Soil Conservation Management in the Great Development on the Northwest of China

Cao Wenhong, Su Anping and ***Hu Haihua***

China Institute of Water Resources and Hydropower Research, Beijing, 100044
E-mail: erosion @iwhr.com

Abstract: This dissertation is focus on discussing basic ideas that soil conservation management is carried out in the Great Development on the Northwest. Coordinate construction of forest and grass must be carried out appropriately according to local conditions. Benefits of sediment reduction of the biological measures should be correctly evaluated. Development of soil conservation with saving water is advocated. It is very important to avoid soil loss in construction of economy. The comprehensive management of soil conservation is pivotal to control soil loss of the Loess Plateau.
Keywords: the Northwest of China, soil conservation, the great development

1 Introduction

Bringing into effect the great development plan on the West and quickening development of the middle and west parts of China is the important decision-making by the Central Government in the 21 century. The abundant soil resource, plenty of light and energy, and biologic diversity make up of the potential advantages in development of agricultural economy. Plenty of energy and mineral resources are elementary conditions in development of industrial economy. However, the frangible ecosystem is the most restricted condition to developing economy on the Northwest area. The ecosystem frangibility is mainly represented by the serious soil loss, the sparse vegetation cover, drought and lack of rain, and so on. Especially, the Loess Plateau with the area of 640,000 km^2, in the upper and middle reach of the Yellow River, is the most severely soil eroded area in the world. The average annual sediment inflow to the river from this area is 1,600 million tons. Therefore, it is the key to insure economy and entironment development in phase that water-soil conservation and ecological construction suited to the characteristics of the Northwest region.

2 Natural, social and economic environment

2.1 Natural environment

2.1.1 Landform

The Loess Plateau has a very complex topography. The landforms disintegrate, and there are numerous gullies: in the loess hilly land, there are 3km to 6km of gully per square kilometre. Both hydraulic and gravitational actions cause gully erosion and the erosion modulus of a gully is generally 10 to 70% higher than the land between gullies.

2.1.2 Soil

The Loess Plateau mainly consists of loess deposits except for some rock outcrops. Loess of a loose structure, uniform texture, high porosity and collapsibility is particularly prone to erosion by water and wind.

2.1.3 Vegetation

The cover rate of the natural and second growth vegetation is less than 10%. It is mostly distributed over forest area, rock and earth mountain, and high grassland region. The other area is bare mountain.

2.1.4 Rainfall

Rainstorms during the flood season are the main eroding factor. The average annual precipitation ranges from 400mm to 600mm in most regions of the Loess Plateau. The rainfall is unevenly distributed over a year: Between 60% and 70% of the annual rain falls in the form of rainstorms from June to September. Long-term observations indicate that heavy rains of short duration and high intensity (60mm/hr to 200 mm/hr) in the flood season result in severe soil loss. More than 40% of the total yearly amount of eroded soil may be washed down in one rainstorm.

2.2 Social and economic circumstances

By the end of 1997, the total population in the Loess Plateau is 90.75 million people, in which, the rural population is 69.20 million people. The total output of food supplies is 24.28 million tons, per capita grain availability is 582 kg, and per capita disposable income for rural residents is only RMB 1,019.

The main characteristics of society and economy of the Loess Plateau region are shown in as follows.

(1) Population density distributes unevenly in the Loess Plateau, the population density decreases gradually from southeast to northwest. The density on the southeast is over 200 persons per km^2, and the density in the middle region is 50 to 150 persons per km^2, and the density on the northwest is under 50 persons per km^2.

(2) The land is utilized irrationally: large proportion of cultivated farmland, over 60% of agriculture, forest and herd land. Most farmland is slope tillage.

(3) Land management is at low level. The average yield is low and only about 50kg/mu.

3 Put the comeback of forest and grass on slope tillage into practice on the Northwest

The Central Government emphasizes especially to make the conservation and construction of ecological environment as fundamentality and “cut-in” point of the West Development. However, if the comeback of forest and grass on the slope taken as an important measure of soil-water conservation is carried out successfully on the Northwest region, it will be faced with the following problems:

(1) The land management is extensive cultivation and low harvest.

(2) The irrational socioeconomic activities of human being such as removal of vegetative cover by land reclamation and overgrazing, and opening up of steep slopes intensify soil loss.

(3) Water shortage results in the low live rate of forest and grass.

(4) The capital reconstruction of cropland is imbalance, and there is no farmland even in a few mountainous areas. Owing to capital cropland is constructed slowly, some farmers worried about the restoration of forest and grass on former cultivated land.

Therefore, in order to solve the above problems, the following means are brought forward as follows:

Firstly, it is an essential method to educate and lead local farmers realizing the importance of the comeback and setting up consciousness of the whole society.

Secondly, the comeback and improvement of ecological environment must be related to benefits of local farmers and their enthusiasm must be mobilized. The inefficient cultivation will be altered and the structure of agriculture will be adjusted. In addition, reinforcing construction of capital farmland and basic establishment of water conservancy improve the elementary living-condition of local farmers.

Thirdly, the objectives and tasks of soil-water conservation must be determined according to natural and socioeconomic features.

Fourthly, the laws for Water and Soil Conservation, Forest, Grassland etc. must be carried out and implemented effectively.

4 Adjust measures to local conditions in construction of forest and grass

Corresponding to obvious zonality of rainfall, the horizontal distribution of vegetation on the Loess Plateau also has the evidence zonality from North to South. Therefore, types of comeback of forest and

grass on the steep slope are not same in different areas.

(1) Arid region where rainfall is less than 350 mm

The arid region lies on the northwest edge of the Loess Plateau. Due to rainfall is seldom, water becomes the limitative ecotype factor, and planting trees and grass in normal circumstance is restricted seriously. In this area, it gives priority to plant grass or plant shrubs enduring drought and barren.

(2) Semi-arid region where rainfall is between 350mm and 550 mm

Semi-arid region lies in the middle area of the Loess Plateau. In this area, climate gradually goes to drought from southeast to northwest. The region is suited to construct shrubbery with low water consumption.

(3) Semi-arid and semi-moist region where rainfall is more than 550 mm

Semi-arid and semi-moist region lies in the southeast of the Loess Plateau. There is rich rainfall in this area in action of season wind. The region is most feasible to plant trees and grass on the Loess Plateau and suited to plant shrubbery and high forest.

5 Evaluate exactly sediment reduced benefits of biological measures

Planting trees and grasses is an important measure of soil-water conservation carried out in the Loess Plateau, its main objectives are to improve ecological environment, control water and soil loss and reduce sediment inflow into the Yellow River.

Natural vegetation cover catches raindrops by interception by the canopy and in the forest litter, protects ground, and reduces soil loss. The litter also improves the soil structure by adding humus. However, most vegetation cover in the Loess Plateau is sparse, including natural second growth forest and grassland, and artificial forest and grass. Planted forests and grasses are still young, the canopy density is low and the forest litter has yet to form. Therefore, there are tremendous difference between natural and artificial forests and grasslands. In the past 50 years, it planted 120 million mu of soil conservation trees and 35 million mu of grasses. The amount is great. But according to the analytical result by Yellow River Committee that reduce sediment into Yellow River by all means of soil-water conservation, the amount of sediment reduction for forest and grass is only 20% or so of the total and the amount is about 80% for the structural engineering measures such as check dam and terraces. So we should not excessively overdraw the effect of the artificial forest and grass against loss of soil-water.

6 The integrated harnessing measures is the key to control soil and water loss

In the past 50 years' practice, the Loess Plateau has been given a high priority for soil and water conservation, and techniques for large scale of soil loss control have been developed. Systematic data have been accumulated and much research carried out. Soil conservation on the Loess Plateau has gone from demonstration projects to comprehensive development; from simplistic and dispersed control to integrated control. The integrated control measures include as follows.

(1) It is planned to integrated regulate in the light of local conditions, making small basin as a unit, and united plan to mountains, rivers, farmlands, trees (grasses) and roads, and combined with engineering measures, biological measures and conservation farming.

(2) The sediment of the Yellow River is mainly from sediment-laden and coarse-sediment area on the Loess Plateau. Thus, it is emphasis to harness the coarse sediment area, meanwhile the key engineering works of gully are built in order to effectively reduce sediment load into the Yellow River.

(3) Water and soil conservation system with complete set and scientific reasonable measures will be established giving considerations both to regulation and development, ecological and economic benefits.

(4) The Law on Water and Soil Conservation must be implemented effectively in order to strengthen management of soil and water conservation work.

7 Advocate developing water-soil conservation with saving water

It is drought and there is little rain in the northwest region. Additionally, the limited annual rainfall is distributed unevenly and 70% rainfall is collecting in 3 to 4 months. So water shortage phenomenon is

very serous in the region. How to save water by each tache and establish water saving society has been a strategic task.

The meaning of soil-water conservation includes 2 aspects of water conservation and soil conservation. So soil-water conservation measures reduce sediment load and also reduce runoff to a certain extent. Soil conservation on the Loess Plateau has gone through long-tern and large scale of harnessing, the sediment inflow into the Yellow River basin has been reduced by an estimated 300 million tons per year and the runoff has also been reduced 2 billion m^3 per year. Therefore the reduction of runoff for soil-water conservation is hardly neglected. It is imperative under the situation to establish the soil-water conservation with saving water on the northwest region owing to water shortage. For examples, tree and grass seeds enduring drought are selected and vegetations with high consumption are not planted.

8 Prevent water-soil erosion in construction of fundamental facilities

Most fundamental construction and resource development, such as exploiting mines, extending roads and building factories, need to quarry and borrow, and may destroy the original landform and vegetation as a result ecological environment is damage greatly. The serious soil loss would be made if soil-water conservation is not regarded reasonably in construction. For example, the border area of Shanxi, Shaanxi and Inner Mongolia of the Loess Plateau is a coarse and much- sediment area with weak ecological environment, and contains abundant of mine resources. Only in the four coalfields of Shenfu, Dongsheng, Zhunger and Hedong, the known areas of coal are 33,000 km^2, the known reserves of coal are over 200 billion tons and equal to the third of the total all over the country. The known reserves of natural gas are over 100 billion m^3 now. It is the national energy base under construction. Along with the base construction, small towns and fundamental facilities such as railway, road, electric power plant and water supply etc also are developing rapidly, and the areas of waste solids are spreading gradually. The amount of annual waste solids is 80 million tons only in the above four coalfields, in which, 30 million tons flow into the Yellow River. According to investigation and analysis, the additional soil-water loss is over 10% of the total loss because of irrational exploiture.

In order to bring the great development on the Northwest into effect and quicken construction of fundamental facilities, the involved departments of government have made primary programming. The highroad construction is the emphasis of traffic and transport. The constructions of railway, airport and pipeline of natural gas are roundly strengthened. Therefore, the construction of ecological environment must be put in especially important position under the great development on the Northwest. The existing experiences and lessons in constructions of fundamental facilities must be summarized and extracted, and the waste solids must disposed appropriately, the destroyed vegetation cover must be recovered. It is absolutely allowed to gain economic development in condition of damaging environment.