

# The Degradation, Prevention and Treatment of Black Soil in Jilin Province

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*Abstract:* - Northeast China's black soil is mainly distributed in the Songliao Basin's upper reaches of Heilongjiang Province and Jilin Province. The black soil area in Jilin Province is about approximately 45,200 km<sup>2</sup>, which accounts for 24.7 percent of the total area. As the result of human interference with black soil in excess, black soil resources in Jilin have depredated noticeably. Serious erosion of black soil, reduction of soil nutrients, the deterioration of physical and chemical properties, and the escalation of soil pollution, have posed a serious threat on the national food production, the security of ecology and environment and socio-economic sustainable development in the future. This paper mainly puts the natural and human factors resulting in the degradation of the black soil into discussion. The natural factors refer to global climate change, the terrain characteristics as well as vegetation cover and so on. The human factors mainly focus on the rapid growth of population, unreasonable way of farming, soil pollution caused by industrial and agricultural production, and urbanization leading to the transfer of soil's practical function, etc. Through studying the mechanism and the essence of soil degradation, prevention and treatment of black soil degradation should begin with the basic characteristics and the process of the occurrence. At the same time soil resources and the environment, should be unified, and different types of degradation should be distinguished. According to the basic principles of ecology and from the perspective of ecological balance the measures of biology, engineer, as well as agriculture should be combined together in order to unify the development and protection.

*Key-Words:* - Jilin Province, black soil degradation, prevention and treatment

## 1 Introduction

Northeast China's black soil and the Great Plains with Ukraine and the United States along the Mississippi River basin are the three major black soil zones. Generally speaking, the black soil types in the northeast area can be categorized into the black soil, chernozem, and meadow soil, etc., which are mainly distributed in the Songliao Basin's upper reaches of Heilongjiang Province and Jilin Province (Figure 1). Black soil has a thick layer of humus, good physical and chemical properties, biological characteristics, and high fertility. The black soil zone in Northeast China has an area of 118,000 km<sup>2</sup>, Jilin Province of which is about

45,200 km<sup>2</sup>, accounting for 24.7 percent of the total area. [1] Jilin black soil area is one of the important commodity grain production bases, while even the younger planting area is also more than 100 years old. The black soil resources have been significantly degrading, posing a serious threat on the national food production, the security of ecology and environment and socio-economic sustainable development in the future.

## 2 The Development and Utility of Black Soil in Jilin Province

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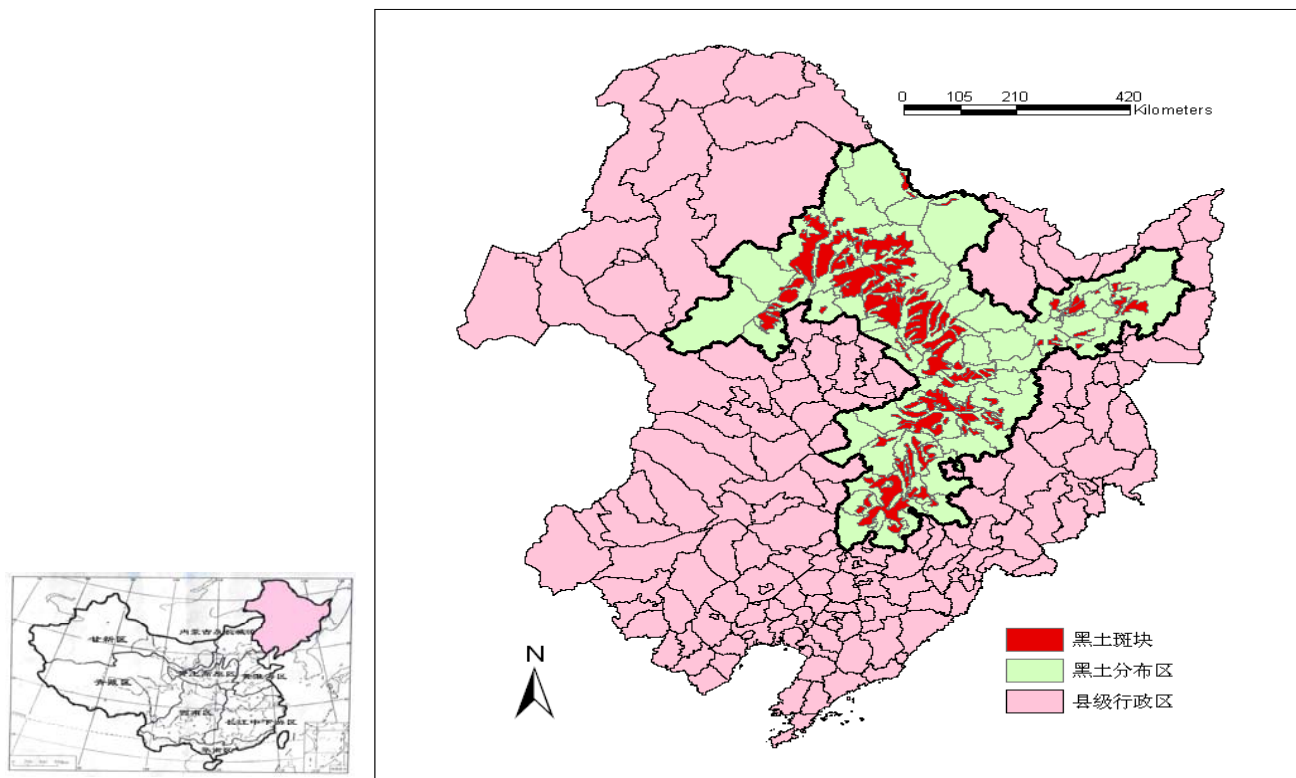


Figure 1 distribution of northeast black soil area and blocks

In the past, due to the small population and a relatively light impact of human activities on the northeast area, the ecological cycle was in a primitive state. At the beginning of 20th Century, with a large number of immigrants moving into this area, they launched a large-scale "Land Cultivation Campaign". After the foundation of New China, the pace of land development was accelerated, and vast new reclamation areas were opened up. Before the cultivation of black soil area, most natural vegetations were forests and grassland meadow plants. And the black soil resources had good natural attributes. Potentially, they can be used for crop production. For example, Da-an, Dehui and Dunhua area in Jilin Province are close to each other and have a similar climate, but because of the different soil types, land productivities are also various. As what can be seen from Table-1, higher proportion of the black soil share of the farmland, the higher unit, of the land yields and the higher productivity of the farmland has. Consequence, black soil is a valuable land resource for cultivation. The changing process of black soil in northeast area of arable land represents the process of black soil's cultivation. The area of the arable land in Jilin Province in 1990 was 39,400 km<sup>2</sup>, and expanded to 55,800 km<sup>2</sup> in 2002 [2], growing by 16,400 km<sup>2</sup> during 12 years, most of which was received through land reclamation in the black soil zone.

Table 1: Comparison of the productivity of arable land in different types of soil in Jilin Province [3]

| Agriculture district/Representative county | The proportion of black soil to arable land (%) | Food production in the arable land per unit area (kg/km <sup>2</sup> ) |
|--|---|--|
| Da-an                                      | 0   | 3134   |
| Dunhua                                     | 3.1   | 4568   |
| Dehui                                      | 40  | 5478   |

With the extension of years in cultivation, due to the natural factors and lack of the awareness of protection and the sustainable development, black soil zone suffers from a series of ecological destruction and environmental pollution. Although black soil is a renewable resource, however, human's disturbance on black soil has exceeded the regeneration capacity of black soil, which results in serious degradation of black soil. The mechanisms of black soil degradation and its protection measures are a matter of priority at present.

### 3 The Degradation Situation and Hazard of Black Soil

The black soil degradation in Jilin Province

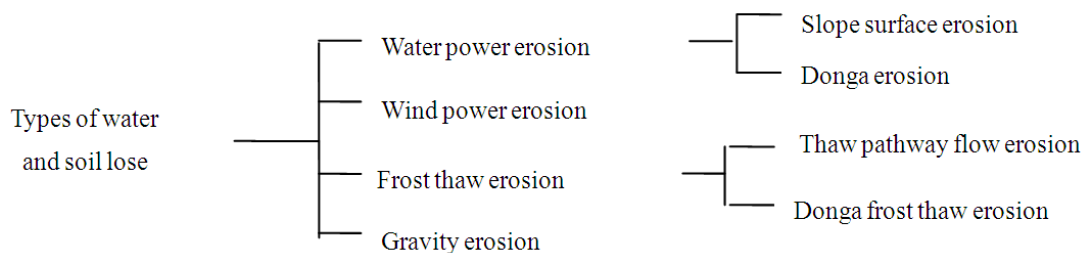


Figure 2 the chart of soil erosion types in the area of black soil in Jilin Province

The main types of black soil erosion in Jilin Province are water erosion and wind erosion.

### 3.1 Serious Erosion of Black Soil

The area of black soil is large in Jilin Province, the landform and physiognomy are levity, hill、hillock and flat are interleaving distributing, so there are all kinds of water and soil lose forms in the area of black soil. The types of soil erosion include water power erosion、wind power erosion、frost blend erosion and gravity erosion. Water power erosion can be divided into slope surface erosion and donga erosion. Frost thaw erosion is divided into thaw pathway flow erosion and donga frost thaw erosion (Figure 2).

#### 3.1.1 Water Power Erosion

The water erosion mainly occurs in the sloping land. Before the section flow of the lamina stream in the ground is formed which makes the mainly shows in three areas: black soil erosion, deterioration of soil physical and chemical properties and soil pollution. Surface soil happen parcel erosion and striae.

The characteristic of the black soil area in Jilin Province is that the slope surface is slow and long, the grade is below 10° commonly. Mass are between 3°-7°,the length of slope is 500-2000m commonly, the furthest length arrive at 4000m,which construct favorable landform condition for the slope surface erosion. The soil erosion and water loss of the slope of arable land in Jilin Province is one of the factors restricting the development of agricultural production. The second national soil survey results show that 20,000 km<sup>2</sup> farmlands in Jilin Province suffer from serious erosion, accounting for 37% of the total cultivated land area. The soil erosion and water loss of black soil are very serious. The annual soil erosion modules reach 110,000 m<sup>3</sup> / km<sup>2</sup>, which have surpassed the erosion intensity of the Loess Plateau [1]. The black soil zone lost average 3-1cm thick topsoil annually. Because of the soil erosion and water loss for many years, the original

thicker black soil layer is now only 20-30cm thick. In Jilin Province, 40% of the soil is less than 30cm thick, and even in some places, loess parent material has emerged and lost its basic production capacity [4]. It is estimated that if the loss of the present arable land of black soil continued for 40 to 50 years, he black soil layer would be lost finally In Sijiazhi country of Shuangyang District, people planted corn and the yield was about 4500kg/hm<sup>2</sup>. Due to the soil erosion and water loss, there are 430hm<sup>2</sup> bare rocks that they have to abandon. The rest land can only be utilized by planting soybeans and grain, instead of corn with the approximate 1000kg/hm<sup>2</sup> output.

After the pathway flow of slope surface marshaled into section flow which wash out the soil of slope surface, which has formed shallow channel, further to development shear channel、gulch、donga network system and so on. The distribution of donga erosion of black soil area is abroad in Jilin Province, the erosion channel are denseness and the area are rather large, the channel length is 100-200m and the deep is 3-6m commonly, there are coast, descend cut and dilapidation and so on around the channel, but there are some areas which are eroded very greatly. Just the coastwise 15km of Songhuajiang River in Liujia countryside Yushu City, there is erosion dry channel which the length is 1.5km; there are 49 pieces large model erosion channel which the deep is 10-40, the branch channel below 10 m has arrived at 306 pieces, the density of donga has arrived at 4440m/km<sup>2</sup> [2], Due to the impact of soil erosion and water loss on large area of bare mountains, a large area of wilderness ranges and corroded ditches appear. Meanwhile, soil erosion and water loss will lead to another serious environmental problem – area-source pollution. According to the survey, in some reaches of River Mushi and River Huifa, the river-beds are more than 1m above the ground, and have become the "above-ground suspended river" of black soil.

#### 3.1.2 Wind Erosion

Wind erosion mainly occurs on the flat ground. The period of strong winds in Jilin province is in April and May every year, when there is only softer topsoil without vegetation cover on the arable land surface .With the spring drought, repeated freezing

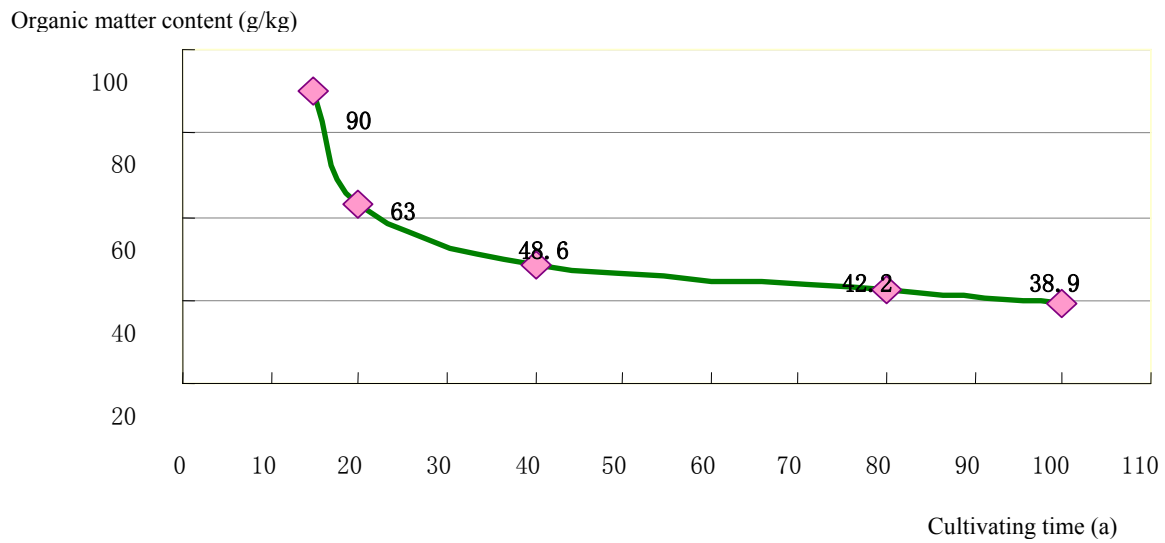


Figure 3 Cultivating of different time changes in organic matter

Table 2 the compare of black soil nutrient content of different types [5]

| Types                                 | Azote entirely (g/kg) | Phosphor entirely (g/kg) | Kalium entirely (g/kg) | Alkali unbind azote (mg/kg) | Availability phosphor (mg/kg) | Availability kalium (mg/kg) |
|---------------------------------------|-----------------------|--------------------------|------------------------|-----------------------------|-------------------------------|-----------------------------|
| Cultivate middle level black soil     | 2.006                 | 1.897                    | 30.63                  | 226                         | 61.30                         | 255                         |
| Non-cultivate middle level black soil | 1.902                 | 1.618                    | 30.63                  | 204                         | 62.50                         | 280                         |
| Up slope in slope plow land           | 2.18                  | 0.51                     | 18.70                  | --                          | 5.60                          | --                          |
| Middle slope in slope plow land       | 1.79                  | 0.50                     | 19.00                  | --                          | 28.40                         | --                          |
| Down slope in slope plow land         | 1.69                  | 0.41                     | 21.10                  | --                          | 5.10                          | --                          |

Table3 the physics character change of the black soil in different reclamation years [10]

| Fixed number of year of the reclamation (year) | Depth (cm) | Capability weight (g/cm <sup>3</sup> ) | Holding water quantity in the farm (%) | The total degree of hole (%) | The gross of the corps granule (%) |
|--|------------|--|--|------------------------------|------------------------------------|
| Early reclamation                              | 0~30       | 0.79                                   | 57.70                                  | 67.90                        | 58.00                              |
| 20 year  | 0~30       | 0.85                                   | 51.50                                  | 66.60                        | 43.00                              |
| 40year   | 0~30       | 1.06                                   | 41.90                                  | 58.90                        | 37.50                              |
| 80year   | 0~30       | 1.26                                   | 26.60                                  | 52.50                        | 35.80                              |

| Soil status            | Bacteria            | Free line bacterium | Epiphyte            | Microorganism gross<br>(Bacteria number/g dry soil) |
|------------------------|---------------------|---------------------|---------------------|---|
| Normal black soil      | $5.829 \times 10^6$ | $3.049 \times 10^5$ | $2.735 \times 10^4$ | $616.13 \times 10^4$                                |
| Degradation black soil | $4.455 \times 10^5$ | $2.495 \times 10^6$ | $3.475 \times 10^4$ | $297.53 \times 10^4$                                |

Table4 the compare of edaphon number between the degradation and the normal black soil [5] Unit:Ten thousand

and thawing, and Soil particles in the state of broken bits, the soil turned up in autumn and fallow land plowed over are even like the "fine flour". When strong winds come, topsoil is stripped away by the wind in different degrees. It has been observed in the level planting wheat field, where the topsoil corroded by wind reaches up to 0.5-1.0cm thickness each year [6].

### 3.1.3 Frost thaw Erosion

The frost thaw is one kind of erosion which can not neglect able in the black soil in Jilin Province. The frost thaw erosion can be divided into two kinds in this area: one is thaw pathway flow erosion; the other is donga frost thaw erosion. The thaw pathway flow erosion is that its chilliness in winter, topsoil and moisture between rocks expanded because of freeze which bring huge pressure to the soil and rock; the ice and snow thaw in the surface layer in spring, and that the freezing layer lower is slow when it passes the heat and thaw, so that formed non pass through layer and produced the soil's surface pathway flow, then work water and soil loss. Donga frost thaw erosion is because of the temperature happened positive-negative movement periodicity, underground ice and underground water of the erosion channel frozen soil layer happened change and displacement ceaseless, which made the frozen soil layer happened freeze and rize, thaw and sink, flow and change and so on, and bring the soil erosion. Donge frost thaw erosion pick up the development of erosion channel, channel bank can develop to 50-100cm every year.

### 3.1.4 Gravity Erosion

Gravity erosion and frost thaw erosion interlace in together and it's difficult to distinguish. Frost thaw action is the primary first stress of the donge frost thaw erosion, is the precondition of the gravity

action, and its final configuration is the gravity erosion. The gravity erosion happen all the year round in the black soil in Jilin Province, but happen in summer motly, its erosion process is very fast.

### 3.2 Reduction of Soil Nutrients and the Deterioration of Physical and Chemical Properties

In the early days (about 5-10 years) of the reclamation of the black soil, the regular cultivation makes the ventilate situation of the soil improved, overfull water dissipate, so that the temperature of the soil increased, the microorganism movement boost up, humus decomounds speedup, which release more efficiency nutrient, exert potential fertility. Here, we can acquire rather high yield even if non-fertilization. but along with the time process, the situation that soil nutrient depress and character exasperate will happen.

With prolonging the cultivating time, soil organic matter content tends to drop. As what can be seen from figure 3, organic matter content of 85-year cultivated black soil dropped from 90g/kg to 38.9g/kg [2]. The poor cultivating measures and production management, and excessive use of fertilizers, pesticides and herbicides resulted in the rapid decline of soil nutrient content (See table 2). Soil bulk density increased year by year, the voyage decreased, the gross of the corps granule reduced and the ability to guarantee water fell (See table 3). Soil biota system and biology vivid character has suffered breakage which mainly represent in the number of microorganism reduced, the number of bacteria reduced and the number of free line bacterium and epiphyte increased [28/29/32/34/35] (See table 4). In some areas, there appeared soil Stalinization phenomenon, which resulting in the higher cost of agricultural production for farmers.

### 3.3 Aggravation of Soil Pollution

The long-term agricultural production by way of plundering and the fast rise of rural enterprises and so on, have led to ecological damage to the black soil environment in various degrees. Such as the piling and dumping of solid waste, the use of the agricultural chemicals and chemical fertilizers, the infiltration of toxic and harmful waste water, as well as atmosphere harmful gases and the fly ashes landing onto the soil with the rain. It can be said that the reality of transfer of the municipal pollution to the village has brought a great catastrophe to the black soil resources. Farmers increasingly executed the agricultural chemicals and the chemical fertilizers simply in order to raise the production, which causes the proportion of agricultural chemicals contents higher than the standard and reduction of the produce quality. Consequence, this will be the biggest obstacle of the food economic development in Jilin Province in the future.

At the same time, along with the prick up of the soil pollution, which bring up the cover fountain pollution in the drainage area, which has made the chroma of COD heighten in Songhuajiang drainage area, which has menace the water resource safety in Jilin Province.

## 4 The Exploration for Reasons of Degradation of Black soil

As a matter of fact, there are many reasons concerned with the black soil degradation, which can be discussed from two aspects: natural factors and human factors.

### 4.1 Natural Factors

The natural factors which influence the black soil degradation in Jilin province are mainly the climate, the terrain and the vegetation and so on.

#### 4.1.1 Climate factors

Global warming causes the frozen soil layer to move to the north, and compared with 100 years ago, the modern frozen soil has already moved approximately 20-30km to the north. With the frozen soil layer moving to the north, the black soil will gradually shrink to the north [7]. Climate warming has accelerated the decomposition of soil organic matter, causing soil organic matter to decrease. With the influence of the East Asian monsoon, black soil area in Jilin province belongs to the continental humid temperate and sub-humid climate. Winter chilliness, spring and autumn are

arid and windy. The dryness degree is  $\leq 1$  commonly, the year average temperature is 2-6°C; The annual average wind speed is 3.24m / s, and the maximum wind speed reaches 27 m / s [8]. Near March-May windy days occupy the annual days of strong winds above 65%. The average precipitation many years is 400-900mm, the rainfall in summer is rich, annually more than 70% of which concentrates from June to September, and much appears in rainstorm form, which has a short of time, and the rainfall intensity is great. Because of the basic bespatter ability is strong that the drencher or rainstorm to the soil body, pathway flow is large, erode fierceness, which work seriously the water and soil loss. At the same time, the day difference in temperature and year difference in temperature is larger, frost thaw alternation is very evidence, and the action time is long. In the process of thaw in spring which work thaw pathway flow, bring serious water and soil loss also. The soil loosen after the thaw in spring and its demur erosion ability depress obviously, according the research result of B.S.Sharratt "water and soil loss in the period of black soil thaw in North American", its approve that "the soil loss increased 24%-90% that pass the frost-thaw alternation than none"

#### 4.1.2 Landform and physiognomy

The terrain of the typical black soil area are many the mountain, attacks the proluvial terrace and the wash plain. Before the mountain, attacks the proluvial terrace region, the terrain load, the fluctuation is big, the ground line gradient majority for 3~8°, the slope length is 500~1000m, the catchment area is big, the surface erosion furrowing is serious. Although the wash plain regional slope is not big, generally in 3° below, the slope long many are 800-1500m. As a result of slope face length, and is the agricultural land, therefore when the rainfall amount and the rainfall intensity are big, has formed the runoff centralism washout, the erosion modulus in 3000~5000t/ (km<sup>2</sup> .a). Black soil terrain landform to a great extent immediate influence soil type evolution and soil erosion intensity, but the soil erosion in turn is also molding the black soil area terrain landform. Because the different slope to accepts the sunlight the length and the soil freezing and thawing is sooner or later different, creates corrodes the degree to have a difference suddenly, south the slope and Dongpo corrode the degree to be high. Therefore, south the black soil area the slope and east slope must generally and west the slope are steeper than the northern slope, the thickness of soil layer must generally and west the slope is thicker

than the northern slope, so forms the vicious circle, further aggravated this area soil erosion.

#### 4.1.3 Vegetation

Although the forest cover rate in Jilin Province is 43.2 percent, however, due to the uneven distribution of forest resources, they are mainly in the Changbai Mountains. Since the cover rate by trees and grass of the farmland area is low, especially the gentle slope arable land area it is hard to protect the black soil. And a phenomenon comes out: high vegetation cover can not play a role in the suppression of black soil erosion. In order to solve the need in the past, in order to satisfy the existent need by increasing the food supplies, the thing that can be done is opened up wasteland and grown food in the situation of fertility level lowlihead, the place that the grade is rather steep, the forest and grass cover would be changed to plow land. The steady forest and meadow campo ecosystem changed into flimsy farmland ecosystem. Because lose the action that the vegetation self-restraint the wellhead and holding the water and soil, which made the water soil loss speed development in seven-league boots. Moreover, in the area of west, the wind erosion prick up, winnow dirt weather increase and the sand area enlarge year after year.

### 4.2 Human Factors

The history of the black soil large-scale reclamation and cultivation is just more than 100 years, but, until then its natural ecological environment has been so good. This demonstrates that human destruction to the ecological environment and irrational cultivation is the main reason for the degradation of black soil.

#### 4.2.1 Influence of population growth.

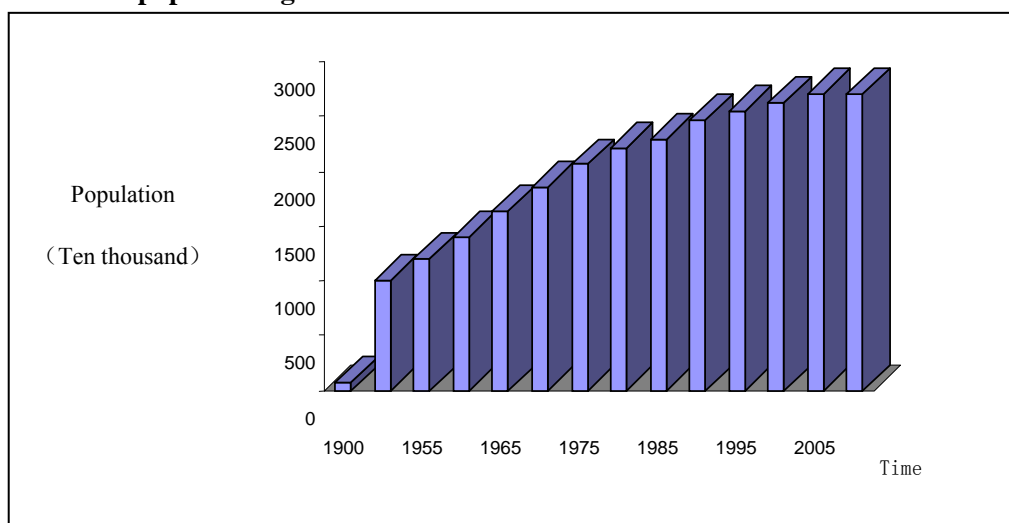


Figure 4 the transformation trend of the population gross in 1900-2007 in Jilin Province

Population growth leads to the excessive use of soil. The population in Jilin Province was 779,000, in 1900, while it was 27,150,000 in 2007, growing 35 times during more than 100 years (See figure 4). The food products from the flat ground could not meet people's needs any more. So they turned to the development of slope land, which destroyed trees and grass and reclaimed the fields, and at last resulted in the erosion of soil and aggravation of water loss.

#### 4.2.2 The influence of unreasonable way of farming

Unreasonable way of farming aggravated the degradation of black soil. The main crops in Jilin Province are corn and soybeans. A lot of farmlands are on the rolling hills, and farmers often make the ridge along the slope, which can easily lead to soil erosion and water loss.

In order to pursue the high yield, farmers have harvested corn continuously for many years, and they increase the production depending on the chemical fertilizers completely. Although the black soil has high productivity, under the "less input, multiple output" plundering type management, the soil nutrients lack obtaining the scientific supplements, which causes unbalance of oil nutrients, decline of soil fertility, as well as the sealing of soil.

#### 4.2.3 The influence of industrial and agricultural production

The black soil area is the industrial and agricultural develop area also in Jilin Province; the industrial and agricultural production causes the soil pollution. In order to pursue the agricultural production, lots of pesticides, herbicides and chemical fertilizers have been used, but organic fertilizer is used a fat lot. At

present, most of the arable lands in Jilin Province haven't used organic manure for more than 20 years and they mainly depended on the chemical fertilizers as the nutrient supplement, which seriously influences the soil environment. The sewage irrigation and farming terra theca largely leave and so on, which made the heavy metal and organic pollution becoming more and more severity in the black soil area, which made the soil productivity level and farm produce quality descend, and a great many crop can't exit because of the contamination content exceed the standard. Recent 20 years, villages and Towns

## 5 The Prevention and Treatment of Black Soil Degradation

Nowadays, facing the situation of black soil resources only relying on chemical fertilizers to maintain the production and the reality of "broken xipi" and "the yellow soil hillock" with no productivity at all, people have already realized the truth that it is not too late to mend the fold even after the sheep is lost. Therefore, the earlier prevention, the less loss. The prevention and treatment of black soil degradation carried out in Jilin Province have achieved good results and mainly focus on the following aspects.

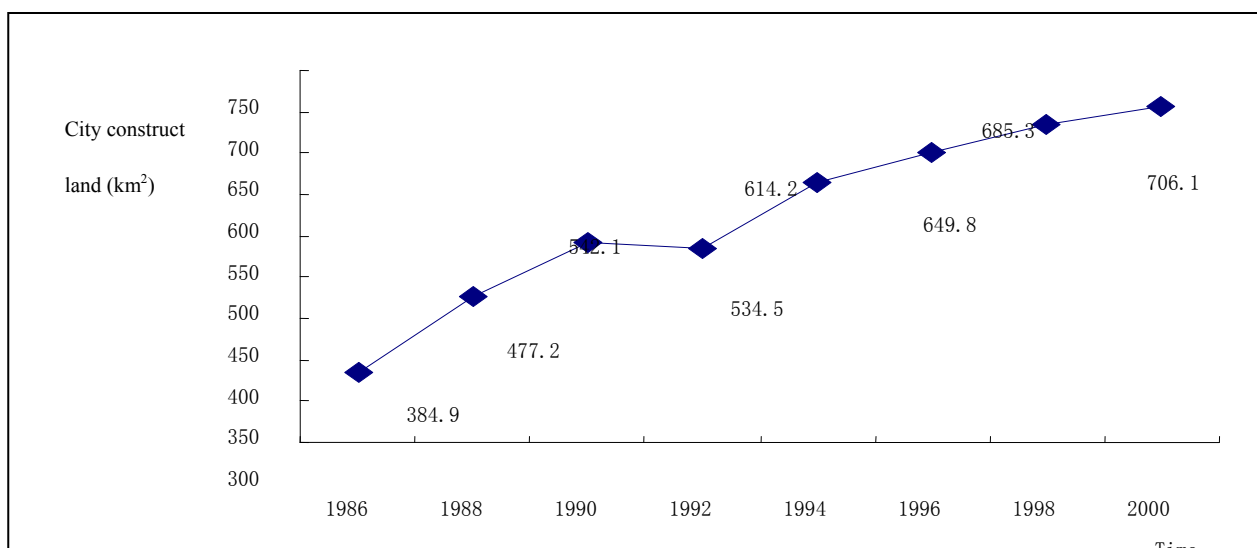


Figure 5 the city construction land increase trend in 1986-2000 in Jilin Province

cost high energy, the old and heavy pollution Corporations expand rapidly; city industry wash out equipment marry again to the villages and towns corporation. In addition to the increase of the industrial "three wastes" emission and the quantity of home scrap, contamination transfer from the city to the country gradually, the pollution range transfer from the living field to the agriculture produce field constantly. At the same time, because of the solid castoff and the city junk stack, which pollute the water and soil, and seize large amount of ground.

### 4.2.4 The influence of urbanization

In the black soil area are distributed Changchun, Siping, Dehui and other cities and towns in Jilin Province. With the acceleration of urbanization, the agricultural black soil resources have been occupied by a few infrastructure constructions (See figure 5), so that the practical function of soil have transferred, and some of the black soil has suffered from permanent degradation[9]. During 1980 to 1999, in Jilin Province, black soil lands with the good quality cut down nearly 20,000 hm<sup>2</sup>. [8]

### 5.1 To Carry out the Study of the Degradation Mechanism

Our country as early as has carried out the related soil degradation question research in the 1950s, but mainly concentrates in the hill mountainous area corrosion prevention, the laterite acidification prevention, the soil fertility restores and so on aspects, although with soil degradation research close related, but the range of study and the depth have the big limitation. The black soil area soil degradation mechanism's understanding and the research are limited, must further strengthen.

Meng Kai, Zhang Xingyi analyzed the mechanism which degenerated to the Songnen Plain black soil to carry on the analysis, divided into physics the black soil degeneration to degenerate, chemistry degeneration and the biological degeneration; Fan Haoming thought that the black soil area agriculture opens up wasteland with the cultivation is causes the black soil outflow the



primary cause, simultaneously, in the humanity intervenes under the condition, certain natural factors to accelerate the influence which the black soil corrodes also obviously to relief come out. Liu Xianchun, Wang Jingkuan et al researched the Northeast black soil area existence's soil erosion form will divide into the water erosion, the wind erosion and the freeze-thaw erosion. The late phoenix qin, Wang Jingkuan et al. have studied in the Northeast area black soil the sulfur distributed characteristic and with the soil nature relations, indicates in the different local black soil the entire sulfur content existence difference. The plant absorption's sulfur element nutrition majority from the soil, along with the section plane deepening, the soil entire sulfur content assumes the drop from the top downward the tendency. The correlation analysis indicated that targets and so on soil entire sulfur and soil ulmin have achieved remarkable or the extremely remarkable related level. After the black soil opens up wasteland, under the present cropping system, the soil fertility, is mainly the organic matter has the remarkable change. Wang Jingkuan also thought that the different black soil area the soil ulmin and the entire nitrogen with open up wasteland the time to have the remarkable relevance, but the entire phosphorus and the entire potassium with open up wasteland the time length obviously not related.

Step up to the understanding of the soil erosion mechanism in the black soil area, and begin with the basic characteristics of the black soil and the starting process in order to study the mechanism and essence of the black soil degradation. Focus on soil erosion, the process and speed of nutrient degradation, the process and the evolution tendency of the black soil degradation, soil pollution and restoration, human interference and impact on soil, and the ecological carrying capacity of the black soil resources and so on. They will theoretically guide the prevention and treatment practice work of the black soil degradation, and provide scientific suggestions.

Table 5: The quantity of water and soil erosion changes before and after the management in the project area in Jilin Province Unit: (t/km<sup>2</sup>a)

|   | The erosion quantity before the management | The erosion quantity after the management | The reduction of soil erosion |
|---|--|---|-------------------------------|
| The slope farmland constructing the level terraced fields | 90.27                                      | 9.98                                      | 80.29                         |
| The slope farmland changing the ridge                     | 216.06                                     | 90.27                                     | 125.79                        |
| The block constructing the cut-ditch                      | 153.17                                     | 9.98                                      | 143.19                        |
| Total   | 459.5                                      | 110.23                                    | 349.27                        |

Note: Data from the 《black soil zone in northeast comprehensive soil erosion prevention and control work report》, December 2006

## 5.2 To Strengthen the Comprehensive Management of Soil Erosion and Water Loss

Unify the soil resources and the environment, distinguish the different types of the degradation, and adopt comprehensive management measures. According to the basic principles of ecology from the ecological balance's point of view, we should combine biological measures with engineering and agricultural measures to make the development and protection unification. On the basis of comprehensive management and research, gradually set up and promote scientific management model to achieve the goal of comprehensively preventing and treating the black soil degradation. In 2003, Songliao Water Resources Commission launched a comprehensive pilot project of preventing and treating soil erosion and water loss in northeast black soil area, marking that the prevention and treatment of soil erosion of this area and water loss have been integrated into national overall plan, which also means the start of carrying out large-scale and high standards to the black soil area.

During 2003 to 2006, Jilin Province mainly carried out comprehensive treatment in Huifa River and Yushu channel pilot area. In the three years, the ecological environment in the project area and farmers' production and living conditions have been remarkably improved. Jilin Province completed the area of total comprehensive management of soil erosion and water loss 6382.96 hm<sup>2</sup>, in of which, the management of farmland 1604.35 hm<sup>2</sup>, barren hills and slopes 872.6 hm<sup>2</sup>, ecological restoration 3761 hm<sup>2</sup>, the completion of a water erosion control, 3 slope stations, 6 small reservoirs, 506 small Water Soil and Water Conservation Project. The completion volume of a comprehensive project was 808,400 m<sup>3</sup>. [2]It has 81.5 percent of the area of soil erosion and water loss reduced to micro, and the black soil's average thickness of 4.82 mm have been protected without losing. Each year, the number of

black soil which is protected is 349.27 t/km<sup>2</sup>, and look at Table-5.

Taking a panoramic view of 3-year comprehensive management of the practice and benefits of the work, what can be seen is that to prevent the degradation in Jilin Province, The biological measures can be taken, such as construction of farmland forest, returning farmland to forests, forestations of barren hills (grass), construction of economic forest in the conditional areas and so on. The agriculture farming protection measures also can be taken, such as ploughing straw back to soil and covering the soil, little tillage and no tillage farming, crossridge, increasing organic fertilizers, and choosing the advanced agricultural machinery and so on. What's more, the engineering measures can be taken, such as building terraced fields, repairing the check dam, additionally building the field drainage facilities and carrying out the gully treatment and so on. To prevent the black soil degradation, the key is that in accordance with the actual situation of the degraded areas; combine the above methods to establish a suitable pattern to the degraded areas.

### **5.3 To Carry out Ecological Restoration Research of Black Soil**

The black soil degenerates the ecology repair should concentrate in two aspects; first, regarding the soil erosion black soil area's ecology repair, another kind is regarding the contaminated soil ecology repair.

Ministry of Water Conservation the upland meadow area (black soil farming and animal husbandry interlocked belt) north the Inner in 2003 Mongolian jarud banner to establish the area is the 10hm<sup>2</sup> experimental model district, guaranteed the soil using the polyacrylamide, to protect fertilizer, to guarantee the function prevention black soil which the water, reformed the land to degenerate, and carried on the ecology repair in the desertification serious pasture, made the good progress. Also has some areas to use plant's and so on planter the survival rate high leguminosae methods, both can maintain the water and soil and may enhance the soil fertility, the prevention soil degradation. Jilin Province should also act according to the actual situation, the development related research, the experimental demonstration, further promotes the implementation again.

Black soil pollution by heavy metal pollution and organic pollution primarily, and concentrates in the industry and the agricultural chemicals chemical fertilizer use many city and countryside intersections and the oil field area. Should

strengthen the heavy metal contaminated soil the chemical fixation plant repair technology, the petroleum hydrocarbon compound contaminated soil plant microorganism repair technology and the agriculture fills the water used biology clean technologies research work, regarding the soil which already polluted carries on the ecology repair.

### **5.4 To Establish Early Warning and Management Information Systems**

At present, we are lacking effective long-term monitoring to the black soil degradation, so we suggest choosing representative places to make the accurate monitoring and research on the black soil loss and its evolutionary process, establishes the black soil area management information system, knows the black soil degeneration tendency comprehensively.

Resources quantity, the quality and ecological environment's change and the dynamic change evolution has the multiplicity and the space and time complex characteristic, the remote sensing, the geography information, the global positioning system and the computer technology solves the resources environment Jindezhen related question effective technological means. At present in the world the most countries had already established the quite mature resources and the environment dynamic monitor system, our country have also completed state-level monitor system's and so on land utilization and land covering change tendency constructions, but the land degradation monitor research are few.

According to the Jilin Province black soil investigation and the existing monitor system's foundation, the black soil resources land utilization's characteristic and so on, being suitable uses the application of local experience to the entire area, namely method which the technical wide range macroscopic monitor and the typical black soil area fixed point network monitor primarily unifies based on "3S". According to black soil degeneration factors and so on performance way, spatial distribution, monitor characteristic carry on the black soil degeneration monitor district, may divide into the black soil corrosion monitor area, the black soil desertification monitor area, the black soil poor denudation monitor area and the salinified monitor area and so on. The unification formulation black soil degenerates the dynamic monitor to plan and to plan, including the monitor content's determination, all levels of monitor cycle's formulation, the localization monitors the mesh point the build and so on. The construction degeneration monitor's

indicator system, the overall evaluation black soil degenerates the influencing factor, establishes quantity, the mass variation overall target system. Foundation black soil resource base database and dynamic monitor database. At the same time, establishes the early warning system and draws up the ecology risk emergency plan.

### **5.5 Perfect legislation, and enhance the awareness of protection**

There are laws to support the protection of the quantity of black soil. However, as to the protection of the quality, the present laws and regulations are not yet perfect, and lack of maneuverability too. We must unify the province's situation, and organize relevant departments to carry out the investigation and research actively, and formulate related rules and regulations, and then enter the legislative procedure after the conditions are ripe, in order to include the protection of the quality of black soil in the legal system, and to create a good environment to the protection. Simultaneously, aiming at the protection of black soil, we should carry out propaganda vigorously through posters, lectures, films and broadcasting and so on to teach farmers the knowledge of the construction and protection of the shelterbelt, choice of scientific planting structure and rational maintenance of soil and usage of fertilizers, so that people who cultivate this land can treasure the precious black soil resources, and protect the black soil and also realize the sustainable use.

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