

CONCLUSIONS

Environmental Conditions in the Region

The upper reaches of the Yangtze River are located in the second topographic level, as well as in the transitional zone between the first and the second levels which cover several geological structural units. All types of rock, ranging from pre-Sinian crystalline rock to loose rocks of the Quaternary Period outcrop throughout the whole region. Intensity of neotectonic movements and earthquakes decreases from the western to the eastern areas. Purple sandstone and purple mudstone are prevalent in the region and provide material for mass wasting.

The region is located in the subtropical monsoon belt and the climatic conditions are warm and humid with heavy precipitation. The average annual precipitation ranges from 800mm to 1,000mm with certain variations from place to place. Seventy to ninety per cent of the annual precipitation is received from May to October. However, big storms and heavy precipitation are the major factors behind soil erosion in the region.

The Jinsha, Yalong, Min, Jialing, and Wu are the main rivers in the region, and the Jinsha River and the Jialing River are the main contributors of sediment to the mainstream of the Yangtze. According to hydrometric data on sediment discharge at Yichang, the average annual sediment discharge is about 530 million tonnes. Of this, 240 million tonnes is from the Jinsha River, and 145 million tonnes is from the Jialing River and both account for 72.6 per cent of the total.

Evergreen broad-leaved forests are prevalent in the region. The main broad-leaved tree species are *Fagus spp.*, *Carpinus spp.*, *Acer spp.*, *Betula spp.*, and *Tilia spp.* In ravines, on steep mountains, and in hilly regions, the common trees are pine, cypress, and Chinese fir. Economic tree crops in the region are oranges, tangerines, tung oil, and tea. Below elevations of 1,000m, the natural vegetation has mostly been removed and turned into farmland, and this could be a major factor behind soil erosion. Soils in the region are red earth, yellow earth, yellow-brown earth, brown earth, purple soil, and paddy soil. The geographical distribution of vegetation and soil in the region varies with the bio-climate and mountain elevation and shows regular variations in horizontal and vertical directions.

The anthropography is characterised by overpopulation, high population density, uneven distribution, and multiethnicity. The total area of four soil-water conservation zones is 3,04,000sq.km. with a total population of 65.3392 million, of which the agricultural population accounts for 59.3526 million. The average population density is 215/km², varying from place to place (in the high mountains there are only 34/km²). In the lower reaches of the Jinsha River, more than ten ethnic groups, including the Yi, Miao, Hui, and Tibetans, are settled.

Rich natural resources and a diverse climate provide good conditions for agriculture, forestry, and animal husbandry. Data on the land use structure in 154 counties point out that the total farmland covers 7.8297 million ha, accounting for 25.75 per cent of the total land, forest land 43.65 per cent, grassland 12.88 per cent, water bodies 3.01 per cent, barren land 6.10 per cent, and non-productive land 8.61 per cent. In general, the land use structure is not rational. The low carrying capacity of sloping farmland is coupled with its low ability to withstand natural disasters.

Recent Status of Soil Erosion in the Region

Data on soil erosion in the upper reaches of the Yangtze River point out that the total area affected by soil erosion is 3,52,000 sq.km. accounting for 35 per cent of the total area of the upper reaches of

the Yangtze River. The average annual soil loss is 1.568 billion tonnes. The region can be classified into four zones by taking erosion modules as the main classification index.

1. An indistinct erosion zone which covers the upper-middle reaches of the Jinsha, Yalong, and Dadu rivers and the upper reaches of the Min, Balong, and Chengdu Plains with a total area of 4,64,200sq.km.
2. A mild erosion zone which covers the northeastern and northwestern border mountains of the Sichuan Basin, the middle-lower reaches of the Wu, and the upper reaches of the Qi, with a total area of 1,76,200sq.km. The annual erosion on the surface is 209.15 million tonnes.
3. A moderate erosion zone covering the middle-lower reaches of the Jialing, the lower-reaches of the Min, the Yalong, the upper reaches of the Wu, the Chishui Basin, the Niulan River Basin, the Heng Basin, and the Yangtze River Basin from Changling to Yichang with a total area of 2,43,100sq.km. The annual erosion of solid material on the surface is 769.94 million tonnes.
4. Several erosion zone areas cover the upper reaches of the Jialing, the middle-lower reaches of the Balong, the lower reaches of the Yalong, the Anning, and the Jinsha from Dukou to Pingshan with a total area of 11,200sq.km. The annual erosion of solid material on the surface is 383.52 million tonnes.

Factors behind Soil Erosion in the Region

The natural factors behind soil erosion are : high mountains, steep slopes, loose soil texture, low vegetation coverage, and a pronounced rainy season with plenty of high intensity precipitation. The soil erosion in the region is aggravated by anthropogenic factors and these have been recapitulated in brief below.

1. Rapid population growth in some areas. For example, in the middle-lower reaches of the Jialing, where the population density increased from 370/km² in 1950 to 596 /km² in 1987.
2. A high reclamation ratio and a large amount of sloping farmland. The average reclamation ratio is 32.46 per cent which is much higher than the national average of 10.4 per cent. Sloping farmland with a gradient of five has an annual soil loss of about 7,14T/sq.km., whereas for sloping farmland with a gradient of 10 it could be 9,260T/sq.km., 15,137T/sq.km. for 20° slopes, and for 25° slopes 21,334T/sq.km.
3. Deforestation. Forest resources in the region are not being used and protected properly. Excessive felling and overcutting for farmland, fuelwood, and construction have resulted in the reduction of forest coverage. For example, in 15 counties in the middle-lower reaches of the Jialing River, forest coverage decreased from 19.75 per cent in 1950 to 8.92 per cent in 1989.
4. Capital construction, such as mountain infrastructural works, building material enterprises, new settlements, mining, and hydropower stations in the mountains, could trigger or aggravate the soil erosion.

Constraints to Socioeconomic Development in the Region

Soil erosion constrains socioeconomic development in several ways.

1. Land resources are destroyed through the thinning of topsoil and loss of organic matter from the soil. Field data show that thinned topsoil could increase runoff coefficient while decreasing water-holding capacity, hence reducing the drought resistance of sloping farmland.
2. The silting of rivers and water projects.
3. Degradation of eco-environmental conditions and poverty.

Until now, people in many areas affected by soil erosion are living beneath the poverty line. In Guizhou Province, there are 11 counties in the Yangtze River Basin, of which 10 counties are affected by soil

erosion. In Yunnan Province, 71.4 per cent of the poor counties are located in areas affected by soil erosion.

Soil-Water Conservation in the Region

How to make these normally productive? Some of the aspects that should be taken into consideration in the future are given below.

1. Promulgated laws and regulations concerning soil management and soil-water conservation such as "The Law of the People's Republic of China Conservation Environmental Protection" (September 13, 1991); "The Forest Law of the People's Republic of China" (September 20, 1984); "The Law of the People's Republic of China on Land Management" (June 25, 1986); and the "The Soil-Water Conservation Act" should be effectively enforced in soil management and soil-water conservation projects.
2. In China, many authorities are working on soil management and soil-water conservation because of their own concerns. This causes overlapping or gaps in soil-water conservation projects. Therefore, an authorised agency is needed to coordinate the work vertically and horizontally.
3. Full and rational use of local natural resources and disposition of conservative farming, biological measures, and engineering in line with local conditions.
4. Radical planning and integrated management with high benefits. Priority should be given to the following aspects.
 - (a) Converting sloping farmland for agriculture into terraces in order to increase the unit output of farmland and solve the "eat and wear" problem of poor farmers. In the middle and lower mountain areas, the reclamation coefficient should be restricted from 0.3 to 0.5 for farmland in foothill areas with a population density of 700 km². Sloping farmland unsuitable for agriculture should be converted into forest land and grassland.
 - (b) Soil-water conservation should be combined with market economy developments in order to increase the income of the local people in soil-water conservation areas. For example, in the middle-lower reaches of the Jialing River, mulberry plantations and sericulture should be developed; the lower reaches of the Jinsha River have good sunshine and thermal conditions for sugarcane and diverse fruits to grow.
 - (c) Build small-scale water conservation projects and carry out soil-water conservation engineering. Form a water system composed of ditches, water pools, and sediment storage dams on the slopes.
 - (d) Integral combination of conservative farming, biological measures, and soil-water conservation engineering.
 - (e) Soil management and soil-water conservation on benefit-gains' scales. Soil-water conservation on odd areas of farmland should be changed to proper watershed management practices.
 - (f) Family planning is a necessary measure for successful soil-water conservation and the education level of the local people also needs to be increased.