



**Soil and Water loss and control  
measures on the Loess Plateau, China**

**中国黄土高原の  
水土流出災害と対策**

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- ❖ Soil erosion in CHINA is the most severe in the world.
- ❖ This disaster affects an area of 3.56 million km<sup>2</sup>, or 37% of China's entire land area .
- ❖ Particularly on the Loess Plateau, where some 400 million tons of sediments are deposited in downstream riverbeds every year. This causes riverbed levels to rise by 8-10cm every year, making the Yellow River one of the world's most noted "raised bed rivers".





“Loess” and “Yellow water”

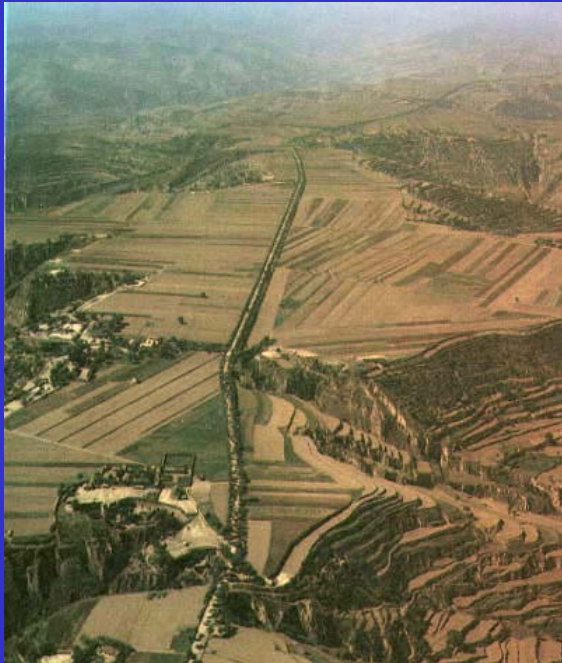
# 1. Topography and climate of the Loess Plateau

Loess Plateau is around 640,000km<sup>2</sup>, making it the world's largest loess region. The Loess Plateau straddles seven provinces in western and northern China.



# The topography of the Loess Plateau consists of:

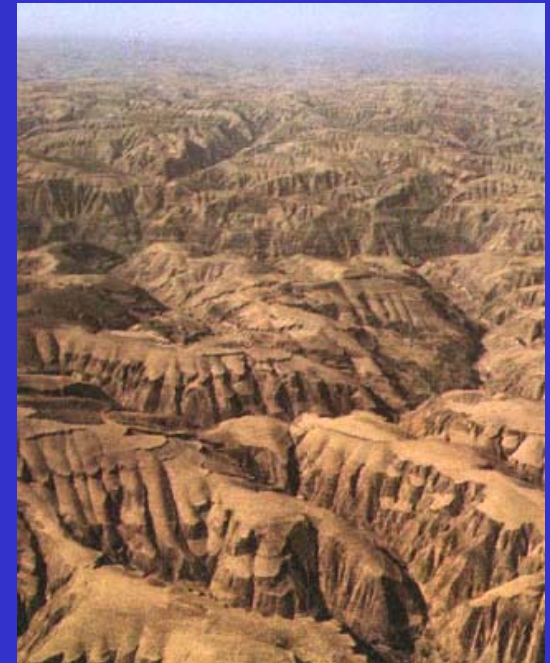
- ❖ “*yuan*” (cliff-edged plains)
- ❖ “*liyang*” (ridges)
- ❖ “*mao*” (hills)
- ❖ “*gou*” (valleys)



cliff-edged plains



ridges



hills



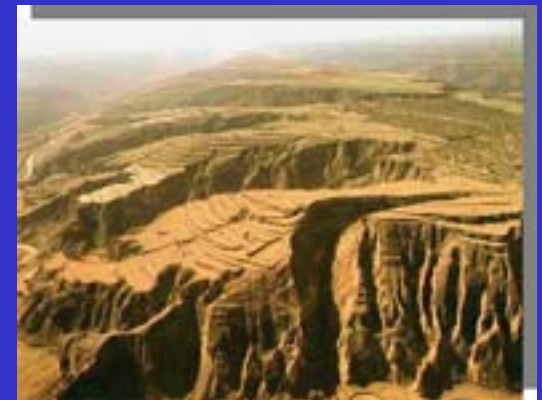
**Loess Plateau is very extreme in relief, the altitude difference between ridges and valleys ranging from tens of meters to 200-300m in some cases. The topography has become fragmented due to severe erosion, and valleys are distributed in a cross-cross, cobweb formation.**

- ❖ **Annual precipitation in this region is 200-650mm**
- ❖ **There is also great seasonal variation in precipitation**  
**54.1% (June-August)**
- ❖ **Despite the meager annual rainfall on the Loess Plateau, much of it is heavy. Rain of an extremely high intensity falls in a particularly short time, and the maximum rainfall in 5 minutes can reach 59.1mm. This approaches the world record for rainfall intensity.**

## 2. Forests on the Loess Plateau

According to the bibliography, the Loess Plateau is known to have been covered in forests and grass plains at one time in the past. Owing to **wars, agricultural activity, economic development** and **other factors**, however, forests on the Loess Plateau have suffered a major decline. In the Qin and Han dynasties (221BC-220AD), for example, the forestation rate was nearly **40%**, had fallen to **6.1%** in 1949.

Thanks to efforts over half a century by the Chinese government, the average forestation rate on the Loess Plateau has now recovered to **9.5%**.





### 3. Soil erosion on the Loess Plateau

The types of soil erosion on the Loess Plateau: **Hydraulic erosion** (raindrop erosion, surface erosion, rill erosion, and gully erosion), **Wind erosion**, **Artificial erosion**(caused by human activity, frequent quarrying, mining, and crop cultivation on slopes) and **Gravitational erosion**(debris flow, collapse, landslide, and tunnel erosion).



## Natural factors influence on soil erosion:

- Loess is soft and susceptible to erosion, as well as collapse.
- High intensity of rainfall in the rainy season
- Sparse vegetation
- Topography

## The results:

Soil erosion area: 430,000km<sup>2</sup>

(The total area is 640,000km<sup>2</sup> )

Soil erosion modulus: 3,700t/km<sup>2</sup>.y

(The maximum can reach 25,000t/ km<sup>2</sup> .y



## **4. Soil and water conservation measures on the Loess Plateau**

On the Loess Plateau, all of soil and water conservation measures carried out in the unit of small basins (30km<sup>2</sup> or less) taking comprehensive account of the natural, economic, social and other conditions of small basins.

**Main measures are as follows:**

- ❖ **Vegetation measures**
- ❖ **Engineering measures** (Terrace field, slope protection and fixation measures, check dam and dam)
- ❖ **Agricultural measures**

## 4.1 Creation of protection forests

The biggest problem in afforestation on Loess Plateau is the shortage of soil moisture. So, before planting forests, the soil must be prepared in order to increase soil moisture. Since rain is relatively frequent in autumn in this region, soil preparation is mainly carried out in autumn.

The most common methods of soil prepared are **Fish-scale pits** and **Level steps**.

# Fish-scale pits

Fish-scale pits is so named because, when arranged in rows along a slope, they resemble fish scales in appearance.



Fish-scale pits is a kind of soil preparation method on steeply sloping land. Here, semicircular holes are dug into a slope, and the excavated earth is used to form a wall around the semicircle, thus preventing water from running off.

The functions of fish-scale pits lie in temporarily storing water that flows down the slope, allowing it to permeate into the ground and thereby storing sediments that flow down with the water. Trees are planted in the fish-scale pits.



## Level steps

Level step is a method used on relatively gentle gradients. Ditches are dug along the contour lines of the slope, the excavated soil is used to form a wall on the outside of the ditch, and the surface flow from the slope is stored, thus adding soil moisture. Trees are then planted in the ditches, as with the fish-scale pits. Level steps are longer and broader than fish-scale pits, and are sometimes used to cultivate pumpkins and other farm produce.



# Tree species

The planted trees are usually indigenous species, selected on the basis of aptitude to local conditions. When planting forests on the Loess Plateau, the more commonly used species include acacia, Chinese pine, elm, poplar, and wild apricot. Drought-resistant shrubs that have low moisture consumption are sometimes used in areas with little water.



10年生刺槐生长状况调查



*Xanthoceras sorbifolia*



油松生长状况调查

*Pinus tabulaeformis*



## **4.2 Creation of terraced fields**

**Terraced fields are mainly distributed on gentle gradients area.**

**Terracing has a major function in preventing surface runoff and soil erosion, At the same time, it is also indispensable to solving the food problems of farmers.**





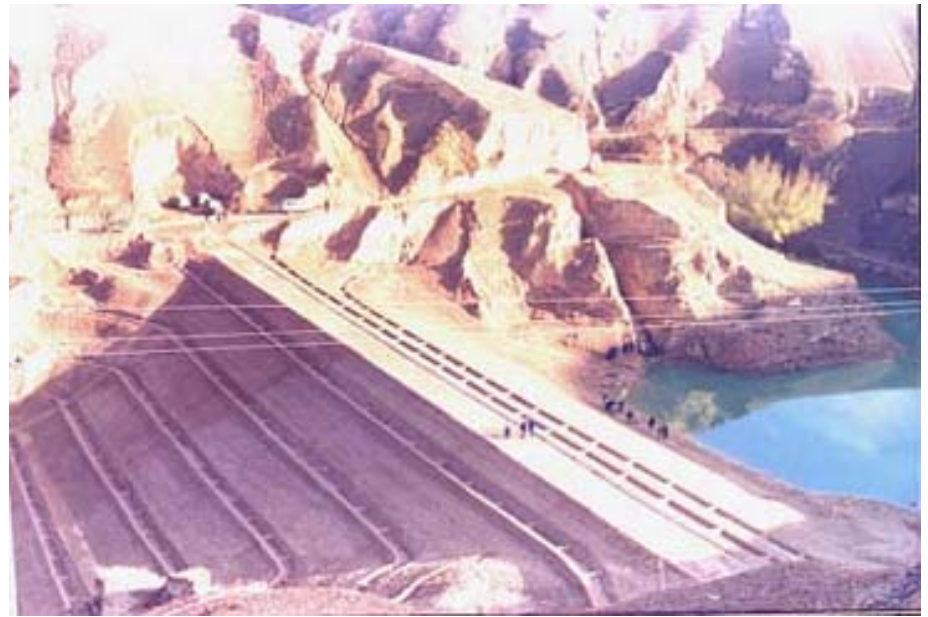
## **4.3 Dams in gully**

**Various forms of slope protection dam are created in valleys on the Loess Plateau.**

- ✓ **Stonewall dams**
- ✓ **Earth dams**
- ✓ **Concrete dams**
- ✓ **Gabion dams**
- ✓ **Earth-filled bag check-dams**
- ✓ **Dams made from loess reinforced with willow**
- ✓ **Dams woven from willow**
- ✓ **Others (according to the type of material used)**



**Earth Check-dam**



**Earth dam**



**Farmland through  
Sediment storage dam building**



**Masonry dam**



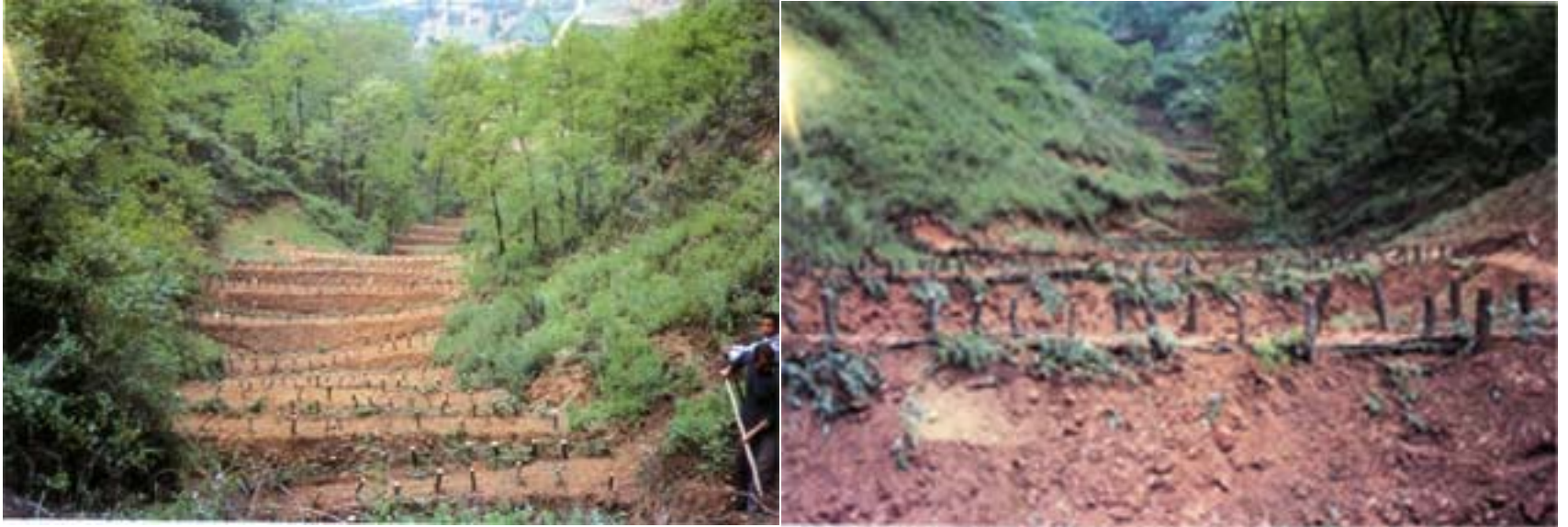
**Masonry dam**



**Concrete dam**



**Gabion check-dam**



**Willow check-dam**

## **4.4 Mountain closing for vegetation restoration**

**One of the causes of severe soil and water runoff on the Loess Plateau is that crop farming, livestock grazing and other human activity has exceeded tolerable limits. In particular, grazing by goats markedly disturbs the land surface, promoting soil and water runoff. As a measure to combat this, ‘mountain closing for vegetation restoration’ is sometimes practiced in places that have been excessively grazed despite a paucity of population and fields, as well as in small basins and other places where soil and water conservation works have not been carried out, for various reasons.**





**Watershed vegetation restoration by “Mountain closing” method**

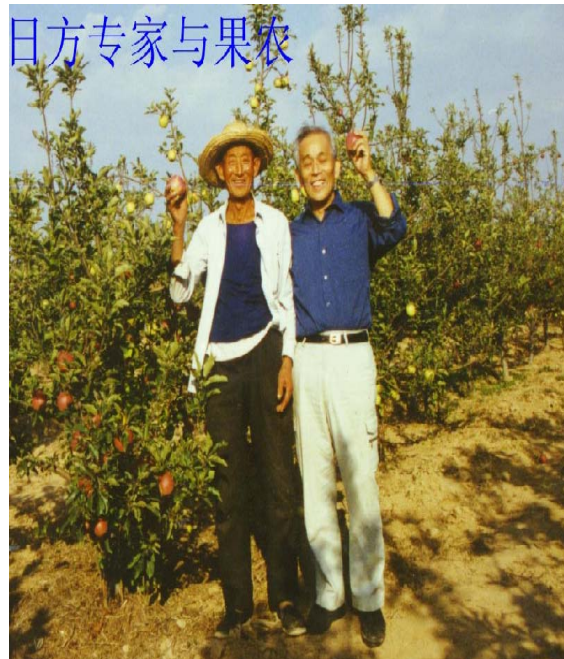
Take the Yuyuan catchment as an example, which has been subject to mountain closing forest nursery continuously for 20 years. In those 20 years, vegetation has been naturally restored, as a result of which this basin is covered with trees. According to a survey, there are 18 families and 49 species of tree now growing in this basin. This is far greater than in basins with manmade forests. The biological diversity of basins that have recovered through mountain closing forest nursery is thought to be extremely rich. Meanwhile, the annual sediment runoff volume from the Yuyuan catchment is a mere 168.83 t/km<sup>2</sup>. Annual soil and water runoff volume from farmland basins in the same region reach as high as 7000 t/km<sup>2</sup>.

In other words, mountain closing forest nursery not only enriches biodiversity but can also reduce soil and water runoff at the same time.

## **4.5 Links between erosion control and social-economic development**

**Since the Loess Plateau is an extremely impoverished region, increasing farmers' incomes and improving the living environment are vital tasks. These are important issues that determine the success or failure of slope protection and flood control. Therefore, when implementing soil and water conservation measures on the Loess Plateau, the aim is to make effective use of water, land, and other exploitable resources, control soil and water runoff and improve the environment, and, at the same time, improve the lives of farmers.**

To help farmers escape from poverty, cultivation of fruit trees and medicinal herbs is planned in small basins on the Loess Plateau. Since there is a wide variance of temperature on the Loess Plateau and hours of sunshine are long, it is most suited to the cultivation of fruit. The cultivated fruit is of good quality and high output.



**Apple**



**Apricot**



*Lycium chinense* Mill.

## **4.6 Publicity and education, and strengthening of management**

### **(1) Policy**

**The Loess Plateau, which suffers severe soil and water runoff, is not only backward economically. There is also a lack of legal awareness, knowledge on soil and water conservation, and so on. To improve the soil and water conservation awareness of local residents, it is vital, for environmental improvement of the Loess Plateau, that the “Soil and Water Conservation Law of People’s Republic of China” (1991, Chinese government) is constantly reinforced and knowledge of soil and water conservation disseminated.**

## **(2) Technical training or education**

To make farmers more proactive, the only option is to inform them directly, through technical training, of practical technology that will increase their incomes. Therefore, TV education programs, newspapers, technical training and other means are used to make farmers aware of agricultural technology, advanced soil and water conservation technology, and small basin management technology. Training in which they can acquire practical or specialized technology to increase incomes and the effects of soil and water conservation is particularly well received.

# Conclusion

- ❖ Soil erosion and water shortage are main problems on Loess Plateau. So, rational use of water resources, erosion control and social-economic development for local farmers are most important things we must to do.
- ❖ Erosion control measures and techniques have made a great progress on erosion control and promoted social-economic development for local people. The techniques have been applied not only on Loess Plateau but also the North China.
- ❖ I believe that techniques mentioned above also can be used in the other areas in the world which has similar condition to that of Loess Plateau.



Thank you!

ご清聴どうもありがとうございます