

NATIONAL SOIL-WATER CONSERVATION PROJECTS IN THE REGION AND LESSONS FOR THE FUTURE

The Yangtze River Basin has an important strategic role in the social and economic development of China. Recent data on soil erosion point out that soil erosion-prone areas in the Yangtze River Basin total 5,62,000 sq.km. of which 3,52,000 sq.km. are located in the upper reaches of the river, accounting for 62.6 per cent of the total. Soil erosion causes constraints in socioeconomic development not only in the upper reaches of the Yangtze River but also in the middle and lower reaches of the river.

Since 1949, some local soil-water conservation projects have been carried out in the area and some of the experiences from these projects have been recorded. Based on old projects and the current situation, a new national project on soil-water conservation in the region was launched in 1988.

National Planning of Soil-Water Conservation in the Upper Reaches of the Yangtze

The upper reaches of the Yangtze River were demarcated as a priority soil-water conservation region in China by the State Council of China in 1988. The soil erosion prone region in the upper reaches of the Yangtze is divided into four soil-water conservation zones: 1) the lower reaches of the Jinsha River and the Bijie Prefecture; 2) the middle-lower reaches of the Jialing River; 3) the upper reaches of the Jialin River; and 4) the Three Gorges. The total area of land is 3,04,000sq.km. of which the Jialin River Basin occupies 1,60,900 sq.km.; the upper reaches of the Jinsha River and the Bijie Prefecture 1,187,005 sq.km.; and the Three Gorges 24,400 sq.km. The locations of the four key zones for soil-water conservation are shown in Figure 6.1 (Commission Office for Soil-Water Conservation 1990). The detailed areas of each of the four key zones are listed in Table 6.1.

Principles of Planning

Five points for planning soil-water conservation projects in the upper reaches of the Yangtze River are described below.

- I The upper reaches of the Jinsha River and Bijie Prefecture
 - II The middle-lower reaches of the Jialing River
 - III The upper reaches of the Jialin River
 - IV The Three Gorges
- a) Fundamental Planning Policy. The fundamental planning policy is a "combination between prevention and conservation with the priority being given to prevention; integrated management is carried out according to local conditions; high priority to four zones, extension to other soil-erosion prone areas".
 - b) According to local conditions and the socioeconomic development stage, under the leadership and coordination of the local government, rational land use in agriculture, forestry, husbandry, fishery, and infrastructure should be determined.
 - c) Three Combinations. (i) Ecological effect - economic effect and social effect, (ii) long-term effect and short-term effect, and (iii) management, exploitation and utilisation and anti-poverty should be considered simultaneously in planning for soil-water conservation.
 - d) Small-scale watersheds should be taken as units to control soil and water in a comprehensive way.

Table 6.1: The Area of Each of the Four Key Soil-Water Conservation Zones

Zone	Province	Prefecture	County	No. of Counties
Lower Reaches of the Jinsha and Bijie Prefecture	Yunnan Province	Chuxiong Yi Autonomous Prefecture	Mou Ding, Yao An, Yuan Mou, Dayao, Wu Ding, Yong Ren, Nan Hua, Chuxiong, Lu Feng	9
		Zhaotong Prefecture	Qiaojia, Zhao Tong, Yiliang, Yongshang, Suijiang, Nu Dian, Da Guan, Yan Jin, Heizi, Shui Fu, Zhen Xiong	11
		Dongchuan City	Suburb (county level)	1
		Quichien Prefecture	Dian, Huize, Malong, Xuan Wei, Quichien	5
		Kunming City	Panlong, Wuhua, Guan Du, Xishang, Jinning, Fumin, Chenggong, Luquan, Anning, Songming	10
	Guizhou	Bijie Prefecture	Hexhang, Weining, Bijie, Dafang, Jiasha, Qianxi, Zhijin, Nayong	8
	Sichuan	Liangshan Yi Autonomous Prefecture	Huili, Ningnan, Leibo, Jinyang, Huidong, Buge, Butuo, Zhaojue, Meigu	9
		Yi Bin Prefecture	Yibin, Pingshang, Yibin City	3
		Subtotal	9	
	Upper reaches of the Jialin (Longnan and Shan Nan)	Longnan Prefecture	Xihe, Lixian, Chengxian, Kangxian, Wudu, Wenxian, Dangchang, Liangdang, Huixian	9
		Tianshui Prefecture	Qincheng, Beldao	2
		Gan Nan (Tibetan) Zangzu Autonomous Prefecture	Zhouqu, Diebu, Mingxian, Luqu	4
		Hanzhong Prefecture	Lueyang, Ninqing, Zheg Ba, Nanzheng, Xixiang	5
		Baoji City	Fengxiang	1
	Sub-total	5		21
Middle-lower Reaches of Jialin	Sichuan	Guangyuan City	Suburb (county level), Qingchuan, Jiange, Wangcang	4
		Mianyang City	Suburb (county level), Pinwu, Jiangyou, Beichuan, Anxian, Santai, Yanting, Zitong	8
		Deyang City	Zhongjiang	1
		Aba (Tibetan) Zangzu Autonomous Prefecture	Nanpin	1
		Suining City	Shizhong, Pengxi, Shehong	3

Zone	Province	Prefecture	County	No. of Counties
Middle-lower Reaches of Jialin	Sichuan	Neijiang City	Anyue, Lezhi	2
		Nanchong Prefecture	Langzhong, Nanbu, Pengan, Guangan, Yuechi, Wusheng, Xichong Nanchong City (county level), Yilong, Yingshan, Cangxi, Huaying	13
		Daxian Prefecture	Tongjiang, Nanjiang, Bazhong, Pinchong, Daxiang, Xuanhan, Wanyuan, Dazhu, Quzian, Daxian City, Kaijiang, Baisha	12
		Chongqing City	Tong Nang, Tonglian, Heduan, Bishan	4
	Sub-total	9		43
		Fuling Prefecture	Fuling, Fengdu, Dianjiang, Wulong	4
		Daxian Prefecture	Kaijian (most of the county is located in the Jialing Basin)	1
	Sichuan	Qianjiang Prefecture	Shizhui	1
		Wanxian Prefecture	Lianpin, Kaixian, Wuxi, Zhongxian, Wanxian, Wanxian City, Yunyang Fengjie, Wushan	9
		Chongqing City	Jiangbei, Nanan, Shapinba, Jiulongpo, Baxian, Changshou, Jiangbei (district at city, county level)	7
Three Gorges	Hubei	Exi Tujia Autonomous Prefecture	Ba Dong	1
		Yichang Prefecture	Zigui, Xingshan, Yichan	3
		Shen Nong Jia	Forest area (county level)	1
	Sub-total	8		27
Total		29		152

Source: Commission Office for Soil-Water Conservation 1990

- e) A combination of engineering-biological measures and conservative farming measures, slope management and gully management, revegetation (reforestation and grass plantation), and land closure should be considered.
- f) The investments needed to meet the planned target should be met by the local government through mobilising local resources with some financial support from the central government.

Planning Procedure

Planning for soil-water conservation in the upper reaches of the Yangtze River is based on an engineering systems' theory, while considering the dynamic equilibrium of the population-environmental carrying capacity. Figure 6.2 shows the planning procedure.

Targets of the Soil-Water Conservation Project in the Upper Reaches of the Yangtze River

- a) **Population Projection.** In China, the legal population growth rate is 0.9 per cent. Because most of the soil erosion-prone areas are in the mountains, the qualifications of the population are relatively low and the population proportion of the minorities is large, giving them a projection

of a 0.10 per cent growth rate. The total population in this region in 2000 A.D. will be 73.7371 million, of which the agricultural population will account for 66.9846 million. The agriculture/population density will increase from 195 persons/km² in 1988 to 220 persons/km² in 2000.

b) **Land Use Adjustment.** The land use structure in this region should be adjusted according to the following aspects:

- the steep sloping farmland on gradients of more than 25° should be gradually turned into forest land or grassland;
- revegetation, which includes silviculture for soil-water conservation forests and non-timber product forests;
- greening of the barren land; and
- rapid growth of non-productive land use should be controlled and slowed down.

The adjusted land use structure for the soil-water conservation zones is given in Table 6.2.

Management of Sloping Agricultural Land. In the soil-water conservation project area, sloping farmland accounts for 62.17 per cent of the total farmland. Management of sloping farmland has two aspects.

1. Turning sloping farmland into terraced farmland (1.9629 million ha).
2. Conservative Farming. Agricultural technology, such as contour tillage, strip cropping, furrow and ridge tillage, plastic film covering, and fallow, should be used according to local conditions. At the end of the planned period, sloping farmland of 1.6679 million ha will be cultivated through conservative farming technologies.

Forest-Grass Measures for Soil-Water Conservation. The total afforestation and reforestation area will be 6.1787 million ha in the project area of which non-timber producing forests will cover 1.6499 million ha and firewood forests 2.2628 million ha. The grass plantation area will cover 1.2315 million ha.

Table 6.2: Land Use Change in Soil Erosion Conservation Zones (unit: million ha)

Item	Total Area	Farmland		Forest Land		Grassland		Others	
		Area	% against total	Area	% against total	Area	% against total	Area	% against total
Present Status	30.4032	7.8297	25.75	13.2718	43.42	3.9158	12.88	5.3860	17.72
At end of the planned period	30.4032	6.5689	21.61	14.9554	49.19	4.9596	16.30	3.9335	12.90

Source: Ibid

(Others: Water bodies, infrastructure, settlement, waste land, etc.)

Soil-Water Conservation Engineering. During the planned period, soil-water conservation engineering of 2,570 items (including sediment storage dam, check dam, and water pools will be constructed, drainage ditches along all slopes, diversion of water tunnels, and flood drainage works) in the project area covering 132.60 million sq.km. will be carried out.

Closing Land for Revegetation. The total land closed for revegetation in the project area will amount to 5.8667 million ha.

Management Aspects

Some of the management measures to be taken have been described below.

- a) Establishing and Developing Institutions for the Project and Coordinating Concerned Agencies into the Project. The soil erosion conservation project covers many diverse socioeconomic sectors and is a comprehensive engineering system with social, ecological, and economic aspects. Therefore, in 1988, the State Council of China approved the establishment of "The Committee for Soil-Water Conservation in the Upper Reaches of the Yangtze River" to be responsible for both planning and implementing the soil-water conservation project. Committees at different levels for soil-water conservation in the project area have been established accordingly and this has been initiated by the principal local government leader.
- b) Policy Formation to Mobilise the People to Work on the Project. Some policies have been formed to mobilise the local people to work on the project, and these vary from county to county in the project area. Some of the major policies carried out are described below.

A Contract Responsibility System was established whereby farmers have the right to contract and manage the new bench terraces built by them. This contract can be handed down to coming generations. Loans, relief, and supply of agricultural materials, such as fertilisers, plastic film, agricultural chemicals, and improved varieties of seeds, will be given to such farmers.

Preferential Support Policy, guaranteeing strong support from the government for people who work hard on the soil-water conservation project has been established.

In the project area, lack of family planning is one of the key constraints to soil-water conservation because of the rapid population growth. The environmental carrying capacity has an imbalance in terms of the local population. Therefore, family planning must be taken into consideration in implementing the project.

Training

Training soil-water conservation technicians and local farmers and involving the local people in decisions made by experts to ensure success of the soil-water conservation project.

Financial and Economic Aspects

The total investment in the project over the planned period is to be approximately U.S.\$ 1.94280 billion of which 20.2 per cent (US\$ 0.39251 billion) will be given in the form of subsidies from the Central Government for the construction of soil-water conservation engineering. Table 6.3 lists the subsidies for different soil-water conservation engineering projects.

Table 6.3: Subsidies for Soil-Water Conservation Engineering Projects (unit: U.S \$/ha)

Item	Converting sloping farmland into terraces	Non-timber producing forests	Other forests	Grass plantations	Land closure for revegetation	Integrated measures
Subsidy	115.1631	71.9770	20.1536	8.6372	3.4549	23.0326

Source: Ibid

(Exchange rate between US\$ and RMB in 1990)

The local contributions will amount to US\$ 78.5030 million, accounting for 4.04 per cent of the total. The investment of the local people in terms of labour will be US\$ 1.47179 billion, accounting for 75.76 per cent of the total investment.

Soil-Water Conservation Benefits

The soil-water conservation benefits include economic benefits, ecological benefits, and social benefits. The ecological and social benefits are not easily quantifiable and are merely mentioned here.

Direct Economic Benefits

The direct economic benefits of the soil-water conservation project are generated by turning sloping farmland into terraces, soil-water conservation forest, and grass plantation. These are listed in Table 6.4.

Table 6.4: Breakdown of Direct Economic Benefits

Item	Area (10 ⁴ ha)	Gain (based on average amount/ha)	Unit price (US\$)	Benefits - starting year
Turning sloping farmland into terraces	196.2940	1125(kg)	0.0960/kg	1992
Soil-water conservation forests	Timber forests	226.5900	Stand growth 3.0m ³	1994
	Non-timber producing forests	164.9920	Output *	1994
	Firewood forests	226.2840	6000kg	1994
Grass plantations	123.1453	5025kg (hay)	0.0549/kg	1992
Total	937.3053			

* 262.50kg/ha for tea-oil, tung trees, Chinese tallows; 375.00kg/ha for tea; 12,000kg/ha for fruit; 150kg/ha for mulberries; 52.50kg/ha for Chinese prickly ash; 750.00kg/ha for Chinese chestnuts, walnuts; 112.50kg/ha for Chinese lacquer

Source: Ibid

Indirect Economic Benefits

The indirect economic benefits of the soil-water conservation project are described below.

Benefit of Water Storage. The water storage increment is calculated according to average annual precipitation, average annual runoff, and the type of soil-water conservation engineering.

Annual water storage by new soil-water conservation engineering methods is about 87,000 million cubic metres. The total benefit will be US\$ 3.3391 million based on water costs at US\$ 0.0038 per cubic metre.

Benefit of Soil Conservation. The synthesised data on soil erosion from a number of places in the upper reaches of the Yangtze River indicate that the soil-water losses will be reduced against the old level by soil-water conservation measures. The reductions are as follows:

- turning sloping farmland into terraces, 80 per cent;
- forests with technical soil-water conservation measures on slopes, 80 per cent;

- non-timber producing forests, 70 per cent;
- grass plantations, 60 per cent;
- conservative tillage, 60 per cent; and
- closing land for soil-water conservation, 60 per cent.

The value of soil conservation is based on the reduced capacity of reservoirs because of silting and the costs of unit reservoir capacity. According to the project target, the annual silting of reservoirs and other water projects could totally be reduced by 161 million cubic metres, the loss of reservoir capacity could accordingly be reduced by US\$ 6.18 million per annum (at US\$ 0.0384 cost of unit reservoir capacity) and these can be considered as economic benefits of soil conservation.

Benefit of Soil Fertility Conservation. This benefit is obtained from the quantity of equivalent fertiliser which is converted from N.P.K. contents in soil lost by erosion. The soil fertility conserved each year is equivalent to 6.7184 million tonnes of fertiliser at a cost of US\$ 2.0845 billion.

Until the end of the project period, the soil-erosion prone area is projected to decrease from 1,70,544.90sq.km. in 1988 to 1,460.6sq.km., soil loss from 772.5088 million tonnes to 235.0392 million tonnes, and erosion modulus from 4,530T/sq.km. per year to 1,378T/sq.km. per year.

Increment of Vegetation Area and Coverage

In the project area, the forest land and pastureland will increase from 12.3329 million ha in 1988 to 18.4116 million ha at the end of the project period; vegetation coverage will increase from 28.4 per cent to 55.7 per cent.

Soil-Water Conservation Project

The soil-water conservation project can sustain the development of agriculture and other economic sectors and increase the anti-poverty capacity in soil-erosion prone areas because of the reasonable land use structure and improved eco-environmental conditions. At the end of the project period, the gross agricultural product will be U.S \$ 11.4818 billion and it will be an increase of 192 per cent over 1988.

Case Study - The Project in Practice

Since 1989, 78 counties in the project area have started to implement the soil-water conservation project. Some progress has been achieved during the last two years (Sichuan Office for Soil-Water Conservation 1991).

(1) Ningnan Case Study

Ningnan County is located in southwestern Sichuan Province on the left bank of the Jinsha River and has a total area of 1,670sq.km. It has an area of 918.6sq.km. affected by soil erosion, accounting for 55 per cent of the total area. Until 1990, areas affected by soil erosion totalling 114sq.km. were brought under planned management and 957.6ha of sloping farmland were turned into terraces.

(a) Important Experiences. Some of the important experiences gained in implementing soil-water conservation projects are described below.

- Combining the conversion of sloping farmland into terraces and building water conservation projects, because water conservation is a major constraint to subtropical agricultural

development in mountain areas. The benefit of converting sloping farmland into terraces is that irrigation systems are improved.

- Establishment of Demonstration Sites. Demonstration sites on the conversion of sloping farmland into terraces have been established. These need certain conditions such as easy access, a comprehensive management system covering the mountain area, water, forest, farmland, and infrastructure to a certain extent and with benefits of scale.
- System of rewards and penalties - the three points to be observed are given below.
 - The deadline is given to complete the conversion and this deadline should be kept, otherwise the farmers involved are fined.
 - Those converting the land will benefit from the new land for 30 years and will be given a land certificate to use the land.
 - Farmers who have fulfilled the contracted quota will be supplied with a certain amount of fertiliser at fixed government prices.
- Small-scale watersheds as basic units for soil-water conservation management.

- b) Benefit of the Soil-Water Conservation Project. Huatan Township in Ningnan County received marked benefits from watershed management from 1989 to 1990. During these two years, sloping farmland of 225.6T/ha was converted into terraces. Ninety-six water conservation projects have been completed with a total length of 113km. A water pool containing 5,000 cubic metres of water has been repaired. In 1990, the total output of grain was 5.0150 million kilogrammes, and this was an increase of 20.2 per cent over 4.173 million kilogrammes in 1988. The average per capita grain output was 605kg; the total output of sugarcane was 613,000 tonnes, an increase of 46 per cent over 42,000 tonnes in 1988. The average per capita income in terms of selling sugarcane was US\$ 94.8177. The total output of silkworm cocoons was 2,14,000kg, an increase by 188.6 per cent over 76,000kg in 1988. The average per capita income from the selling of cocoons was US\$ 26.2956, and the total income was US\$ 166.3628, an increase of US\$ 124.7601 in 1988. Therefore, the living conditions of farmers have risen from "enough to eat and wear" to "well-to-do". The farmers in the township possess 916 bicycles, 14 motorcycles, 1,277 radio cassette recorders, 900 sewing machines, 1,513 colour television sets, 95 washing machines, and 19 vehicles. Their total savings' deposits are US\$ 673,704.00.

The soil-water conservation project in the township has preliminarily functioned to attack poverty in areas affected by soil erosion to improve the local ecological conditions. For example, the area covered by vegetation accounts for 65 per cent of the total area.

(2) Shizhong District of Suining City (County Level)

The Shizhong district of Suining City is located in the central part of the Sichuan Basin on an area of 1,873.31sq.km. The total population is 1.29 million, out of which the agricultural population totals 1.16 million. The average per capita holding of farmland is 0.056ha. Since 1989, an area of 198sq.km. affected by soil erosion which contains 10 small-scale watersheds has been managed with preliminary benefits.

- (a) Forest Coverage Increased. During the past two years, a soil-water conservation forest of 4,506.70ha has been planted. Non-timber producing and fruit forests account for 1,673.30ha, fuelwood forests 940.00ha, and 1,133.33ha have been closed to allow young plantations to develop. Forest coverage has increased from 6.6 per cent to 23.08 per cent.

- (b) Soil erosion in the managed area has effectively been controlled. Integrated management of this area includes the following aspects:
- converting sloping farmland into terraces: 1,506 to 6,667ha;
 - repairing old water pools: 349 items;
 - constructing new water pools: 3,759 items;
 - constructing sediment storage dams: 22,997 items;
 - building flood drainage works and water tunnels: 1,408.00km; and
 - conservative farming practised on 13,320.00ha.

According to a field survey of the managed area of 198sq.km., the total soil loss and erosion modules decreased from 1.7281 million tonnes and 8,728T/sq.km. per year in 1988 to 0.619 million tonnes and 3,116T/sq.km. per year respectively.

- (c) Soil moisture increased. The field survey points out that, after converting sloping farmland into terraces during the rice-growing season, about 97 per cent of the total rainfall could be contained by the soil used. After afforestation on the wasteland in managed areas, runoff of about 0.5278 million cubic metres was held *in situ* during one year.

- (d) Land carrying capacity improved. After converting sloping farmland into terraces, several changes could be observed:

- grassland on farmlands decreased by 13.5° on average; and
- the topsoil has increased, areas with topsoils of less than 30cm have increased by 79.9 per cent; areas with topsoil ranging from 30cm to 50cm increased by 54.9 per cent; and areas with topsoil of more than 50cm increased by 4.6 per cent.

- (e) Grain output increased. In managed areas of 1,510.1333ha, grain output increased by 2.8003 million kilograms.

- (f) Income increased in 1990, along with the agricultural income from grasslands in managed areas (US\$ 18.7286 million), at the rate of 10.2 per cent over 1988. The average per capita income has increased from US\$ 55.4702 in 1988 to US\$ 71.7850.

(3) Guangan County

Guangan County is located on the western side of the middle section of the Huaying Mountains which stretch along the eastern borders of the Sichuan Basin. It has an agricultural population of 1.04 million. Areas affected by soil erosion total 1,019.9sq.km., accounting for 64.89 per cent of the total area with erosion modules of 7,351T/sq.km. per year.

- (a) Progress. According to 1990 data on the project, since 1989 some achievements have been realised in the county. They are as follows:

- conversion of sloping farmland into terraces, 940.0ha;
- soil-water conservation forests, 1,486.6667ha;
- non-timber product forests, 7,600.00ha;
- grass plantations, 280.00ha;
- closing land for soil-water conservation, 820ha;
- conservation tillage, 5,926.6667ha; and
- water projects: 1,120 water pools, 192 small reservoirs, 16,075 silt basins, water diverting tunnels, 282km.

(b) Benefit from project progress. The landscape of some of the soil erosion-prone areas has changed. Nan Feng was at first a barren foothill. However, during the past two years, sloping farmland of 45.3333ha has been converted into terraced land of 80ha and this has been closed for reforestation - there is a peach orchard, a plum orchard, and a pear orchard of up to 20,000 fruit trees.

After converting sloping farmland of 940ha into terraced land, the topsoil depth on the new farmland of 40.67ha increased from 5cm to 50cm on terraces covering 540ha. The water-holding capacity also increased from 17 per cent to 20.5 per cent. Soil loss decreased by 69,100 tonnes and the contents of organic matter in the soil to 223.96 tonnes.

Terracing combined with a water conservation system on the slopes results in the runoff being conducted down the slope in a safe non-erosive manner.

In 1990, the grain output from the terraced area increased by 1.215 million kilogrammes being equivalent to the total grain output of one medium township. The per capita income increased by US\$ 20.

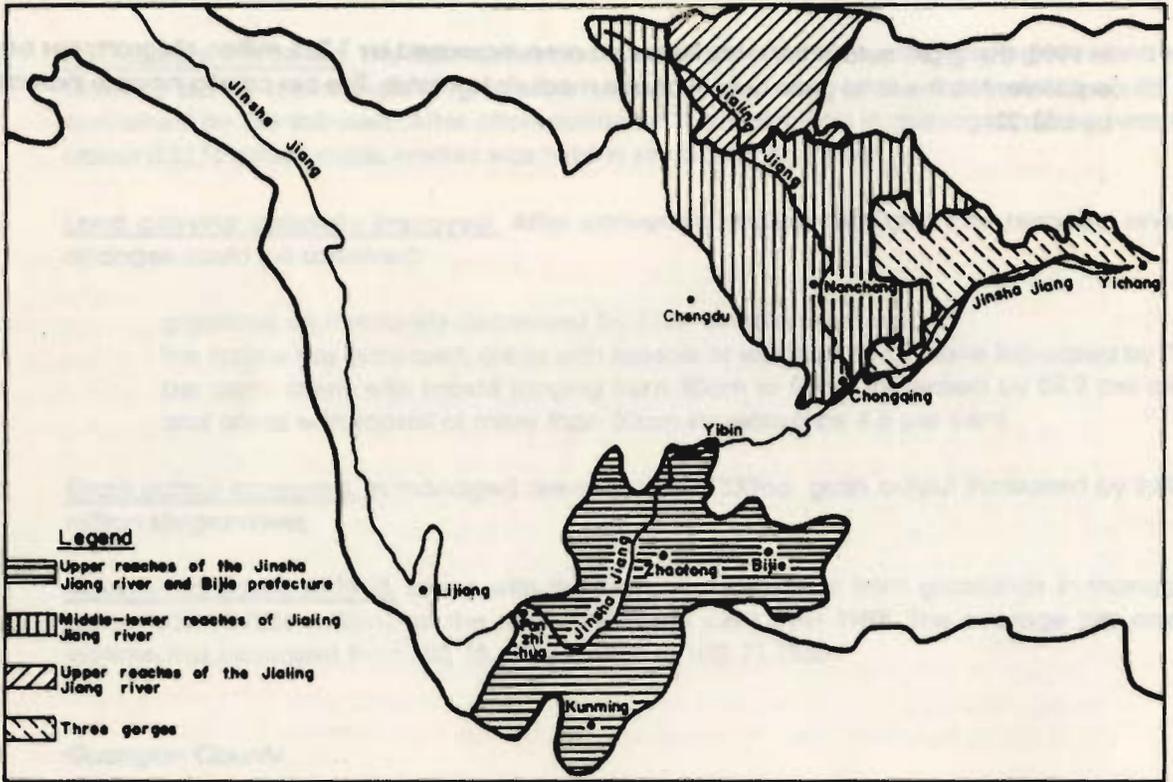
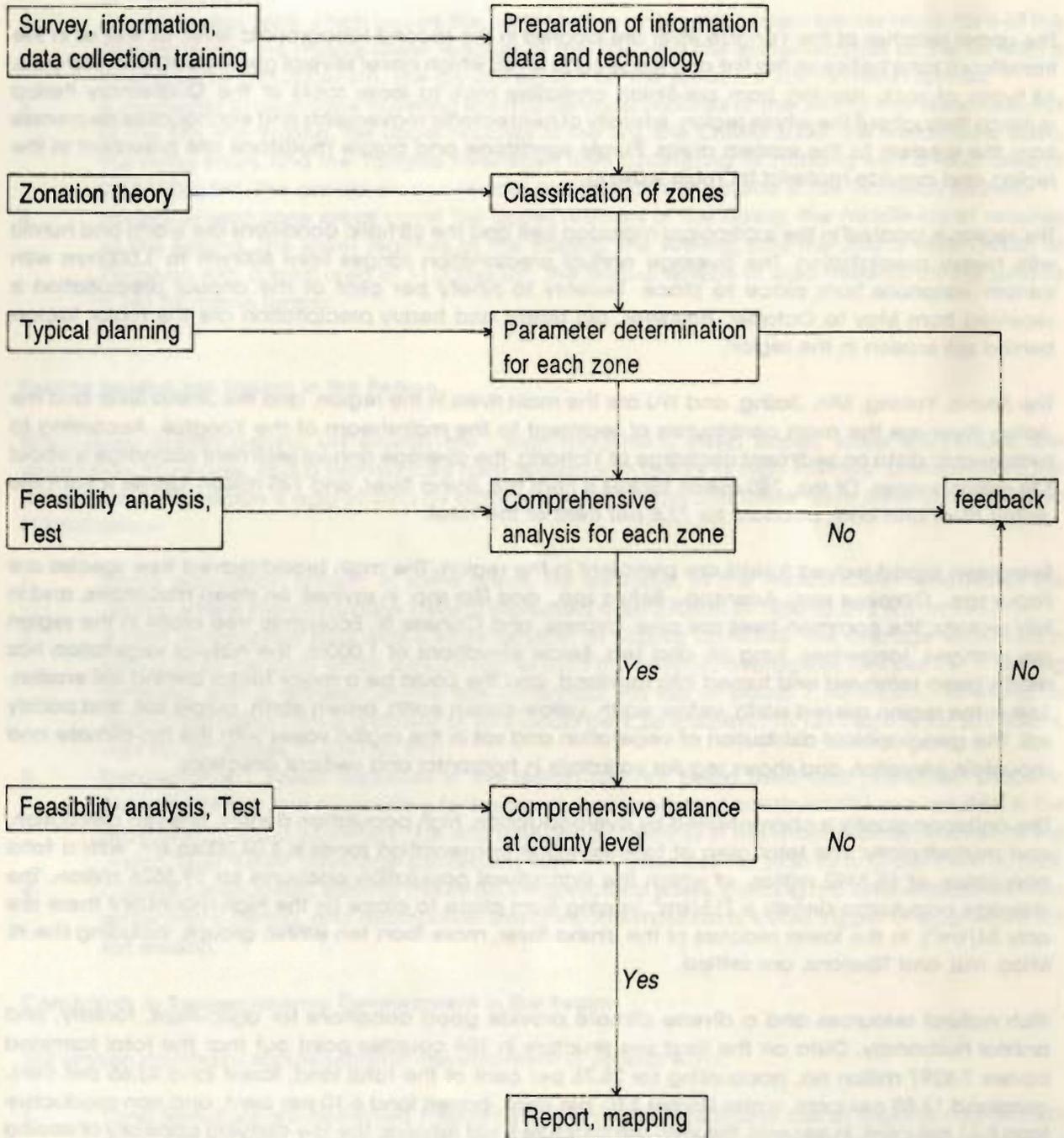


Figure 6.1: Sketch Map of the Four Key Soil-Water Conservation Zones in the Upper Reaches of the Yangtze River

Source: Commission Office for Soil-Water Conservation 1990

Figure 6.2: Flow Chart of Planning Procedures for Soil-Water Conservation in the Upper Reaches of the Yangtze River



Source: Commission Office for Soil-Water Conservation 1990