THE STRUCTURE AND DYNAMICS OF THE LAND RESOURCES SYSTEM IN THE FARMLAND SHELTER FOREST REGION IN THE NORTHEAST PLAIN

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ABSTRACT: The structure and dynamics of land resources system in the shelter forest region in the Northeast Plain is discussed according to the remote sensing and statistical information from the typical profiles and spots. For agricultural utilization, the land resources system is made up of five components, i.e. man, land resources, water resources, climatic resources and barren land. The local economy depends heavily upon its land resources, especially farm land. Having been exploited for 50–60 years from the 1930s to 1980s, it has already changed from the reclaiming period into the declining period. There is no waste land to be reclaimed. Facing the increase of population and requirements and the decrease of farmland fertility, proper management of land resources is indispensable if local economic and living level is maintained. It is imperative to make artificial regeneration (highest input) for the land resources and to keep fine circle of the system. If only natural regeneration if relied, the system will be changed to vicious circle.

KEY WORDS: land resources system, land reclamation, farmland shelter forest, Northeast Plain, remote sensing

I. INTRODUCTION

The shelter forest region in the Northeast Plain, refers to in the windy and sandy area the west of the northeast region, covers an area of 2×10^7ha (about 2/ 3 of the Northeast Plain, China) . Since the 1920s the large scale reclamation for farming and stock raising, especially after the founding of the People's Republic of China, there was a sharp increase in population and a widespread exploitation in land resource, supplying the national economy with a lot of grain and livestock products, becoming one of the important production base

in China. After the first phase of the project of "Three—North" Northeast, Northwest and North) shelter forest had been finished in the middle 1980s, the unique farmland shelter forest network was formed, the main functions from southeast to northwest were to conserve water and soil, to protect farmland, to prevent wind and fix sand, providing good conditions for effective use of land resources. In the region the natural conditions are favorable to farming and stock raising and the land resources can be farther utilized rationally.

II. THE MACROSCOPE SITUATION OF THE LAND RESOURCES SYSTEM

The area extends across the temperate and warm temperate zones, belonging to continental east monsoon zone. The frostless season is 120—170 days, $\geqslant 10°C$ accumulated temperatures are 2,380—3,380°C , the annual precipitation is 350—650mm (decreasing progressively from Southeast to Northwest). These factors basically meet the need of crop and grass growth, and satisfied the need of dry farming and herd growing, but in spring deficient in rain and frequently occurring in drought impaired the production of agriculture and stock raising because the difference distribution of the precipitation in time and space. In recent ten years, the found of great scale plain farmland shelter forest—network improved some of the situation.

There are the Songhua River, Nenjiang River, East and West Liaohe rivers, and a lot of lakes and reservoirs so water resources is abundant. The primary natural vegetation are forest steppes and meadows. There are mixed broad—leaves and coniferous forests in southeast area.

There are some differences between the land resources system of the east and west part of the region forming the areal differentiation, i.e. the east semihumid intensive agriculture subregion, the west semiarid extensive agriculture and stock—raising subregion, the boundary line is 500mm precipitation line. Now according to the Landsat images we introduce these subregions (Fig.).**1. The Subregion of East Semihumid, Intensive Agriculture**

The pattern of three big cities (Harbin, Changchun, Shenyang) and one middle city (Siping) are clearly discernible. A lot of villages and towns are densely distributed, railways and roads are across. The streams winding blow out the mountains in southeast area then converged into the Songhua River or Liaohe River. The network of farmland shelter forest are closely and likely. The continuous stretch of farmland have same colour.

The characteristic of the subsystem are the fine natural conditions, higher population density, higher reclaiming rate, the relatively simple landuse and the large intensity of artifi-
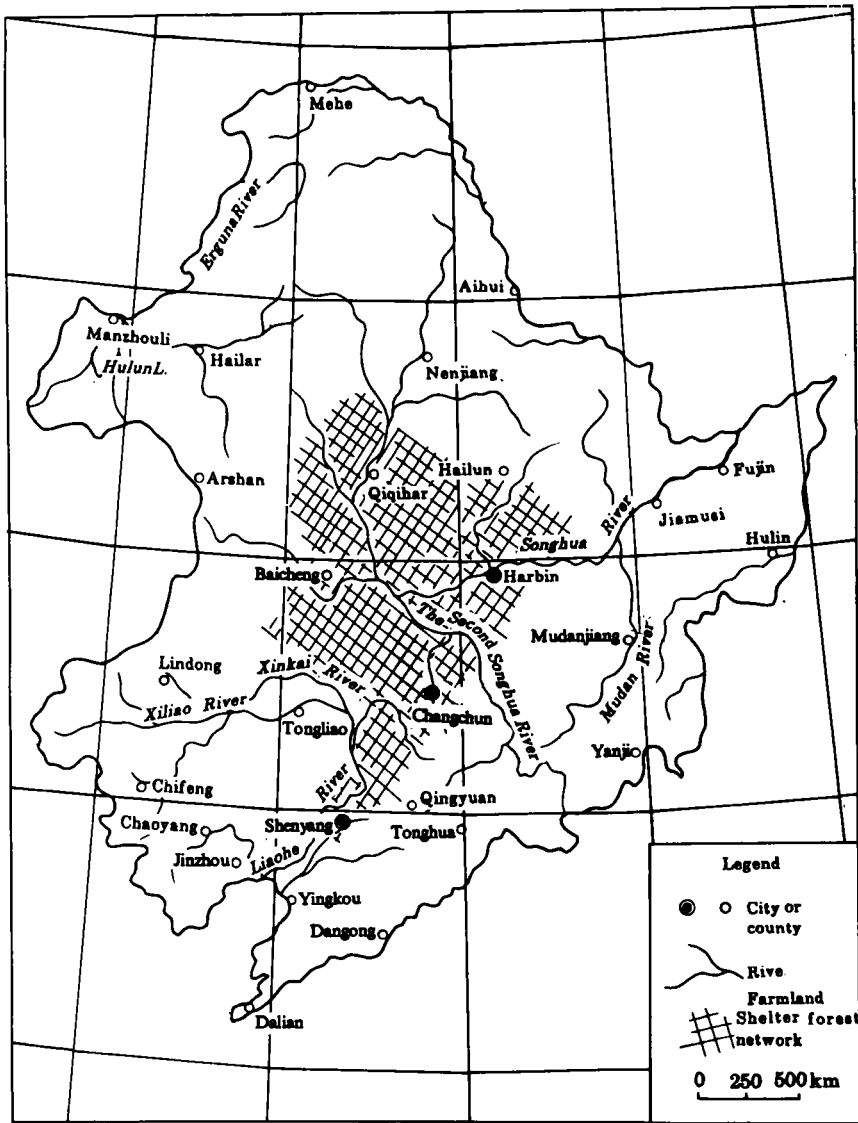
—323—

cial activities.

Fig.1 Map of the farmland sheltering forest–network
in Northeast China Plain

2. The Subregion of West Semiarid Extensive Agriculture and Stock Raising

There are four middle cities–Qiqihar, Daqing, Baicheng and Fuxin, villages are comparatively scattered. A lot of lakes, salt marshes, and continues sand dunes are distributed. The area is closed in the main. There are some natural meadows but they have been damaged to appear a lot of saline spots. The subsystem is easier damaged, with lower productiv-

ity, more limiting factors and larger unprofitable consumption.

III. THE STRUCTURE OF THE SYSTEM

1. The Basic Component Parts of the System

The system is made up of five parts: people, useable land resources, water resources, climate resources and barren land (Fig.2).
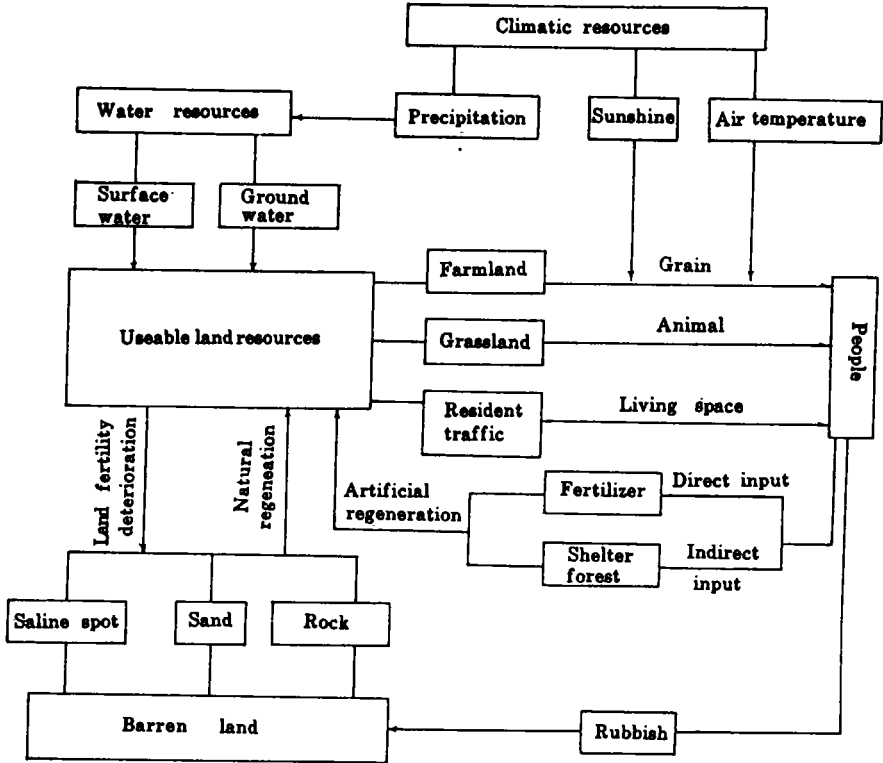

Fig.2 The structure of the land resources system

1) People: as the user of the land resources they moved out a lot of energy and material from the land, in the form of agriculture or stock raising production, at the same time, input directly or indirectly the energy and material, in the form of fertilizer, water conservancy facilities, shelter forest project and so on. The consumption of the land resources are decided by production mode, living level and increasing rate. The amount and quality of the people are changeable. The land resources of the system was exploited and utilized for agriculture and animal husbandry later. The native population were fewer. The population density increased quickly as a result of natural growth and immigrant growth.

2) Useable land resources: useable land resources are the key of the system. The land could be reclaimed easily to product the grain, animal, trees, resident place and so on[2]. They are static space location, unreplaceable, difficult for natural regeneration[3]. Because longer times of contending with the declination caused by the artificial use, the land resources are the declining resources in the case of the fewer artificial input. In the system the land resources was higher original fertility and exploited later, but under the larger scale, faster speed and higher agro—technical level a lot of material (grain and animal) were take out from the useable land resources so that the useable land resources were consumed faster.

3) Water resources: water resources are the surface water and the ground water. They can move in certain area. The people already understand some methods about protective use of water resources in the long time agriculture producing, for example, of building reservoir and irrigation canals.

4) Climatic resources: climatic resources include precipitation , air temperature and sunshine. They help the land resources to provide the living conditions of crops or herbage. They are stable in long time and consistent in large area.

5) Barren land: barren land are unsuited to use in agriculture, stock raising or living. They are the results of climatic changing or geologic action. The forming period is longer in nature state, besides some land are the result of irrational protection in the artificial use. The artificial forming speeds are faster.

2. The Dynamic Process of the Material and Energy in the System

Because agriculture is taken as the dominant production in the system, the primary dynamic processes of the material and energy are the sowing and reaping of the crops. So the people, useable land resources, the water resources, the climatic resources and barren land are connected each other to form the dynamic process of material and energy.

In nature the primary sources of the material and energy are the land resources, water resources and climatic resources that be relied by the growing of the crop. For the crops the land resources provided the living space and soil nutrient, the water resources provided the moisture content and the climatic resources provided the heat, ray and some moisture content. The crops will be ripened and reaped then be moved out the system as the crops absorb material and energy. In the consuming process of the every resources, the climatic resources can be relatively stable in long time and large area; the water resources can also be stable because of its moveable feature and the protecting methods. But the useable land re-

—326—

sources will change into the barren land because of its unmovable and unreplaceable feature.

As the user of the natural resources, the people gained the mature crop and breed them self with the lapse of time, the material and energy of land were further consumed. The rate of breeding affect the decrease rate of the land fertility through directly affecting the need of food. Moreover, the breed of people will need more living space so that a part of land will be consumed.

In the stock raising of the system the material and energy are slightly different from agriculture in form, but the drain on land resources are same besides increasing one step in process (the land resources→the herbage→the animal→people for stock raising, the land resources→the grain→the people for agriculture).

The people get the material and energy—crops or animal from the land, at the same time also put certain material and energy into the land. In the system the primary artificial inputs are the putting of fertilizer and the building of the shelter forest—network. The fertilizer is directly put into the land then become into the land fertility. The shelter forest—network indirectly form a part of the land resources through protecting the agro—eco—environment, decreasing the natural decrease of the land fertility and improving the effect use of land fertility.

In the system the building of the plain shelter forest—network are very important for ensuring the dynamic process of the material and energy (land resources—grain—people). Because the agro—exploiting the land were seriously imperilled by the primary wind—sand disaster. The wind stripped the high fertility topsoil, resulting in land desertification, alkalization and aridness. The eco—environment were worsened day by day so that the land resources was wasted. The agriculture and stock raising were impaired. The problem were solved partly through building of the plain shelter forest—network that created the fine conditions for the long term use of land resources (Fig.3).

IV. THE DYNAMIC SITUATION OF THE LAND RESOURCES SYSTEM

1. The Dynamic Situation of Primary Factors in the System

According to the analysis of the dynamic process of the material and energy, the reclaiming situation of land resources, the per unit area yield, the artificial inputs and the changes of the land fertility are selected to analyse the dynamic trend in the typical regions I_0 and II_0 (I_0 belongs to I subregion, II_0 belongs to II subregion).
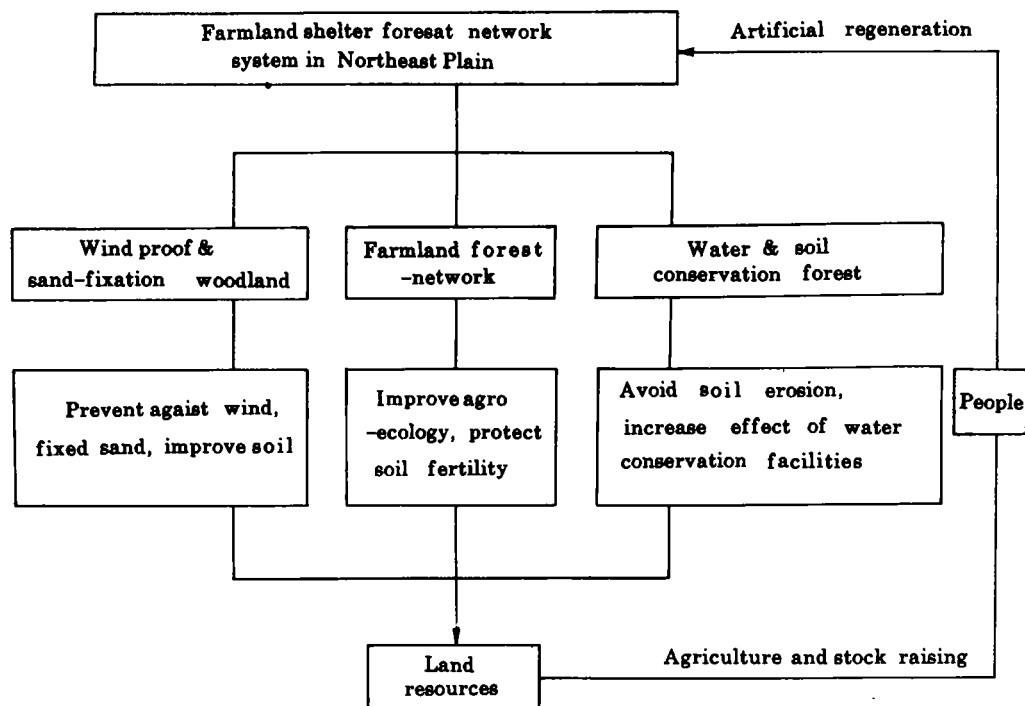
—327—

Fig.3 The function of farmland sheltering forest–network system

1) Population situation: the average annual increasing rate of the population density were 1.4% (I_0) and 2.9% (II_0) from 1949 to 1977, 2.6% (I_0) and 11.0% (II_0) from 1977 to 1980, 1.6% (I_0) 4.5% (II_0) from 1949 to 1980.

2) Reclamation of land resources: according to the information of land use the land reclaiming rate reached 50% (I_0) and 25% (II_0) in 1977, 65% (I_0) and 35% (II_0) in 1980 and 70% (I_0) and 50% (II_0) in 1986. The reclaimable land rate are about 65% (I_0) and 40% (II_0). That shows the reclaiming rate already reached or accessed the reclaimable rate in 1980 and exceeded the rate in 1986. The reclaiming rate increased 40% (I_0) and 100% (II_0) from 1977 to 1986.

3) Per unit area yield of grain: in recent decade the per unit area yield of grain already reached higher level about 7500 kg/ ha (I_0) and 1500 kg/ ha (II_0). These were waved because the changes of weather (Fig.4).

4) Artificial inputs: the chemical fertilizer and plain farmland shelter forest–network were the primary artificial inputs in the land resources system. The chemical fertilizer inputs increased from 75 kg/ ha in the beginning of the 1970's to 750 kg/ ha (I_0) and 300 kg/ ha (II_0) in the 1980's. The building of the shelter forest–network made the rate of for-

—328—

est cover excess 10% in plain. The method occupied fewer farmland but had comprehensive effects of windproof and sand–fixation, preserving moisture and fertility, providing the timbers of firewood. The purposes of protecting the land resources and decreasing the waste of land fertility were gotten (Fig.5).
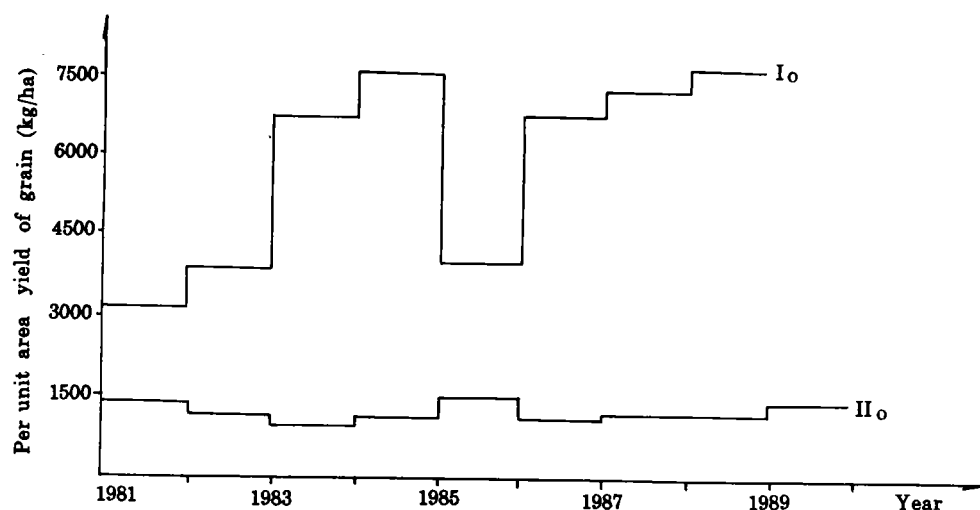

Fig.4 The curve for per unit area yield of cereals

5) Land fertility: there are different soil fertility at the different geomorphic area (Table 1), but generally the land quality in Ⅱ subregion is worse than that in the I subregion. So in the Ⅱ subregion the land degeneration and eco–environment deterioration are easier happened than in the I subregion though in the Ⅱ subregion the rate of reclaiming was lower than in the I subregion. The changes of land fertility are showed in Table 2 and Table 3.

Table 1 The fertility of main soil

| Soil type	Nutrient			
	Humus (%)	Total N (%)	Total P (%)	Total K (%)
Grey brown earth	1.8–2.3	0.10–0.14	0.08–0.10	2.28–2.36
Dark brown soil	1.3–2.0	0.08–0.12	2.20–2.42	2.20–2.42
Baijiang soil	1.6	0.10–0.12	0.07–0.08	3.30
Black soil	1.0–1.9	0.05–0.13	0.06–0.10	1.74–2.28
Chernozem	1.4–2.0	0.10–0.13	0.06–0.08	2.26–2.39
Light chernozem	1.4–1.7	0.08–0.13	0.06–0.08	2.07–2.34
Meadow soil	1.1–2.2	0.07–0.15	0.04–0.11	2.12–2.41
Alkali–Saline soil	1.0–1.6	0.09–0.12	0.05	2.12–2.45
Sandy soil	1.1–1.7	0.07–0.09	0.04–0.07	2.06–2.43
Bog soil	2.10	0.12	0.09	2.32
Alluvial soil	1.0–1.8	0.08–0.13	0.05–0.59	2.06–2.47
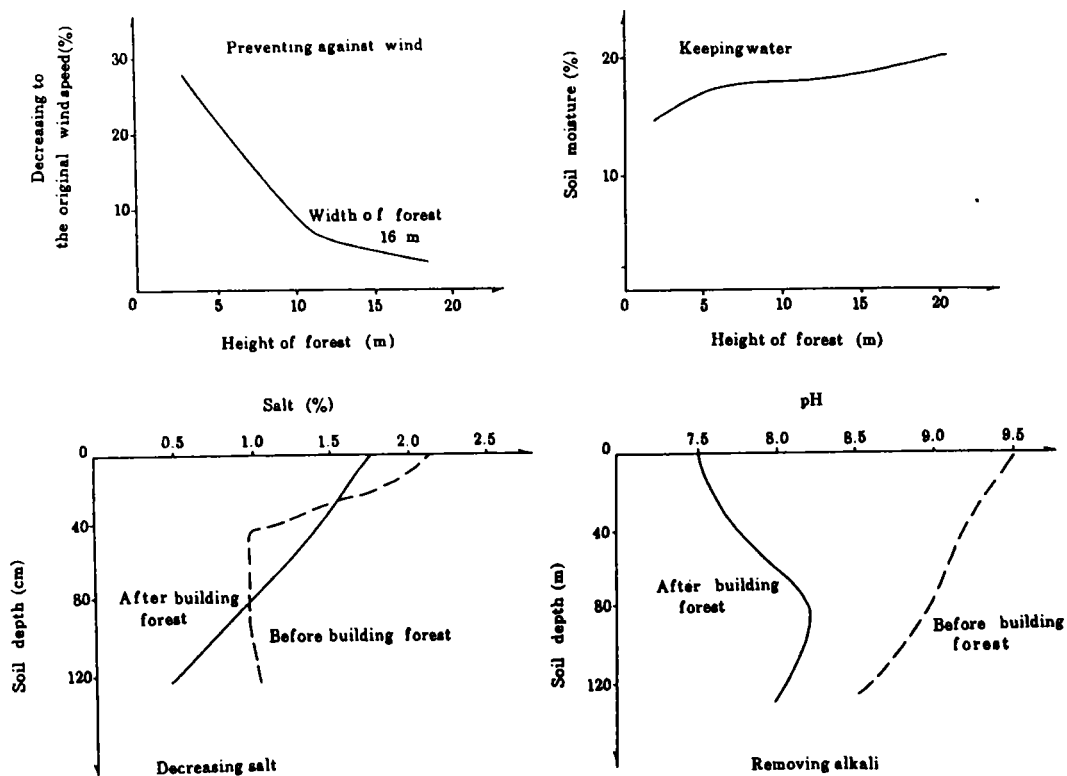
Fig.5 The effect of farmland sheltering forest–network in the plain

Table 2 The changes of farmland fertility

Place		Fertilizer						
		Humus (%)	Total N (%)	Total P (%)	Total K (%)	Quick–acting N (ppm)	Quick–acting P (ppm)	Quick–acting K (ppm)
I_0 (Chaoyangpo village of the Gongzuling City)	1959	4.30	0.17	0.06	2.845	96	60	288
	1981	1.84	0.112	0.039	2.277	96.8	38.4	109
II_0 (Dabushu village of the Qian'an County)	1959	1.447	0.107	0.030	2.218	93	7.6	126
	1984	1.309	0.102	0.031	2.143	86	5.1	108

Table 3 Comparison of soil fertilities between cultivated land and natural soils

II_0 (1981)	Land type	Humus %	Total N %	Total P %	Total K %
Light chernozem	Grassland	2.2989	0.1361	0.0197	2.143
	Farmland	1.5400	0.0960	0.0220	1.080
Light chernozem	Grassland	2.6571	0.1483	0.0203	4.580
	Farmland	1.6800	0.0960	0.0180	1.840

2. The Dynamic Trends of the Land Resources System

Through analysing we got the following dynamic trends:

1) In the east subregion the increasing speed of the population density was lower than in the west subregion, but the original population was more than in the west subregion. So the population density accelaratively increased in whole region.

2) The rate of land reclaiming already exceeded the reclaimable rate. In the region with fragile ecological conditions the excessive reclaiming are very easily forming the bad result of barren land expending and agro—eco—environment deterioration day by day.

3) In the production of the agriculture and stoke raising the unbalance between the output and input made the fertility of farmland (or grassland) to be reduced. This is even more important that the nutrients were decreasing day by day to form the nutritive limit factor so that the continuous productive forces become even more weak.

V. CONCLUSION

1) Though the land resources have been exploited later in the region, the land reclaiming rate increased fast. In the initial stage of the 1980's the reclaiming situation already reached the extreme level. The land were apt to be damaged. People don't ought to continuously reclaim the land for the benefit in the present moment.

2) Because the increase of population become a problem[4], population control must be seriously carried out. If the increase of the population density will cause the increase of consumption of the grain and livestock products so that the rate of commercial grain will reduce, at the same time the residential area expend, the increase of the load of land resources will make the land resources to fast decline.

3) Because the people understand and protect the land resources not enough in the reclaiming period, the land fertility have enormously decreased under the excessive reclaiming, extensive cultivation and fewer artificial input. The land resources system have interned into the land fertility declining period. The system will face two dynamic trends. One is relying the artificial regeneration to keep the production forces and permanent employment of the land resources, and the fine circle of the system under the presupposition of increasing the artificial inputs. Another is still using lower inputs to allow fast declining of the land resources and form the vicious circle even couldn't return, there are a lot of examples human history.

4) The project of the plain farmland shelter forest–network was the great artificial input after reclaiming of land resources in an all–round way through controlling and remaking the harsh natural factors–wind, sand, salt, alkali, dry and so onto improved the agro–eco–environment and decrease the wastes and recession of the land resources, this provided the basic conditions for the effect of the further artificial inputs and the fine presupposition for the forever employment and the fine circle of the land resources in the system.

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