880	16460	16160	16200
China(C)	75060	84000	94460	99000	111800	101000	99300	95700	94970
N/C(%)	3.5	9.8	13.1	14.7	14.0	15.7	16.6	16.9	17.1

Table 2 Trend in per capita farmland area in Northeast China and the whole China(ha)

	1851	1887	1914	1940	1950	1970	1999
Northeast China(N)	0.67	0.51	0.42	0.47	0.36	0.21	0.15
China(C)	0.32	0.19	0.18	0.18	0.17	0.12	0.08
N/C(%)	2.09	2.68	2.33	2.61	2.12	1.75	1.88

2.2 Distribution of Land Reclamation

In Northeast China black soil, chernozem, and meadow soil of high fertility are abundant. Black soil in particular, with an organic material content of about 30 – 80g/kg and excellent texture, is the most fertile soil in China. It is mainly distributed in the north and middle-east of the Songnen Plain of Northeast China, covering about 10×10^6ha, and being one of the three largest black soil zones in the world. The Fig. 1 shows the basic distribution of reclaimed land in Northeast China.

3 MAIN DRIVING FORCES OF LAND RECLAMATION IN NORTHEAST CHINA

3.1 In-migration and Population Origins

The population of Northeast China has increased dramatically during the last 100 years(ZHAO and XIE, 1988, Table 3) . Heilongjiang now has a population of over 32.6×10^6, Jilin 22.5×10^6, and Liaoning 35.7×10^6. These people are mostly Han nationality immigrants or their progenies. Of the local minority groups, the Manchus have sunk without a trace, the Koreans are over a million strong (mostly in the southeast of Jilin Province).

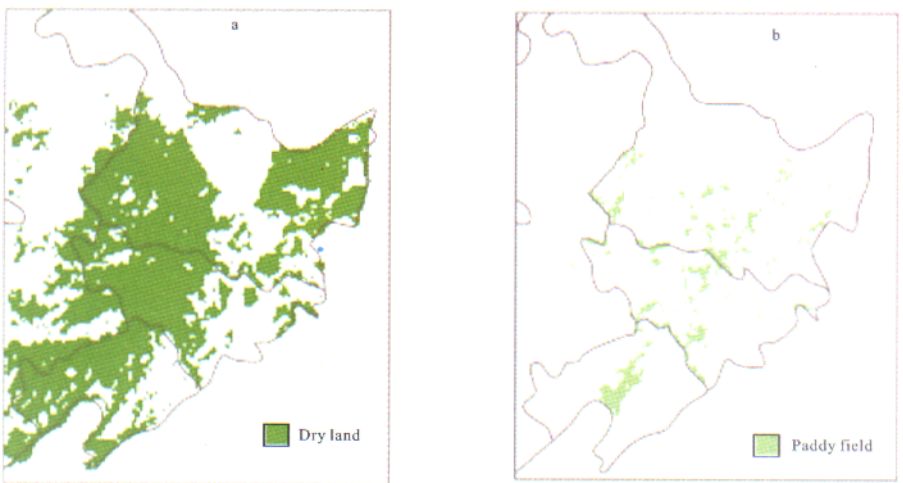

Fig. 1 Distribution of dry land(a) and paddy field(b) in Northeast China (1999)

Table 3 Population change in three provinces of Northeast China ($\times 10^3$)

Area	1887	1914	1940	1952	1970	1999
Liaoning	4450	12130	15250	19300	30800	41900
Jilin	450	5580	8030	10500	19000	26700
Heilongjiang	270	2030	3150	11000	25000	38100
Northeast China(N)	5170	19740	26430	40800	74800	106700
China(C)	376140	445240	510790	574820	829920	1243400
N/C(%)	1.4	4.3	5.2	7.1	9.0	8.6

3.2 Increase in Population of China

Agriculture and food production are always foci of the government and the people of China because of the stress of increasing population. Since 1949, food production in China has improved greatly and the total output has increased about 3.5 times. Concomitantly, the regional status of food production has changed markedly. The condition of "from south to north" formed over a long period in history, has been reversed. North China and Northeast China have become the growth centers of food output in China. From 1984 to 1996, the increment in food output was about 67.4×10^9kg, accounting for about 68.5% of the total increment in China. From the present situation and the development trend, it can be seen that the potential increase in output in the northeasten China, which is determined by many factors, such as per capita arable land area and water resources, notably exceeds that in Northeast China(LIU and TONG, 1998).

The northeasten China includes the provinces of Heilonjiang, Jilin, Liaoning and four eastern leagues of Inner Mongolia. The total land area is about $1.244 \times$

$10^6 km^2$ and the population about 110×10^6. Data showed that total food output in this area in 1996 was ca. 81.05×10^9kg, accounting for 14.9% of that of China. Output of corn and bean respectively accounted for 32.7% and 44.0% of that in China. Among the first ten counties with the biggest food output in China, 9 counties and cities belong to the Northeast China. The commodity rate of food production is high in Northeast China; about 55.7% and 55.10% in Jilin and Heilongjiang provinces respectively. Jilin and Heilongjiang provinces hold food production as the primary occupation of people in respectively first and second place in China.

3.3 Advance in Land Reclamation and Agriculture Technology

If farmland in Northeast China is classified into three grades, i.e., high, medium and low output, according to the criteria of above 6000kg/ha, 3000 – 6000kg/ha and under 3000kg/ha respectively, the total medium- and low-output farmland of this area is about 19×10^6 ha, which accounts for 64.0% of the total arable land investigated by the RS technique. There are still some disadvantages of farmland, such as infertility, water-logging, salinity, sandification, and sloping. In the comprehensive exploitation of the period of 1987 – 1997 in China, about 2.5×10^6ha of medium-and low-output farmlands had been reformed(average increase in food per ha is about 1800kg), or 1/7 of the total medium- and low-output farmland has been transformed. It is predicted that 7×10^6ha of medium-and low-output farmland will be harnessed by 2005.

Technology has played an important role in the increase of reclamation in Northeast China. New technology, such as film covering in cold and semi-arid areas, development of fine seeds, application of new fertilizers, prevention of pest disaster, and improvement of agriculture mechanization, has contributed a 23% – 30% increase in reclamation. The national-level tackling of key scientific and technological issues and the promotion of demonstration areas of science and technology in each province have contributed to the formation of highly productive and stable farmland through the integration of many advanced and practical technology. The output of corn, rice and bean in such farmland can reach 800, 600 and 3000kg/ha respectively, or double the output of traditional farmlands under similar conditions. The application of biological and information technology will further make the output increase greatly.

3.4 Climate Warming

The climate tends to be extreme in Northeast China. In Harbin, people used to huddle around their Soviet stoves drinking vodka in January because strong and cold winds prevailed. Activity slowed to a crawl in this snowflake-spitting weather, while animals sensibly passed the entire season in hibernation. At the higher latitudes along the Sino-Soviet border there was a nine-month snow period (from September to next May). South of Harbin, the cold snap lasted from November to next March.

Such cold climate historically interfered with land reclamation, but now consequent to global warming more land has been reclaimed in the Northeast China since the mid 1900s. According to some researches, if the global temperature increases about 2℃, the northern survival border will move northward about 110 – 160km for apple, 220km for cotton, and so forth. Meanwhile, productivity of the main agro-ecosystem will increase 36.4% and the growth period of plants will be protracted 15 days (XIU and ZHUANG, 1996). Now a paddy field has been reclaimed near the Wsuli River — unbelievable 30 years ago. Under the situation the paddy field reclamation in the three provinces of Northeast China all express to expanding trend sharply. Among them, the development of paddy field is a play particularly in Heilongjiang Province (LIU *et al.*, 1998). Through development of past 50 years, in the three provinces of Northeast China the paddy field occupied from 1.3% of whole national paddy field in 1949 to 11% in 1999, and become the important and high-quality rice producing base in China(Fig. 2).

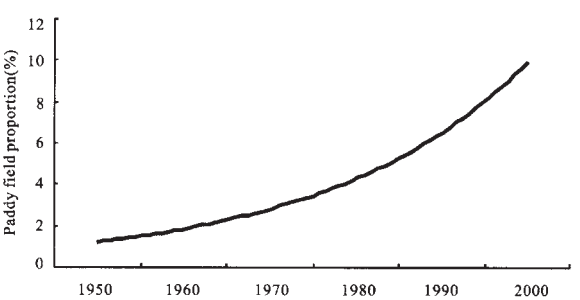

Fig. 2 The change of paddy field proportion of Northeast China to the whole China

4 CONCLUSION

The 20th century has been the most important period for land reclamation in Northeast China. In this period the rate, intensity and quantity of land reclamation had

been staggering, and more than 100 000km^2 of land was converted into farmland. This magnitude of land reclamation inland is unique in the world. Research on the land reclamation of Northeast China can provide some data on the effect of human activity on environment.

As in many other places in the world (LU, 2001), the primary driving force of reclamation in Northeast China was the increasing pressure of population. In the 20th century the population increased from 10×10^6 to 110×10^6 in Northeast China and from 400×10^6 to 1.3×10^9 in China. Population pressure is thus the most important driving force for land reclamation.

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