

## LAND RESTORATION IN CHINA

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**ABSTRACT:** China has a land area of 9.6 million km<sup>2</sup>, 65% of the total land area of the world. Only 14.2% is cultivated at present, 0.5% is under fruit trees, 34.8% is in grazing. 17.2% is under forests, 2.6% is used for industry, communication and urban purposes, and 3.5% is covered by water. Of the remaining 27.2%, much is high and barren desert, or under permanent snowfields, or not yet used, or unable to be used with available technologies. Land resources have not been properly developed in some parts of China, owing to the pressure from population growth and other socioeconomic problems. For China as a whole, land restoration has made great progress. One solution is to increase the crop land area through reclamation.

**KEY WORDS:** land use, land restoration

### I. PRESENT LAND-USE IN CHINA

China has a land area of 9.6 million km<sup>2</sup>, 65% of the total land area of the world. Only 14.2% is cultivated at present, 0.5% is under fruit trees, 34.8% is in grazing. 17.2% is under forests, 2.6% is used for industry, communication and urban purposes, and 3.5% is covered by water. Of the remaining 27.2%, much is high and barren desert, or under permanent snowfields, or not yet used, or unable to be used with available technologies. These details are from the Map of China's Land Utilization, at a scale of 1:6,000,000, made by the Institute of Geography of the Chinese Academy of Sciences and published in 1980 by the Map Press, Beijing, and a recent survey by the State Land Administration.

In China, crop land is unevenly distributed although most is concentrated in the eastern monsoon area, especially in highly developed regions such as the North China Plain, the middle and lower Changjiang (Yangtze) Valley, the Sichuan Basin, and the Zhujiang (Pearl River) Delta, where crop lands occupy 50-60% of the total land area. Crop land varies in quality and therefore productivity. According to statistics for 1981-85, 16.8% of the

total crop land is highly productive, with an average yield of 6,000 kg / ha, 46.4% is of medium productivity, with an average yield of 2,250–6,000 kg / ha, and 36.8% is of low productivity, with an average yield of < 2,250 kg / ha.

China now occupies 0.7% of the world's total farmland and supports 0.23% of the world's population. Since 1949, starvation has been eliminated, and China has the largest food output in the world: 332.1 and 353.4 million tons in 1979 and 1982, respectively. At the same time, Chinese farmers have been improving agricultural soil in most parts of the country. One example is the widely distributed paddy soil. Another success is the irrigated oasis such as the ancient one at Dunhuang in the western Hexi Corridor. The rich alluvial plains of those oases have been cultivated and irrigated for more than 2,000 years; the fertile tilth has been developed to a depth of > 2m. To date, China has 0.45% of total crop land under irrigation, which comprises about one-quarter of the total irrigated area in the world.

## II. LAND DERELICTION IN CHINA

Nevertheless, land resources have not been properly developed in some parts of China, owing to the pressure from population growth and other socioeconomic problems. The main aspects are as follows.

### 1. Land Desertification

The total area of desert and desertified land is > 130 million ha, 13.5% of the total area, mainly in the arid and semi-arid northwest. Land desertification has accelerated during the last few decades. The Mu-us Sandy Land, at the semi-arid southern margin of the Ordos Plateau, is probably the most notorious example. Since the Tang Dynasty, more than 1,000 years ago, it has been subjected to the southward moving of a sandy desert, with shifting sands drifting > 100 km southwards. Especially during the last 300 years, owing to the accelerated removal of natural vegetation a broad belt of shifting sands 0.60 km wide has occurred along the Great Wall. Another example is Daqinggou District in the Korqin Steppe. In the 1950s, shifting sandy land occupied 40.2%; but in the mid 1970s, shifting sandy land had developed and occupied 20.7% and semi-fixed sandy land occupied 49.8%. Desertification has developed with astonishing rapidity.

### 2. Land Loss and Soil Erosion

During the last several thousand years, and especially over the last 100 years, many regions have been over exploited, resulting in heavy loss of crop land grassland and forest resources and severe soil erosion. According to the recent data, the total area of soil erosion is > 150 million ha, 15.6% of the total land area.

It is most serious in the Loess Plateau, which was once the cradle of Chinese civilization. Owing to the nature of the original geomorphology, the properties of the loess, the characteristic rainfall, and the effect of the economic activities of mankind on the earth's surface, this area is now subject to severe soil erosion and low agricultural productivity. Yields of grain are  $< 0.75/ha$ . The Huanghe River carries 1.6 billion tons of silt out of this region every year. The topography is changing continuously. The land surface is becoming deeper, wider and longer. Subsequently, erosion results in sedimentation. Slopes become much steeper after the land surface has been broken. This process is then reversed, as the surface moves towards a new topography.

Another example is the old reclamation area in the pioneer settlement belt of Heilongjiang Province. Owing to extensive use of land and the positioning of most crop land on gentle slopes without conservation measures, about half the total crop land has suffered from soil erosion. About a quarter of the total crop land has lost half its top stratum of fertile black earth after  $< 100$  years cultivation. Some areas have lost all their topsoil, leaving yellowish loess parent materials exposed.

### 3. Land Salinization

Salinization is inflicting great havoc in the northwest China and along the coast. According to one estimate about one-fifth of the total crop land in China has suffered to some extent from salinization, the total area of salinized soil is  $> 33.3$  million ha. less only than Australia, the Soviet Union and Argentina. Two kinds of salinized soil are distinguished: (i) salinized crop land, about 6.67 million ha. mainly distributed in the eastern monsoon and coastal areas; and (ii) undeveloped salinized land of  $> 25$  million ha. in the arid and semi-arid regions of the northwest China.

Major causes of salinization are the overuse of irrigation water in arid areas with inadequate drainage. In the oases of the middle and lower reaches of the Tarim River, the largest inland river of China, for example, usually  $> 15,000-22,500 m^2/ha$  of irrigation water (even  $45,000-60,000 m^2/ha$  for paddy rice) are used annually without any drainage. Thus, not only are huge amounts of precious water wasted, but also large amounts of salt are deposited in the crop land every year. Once salinity has built up the crop land has to be abandoned resulting in a barren wasteland. Chinese farmers have now begun ambitious campaigns to combat this hazard.

### 4. Undeveloped Land

Because of particular physical or social conditions unfavorable to the agricultural use of land, there is still 0.32 million ha of potentially arable land throughout China that is not cultivated. This land is chiefly in the northeast and northwest China. The Sanjiang (Three Rivers) Plain in the northeast China is now the most important reclamation area in the

country. From the viewpoint of possible agricultural reclamation, seven major undeveloped regions can be identified (Table 1).

**Table 1 Distribution of undeveloped arable land in China**

Regions	Area of undeveloped arable land (million ha)
North China	6.2
Northeast China	3.5
Northwest China	16.2
East China	1.8
South-central China	2.8
Southwest China	1.5
Total undeveloped arable land	32.0

## 5. Mining

The area of land disturbed by mining in China is probably 0.2 million ha. It has been estimated that, at present, the rate of production of derelict land by miners in China is 20,000 ha / yr., and that by the end of this century the rate will exceed 33,000 ha / yr.. The rate of production of derelict land by strip-mining is also serious. The extent of land damaged by deep-mining subsidence is shown in Table 2.

**Table 2 The extent of land disturbed by deep-mining subsidence in China**

Province or region	Area of land disturbed (ha)
Jiangsu, Anhui, Hebei, Shangdong	2400
Kailuan	8000
Xuzhou	2700
Xinzuongzi in Huaman	270
Zhangzuong, Zhuzuong in Huaibei	200

The total area degraded by man's activities may not seem great in terms of the total land available in China. but these areas are a scarce resource, often in the regions of dense population, where many people suffer from degradation of the land. There are also increasing population pressures, and a threatening country-wide and worldwide shortage of food. Land is not a resource which automatically renews itself like rainfall or sunlight. So we are now having to consider how we are using this critical natural resource. We have to be prepared to restore exploited land to a condition approaching its original biological potential for production and amenity. In China, the need to restore degraded or destroyed land is now widely accepted and is being given priority by the Government and other bod-

ies.

### III. MEASURES FOR LAND RESTORATION IN CHINA

For China as a whole, land restoration has made great progress. As an example of the control of desertified land, a case study of Yangqiaupan in Jingbian County, Shaanxi Province is briefly described in Table 3. In the light of the characteristics of the degraded land in the northern China, the following measures have achieved remarkable results.

1. Land resources in arid and semi-arid lands are used rationally to ensure that the type of land-use is related to the ecological characteristics of the area. The appropriate utilization indices are set in relation to the possible trends and characteristics of the environmental changes after exploitation and utilization.

Table 3 Example of desertified-land control in Yangqiaupan,  
Shaanxi Province China

Type of desertified land	Proportion before control (%)	Proportion after control (%)
Shifting sandy land	38.7	29.8
Semi-shifting sandy land	29.3	16.6
Semi-fixed sandy land	21.3	32.2
New crop land	10.7	21.7

2. Control measures appropriate to local conditions are adopted where desertification has developed. For the last three decades, more than 40 million ha of eroded land has been improved. Of this, 18.3% has been formed into terraced fields and 53.3% has been changed into forest used for water and soil conservation. In the Loess Plateau, the most serious erosion region in China, 0.75 million ha of land has been improved, 17.5% of the total area of erosion in this region. The focus on water and soil conservation has shifted from plot and section improvement to integrated small river basin improvement. In an individual basin, according to local conditions, the structure of the agricultural economy has been adjusted step by step, using technical measures and biological engineering to preserve water and soil, so as to reestablish an appropriate agricultural ecosystem. It is planned that 0.3400 small basins will be improved in various parts of the country, with the total area of > 50,000 km<sup>2</sup>, 5.4% of such river basins had been improved by 1983 in the first stage of the programme.

3. A large-scale shelter belt system has been constructed to mitigate and hold back desertification. The Three North region, which includes parts of the northwest, northeast and north China, stretches from the Pamir Plateau of Xinjiang Autonomous Region in the west to Nenjiang Plain of the Heilongjiang Province in the east, a vast desert land. Some

120,000 km<sup>2</sup> of desert had already formed in this region before history. But in the last half of this century, 50,000 km<sup>2</sup> of newly desertified land has developed and a further 158,000 km<sup>2</sup> is likely to be desertified. Thus, the total desertified area may be > 328,000 km<sup>2</sup>, 3.4% of China, ranging over eleven provinces, 207 counties, with a population of 55 million and crop land and artificial grassland of 10 million ha. To prevent desertification, a programme of construction of shelter-belt systems has been launched in this region, and approved by the State Council in 1978. At the first stage, 5.93 million ha of protecting forest was planted. In recent years, the project has been accelerated and the large-scale shelter belt emerging in the Three North region has become widely known as the Green Great Wall of China.

4. Much mined land has now been restored to the former use in the same or improved condition. Successful work has been carried out by the Tiandu iron mine in Hainan Island. After mining, the spoil was reconstructed, drainage works were undertaken, subsoil and topsoil was replaced and the area was returned to recreation. However, although > 13,300 ha have been restored, the rate of reclamation is probable < 1% each year.

In the contour mining, careful replacement is possible by the block cut method. After an initial section has been cut, the overburden from the next section is hauled back to fill the first section and covered with topsoil. By this method, the disturbed land can be completely restored. Details of reclamation of strip-mined land in recent years are given in Table 4.

**Table 4 Reclamation of derelict strip-mined land in China**

Region	Area of land reclamation (ha)	Area of land restored (ha)	Proportion of land restored (%)
Fushuch	400	61.8	15
Yimahe	400	146.7	37
Xiaohongtan	400	150	37.5
Lingbei	800	200	25
Kebau	133.3	120	90

Deep-mining has attracted other industries and as a result, is now in centres of high population. Consequently, many people are affected by the dereliction, and land becomes sterile in the places where it is in shortest supply. Whole areas have been degraded and economic development retarded. Because of subsidence, land restoration has to begin with earth-removing, to landscape the sites, and drainage has to be undertaken. Cultivation must then follow to relieve compaction. Local progress in reclamation is shown in Table 5.

**Table 5 Local reclamation of deep-mined derelict land China**

Region	Area of land restored (ha)	End-use of restored land
Xuzhou	83.5	Industrial, building
Datuch	27.9	Residential and associated urban
Qiantai	26.7	Fishing
Xinzuongzi	66.7	Forestry
Kailuan	16.7	Industrial, building, forestry
Yiangqian	30.9	Agriculture
Xiaoguan	60.5	Agriculture, recreation

#### IV. COST OF LAND RESTORATION IN CHINA

Owing to the population pressure, China is suffering from a serious shortage of arable land and low productivity. One solution is to increase the crop land area through reclamation. Good-quality arable land is fully used, and the amount of unimproved arable land is limited. It is scattered in remote areas often with adverse climate and is in poor condition. Land reclamation is expensive; at least 3,750–7,500 yuan/ha. In contrast, the average output is only 0.600 yuan/ha/yr. Therefore, the benefit is very low.

Another way of increasing production is to improve low-productivity crop land. This is cheaper than land reclamation and of more benefit. For example, in some areas of Heilongjiang Province, the average investment has been 150–225 yuan/ha for soil improvement and the ratio of productivity has increased by 20%. This is very different from the costs of restoring mined land, which may be very high. The costs include site acquisition, earth removing, drainage, fencing, surface treatment and landscaping, fertilizers, seeds and planting material. Restoration costs following strip-mining have been estimated at 7,500–10,500 yuan/ha, those following deep mining are about 30,000 yuan/ha. However, the costs differ from region to region (Table 6). The costs quoted are well above what might be regarded as the normal value of the land; this seems inevitable. The aim in all reclamation must be to keep costs as low as possible, commensurate with achieving a proper result.

**Table 6 Costs of land restoration after deep-mining in China**

Region	Cost (yuan/ha)
Xiaoguan	15,000–22,500
Bantang	28,500–30,000
Changde	30,000–33,000
Jinping	39,000
Kailuan	> 30,000

## V. POLICY IMPLEMENTATION AND EDUCATION IN LAND RESTORATION

The area of crop land is decreasing, while the quality of some crop land is being upgraded. Ecosystems are being seriously damaged. These problems have aroused serious attention in China. In 1985, the State Land Administration Bureau was established. Since then, acts such as the Land Administration Act (1986) and the Mining Resources Act (1986), following the earlier Environment Conservation Act (1979), have been put into effect.

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