What are the difficulties in conserving and developing the only four major black soil regions in the world?

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On the earth, there is a special ecological strip, where there are four distinct seasons. In this area, the weather is warm and humid during the summer, and cold and dry during the winter. These unique geographic and climatic conditions have created a rare type of soil - the black soil.

Across this ecological belt, there are only four major black soil regions in the world, namely the Mississippi Plain in North America, the Northeast Plain in China, the Ukrainian Plain in Ukraine, and the Pampas Plain in South America, with a total area of less than 5 million square kilometres. Each black soil region acts as a local repository of black earth and, at the same time, they have gone through the process of development, degradation, protection, utilisation, etc. How do local experiences inspire the conservation of China's black soil region?

One part of the black soil region ready for spring ploughing on the outskirts of Harbin, Northeast China. Photo By Wang Ying, The Beijing News

The four major black soil regions, each one a granary

Black soil is a treasure of nature formed in the course of a long history, and it's only formed in the temperate humid climate with some characteristic conditions, e.g. grassland and meadow vegetation. Year after year, grass grows withered and flourished back and forth, accumulating a thick layer of organic matter on the surface. After millions and millions of years, the black soil formed. Every centimetre of black soil needed hundreds of years to accumulate.

According to data provided by the China Agricultural University, the world's largest black soil region is located in the Ukrainian Great Plain in Eastern Europe, with an area of 330 million hectares, of which 148 million hectares are in southern Russia and 34 million hectares are in Ukraine. This agricultural area was developed early and already had a certain scale at the beginning of the 20th century. Known as the "breadbasket of Europe," it has operated extensively. In the Soviet era, the region's gross agricultural production value accounted for a quarter of the Soviet Union's total output, and sugar beet and potato production occupied more than half of the country.

The second largest area of black soil regions is located in the Mississippi Plain of North America, with 200 million hectares in the United States, 40 million hectares in Canada and 50 million hectares in Mexico. In the United States, for example, the black soil region encompasses most of the Corn Belt and the Wheat Belt, and is an important area of "commodity grain agriculture", known as the "breadbasket" of the United States.

The third largest area of black soil regions is located in Asia, with an area of 120 million hectares, mainly in the north-eastern plains of China. It was only in the middle of the 19th century that agricultural cultivation began on a certain scale. It was only after the founding of New China that large-scale development began, and during the period 1950-1958, Heilongjiang Province experienced the highest growth in arable land in the country, with a 32 per cent increase over 1949. Since then, the pace of development has accelerated even further, and as of 1978, there were 5.93 million hectares of land developed for cultivation in Heilongjiang Province, averaging 200,000 hectares per year. It was also the period when the Northern Great

Wilderness *(Beidahuang)* was transformed into the Northern Great Warehouse *(Beidacang)*.

The fourth largest area of black soil regions is located in the South American pampas, covering 105 million hectares, of which 89 million hectares are in Argentina, 13 million in Uruguay and about 4.3 million in southern Brazil. Argentina occupies the largest area of black soil region and is an important part of the global breadbasket. The region's black soils have been reclaimed for 120 years and are mostly used for growing food, oilseeds, fruit trees, fodder and fibre crops. The main crops grown in Argentina are wheat, maize, sorghum, barley, soybeans and sunflowers, while the black soil region of Uruguay is mainly used for cattle and sheep grazing.

Historical crisis, Black Storm threatens black earth regions

Compared to China, foreign countries have generally developed their black soil regions earlier, and therefore have encountered the problem of black soil region degradation earlier as well.

According to the information provided by the China Agricultural University, in the 1920s and 1930s, due to the excessive destruction of grass and land, the destruction of vegetation on the ground, soil erosion was serious. In the Great Plains of Ukraine and the Mississippi River basin of the United States, highly destructive "Black Storms" occurred one after another. In 1928, the "Black Storm" swept through almost all of Ukraine, destroying 5-12 cm of soil in some places, affecting up to 20 cm of soil surface in the worst cases.

In North America, soil degradation also occurred quickly as European settlers cleared the land. The first dust storm in the United States began in November 1933, which blew away more than 5 cm of superficial soil, and in 1934 a "black storm" swept away 300 million cubic metres of black soil region, reducing wheat yields by 5.1 billion kilograms that year.

In the time that followed, black storms were frequent, and in 1935, data from a United States field erosion survey showed that about 20 million hectares of land were lost to black storms. At the same time, wind-eroded soils suffer severe disruption of their granular structure compared to covered soils.

South America's black soil region also did not escape the crisis. The data show that as early as the early 16th century, the European powers began the colonisation of South America and, in the centuries since then, the increase in the number of people, agricultural development, the rapid development of pastureland, etc., have accelerated the phenomenon of erosion of the black soil region. Until today, soil erosion in the black soil region of South America has been relatively serious.

Black soil conservation, what they have done

With regards to food security, black soil region degradation has attracted the attention of all countries, and almost as soon as large-scale erosion occurs, corresponding conservation efforts begin.

Research data from the China Agricultural University show that the United States began to implement conservation measures after the "Black Storm" occurred, and various forces, including the Government, agricultural enterprises and social organisations, invested huge human and material resources in the protection of black soil region. The United States established soil conservation demonstration sites and soil conservation management areas throughout the country, such as the establishment of an emergency response agency - Soil Erosion Management Bureau in 1933, the establishment of many permanent small watershed demonstration areas. By 1935, the U.S. Department of Agriculture established the Soil Conservation Service as a permanent agency to replace the Soil Erosion Service. At the same time, private soil conservationists were assigned to small watershed demonstration areas to test the effectiveness of soil management and conservation measures. Since then, a conservation tillage system has gradually developed in the United States, and by now, conservation tillage covers more than 75 per cent of the black soil areas of the United States.

The main measures to counteract black soil degradation in Ukraine include crop rotation to preserve rootstocks, row-cropping, ploughing without plough walls, and planting taller crops as hedges on the margins, etc. In 1999, the Government of Ukraine proposed 25 research projects for the immediate future of the country's agriculture, of which four were related to soil use conservation.

In South America, the most basic experience in conservation and utilisation is to follow nature, not to produce in a predatory manner, and to develop and utilise the land in a protective manner. Specific methods include returning slopes to rivers, returning ploughs to forests and grasses, using soils with slopes of more than 3 degrees as pasture areas and planting pasture grasses, and using land with large slopes mainly as forest land. Currently, more than 85 percent of the area in the black soil region of South America is under conservation farming.

What can we learn from experts' opinions and foreign experience?

Compared with foreign countries, the development time of the black soil region is short. The reclamation history of the black soil region is only more than a hundred years. However, because the intensity of reclamation is too large, the degradation crisis has already appeared. In the past 60 years, the organic matter content of black soil plough layer in China has decreased by 1/3, in some areas by 50% . In addition, the black soil layer has decreased by more than 20 cm on average.

"The degree and performance of black land degradation in Northeast China are not the same, but the common feature is that the black soil layer is 'thinning, weakened and hardening'." Li Baoguo, a professor at China Agricultural University, said that compared with foreign countries, China's black soil protection work is more difficult, "there are three main reasons, first, China's man-land conflict is more prominent, the pressure to protect the quantity and quality of black soil region resources is greater, and in the protection, food production also needs to be stable and rising. Second, China's implementation of the family contract responsibility system, each household arable land area is small, and most of them are scattered small plots, resulting in black soil region protection technology in the technical implementation, promotion and policy system are difficult. Thirdly, the regional monsoon climate characteristics of China's black soil region are more distinctive, the terrain is diverse in diffuse post and slope depressions, and the soil types and characteristics are spatially variable, which requires higher regional applicability of black soil protection and utilisation technologies."

On the basis of absorbing and learning from foreign black soil region protection and utilisation technologies, and combining the practical

experience of China's northeastern black soil region over the past decade or so, Li Baoguo put forward three suggestions, namely:

"Firstly, attaching importance to the scientific and technological research and development of black soil region protection and utilisation, and according to the advanced experience of foreign black soil regions, we should pay special attention to the following work at present: vigorously promoting conservation farming or utilisation technologies.

Secondly, systematically planning and optimizing the use of black soil. This involves integrated planning with a systemic view of mountains, waters, forests, fields, lakes and grasslands. Plant forests in forest-friendly areas and grasslands in grass-friendly areas, restore wetlands in a reasonable manner, scientifically determine the area of rice fields and drylands in accordance with the characteristics of water resources distribution, and develop saline and alkaline soil resources in low-lying areas. These measures will guarantee the black soil area great ecological security through the systematic deployment of resources.

Thirdly, implementing innovative technology promotion models, which integrate 'policy, market and technology'. In this way, we will solve the problems of fragmented land plots, low agricultural productivity, low efficiency, and difficulty in technology promotion."