

SOIL AND WATER CONSERVATION IN CHINA

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1 SITUATION OF SOIL AND WATER LOSS IN CHINA

China has an area of 9.6 million km² with high land in the west and low land in the east. Mountains, hills and plateaus account for 2/3 of the total area. Out of the total area, arable land is around 135 million hectares or 14%, forestry is around 167 million hectares or 16.5%, natural grassland is 280 million hectares or 29%, fresh water body is 18 million hectares or 2%, land used for construction is 27 million hectares or 3%. The rest 35% are composed of deserts, gobis, glacier and rocky mountains which are difficult for agricultural use. Most part of China belongs to the east Asian monsoon climate with a sharp temperature difference between the north and south. It is cold and dry in winter due to the Siberia cold current, hot and rainy in summer under the effect of warm and wet monsoon from the southeast of Pacific Ocean. Most of the rain falls in July and August. The annual mean precipitation in various areas differs greatly. The annual precipitation decreases from above 1,500mm in the southeastern coastal areas to below 50mm in the inland northwest gradually.

China is one of the countries suffering from most serious soil and water loss in the world. Due to its special natural, geographic, social and economic conditions, soil and water loss has become a major environmental problem. Soil and water loss in China has the following characteristics:

(1) Wide distribution and large area. According to the results of the second national remote-sensing survey released recently, the total area of soil and water loss in China is 3.56 million km², accounting for 37% of the total national territory. This includes 1.65 million km² affected by water and 1.91 million by wind, out of which 260,000 km² is affected by both water and wind. It is found that the west part of China suffers the most serious soil and water loss with the largest area of 1.07 million km², the central part with an area of 490,000 km² and the east with an area of 90,000 km². The soil and water loss is mainly distributed in the middle and upper reaches of the Seven Main Basins, such as the Yangtze River, Yellow River, Pearl River, Haihe River etc.

(2) Differentiated erosion causes and complicated types. Erosion caused by water, wind, freezing and thawing, and gravity such as landslides and mud-rock flows has different features and is interlinked. The Loess Plateau in the northwest, black soil zone in the northeast, red soil hills in the south, mountainous areas with both rock and earth in the north, rocky mountains in the south are mainly affected by water erosion and certain gravitational erosion. The Qinghai-Tibet Plateau is mainly affected by erosion caused by freezing and thawing. The sandy area and grassland in the dry west suffer from serious wind erosion. The areas with both farming and husbandry in the semi-arid areas of the northwest are affected by the combination of both water and wind erosion.

(3) Serious soil loss. According to statistics, the annual soil erosion in China amounts to 5 billion tons. The total annual soil erosion in the Yangtze River basin is 2.4 billion tons, including 1.56 billion tons from the upstream. Sediment from the Loess Plateau of the Yellow River basin into the river is as much as 1.6 billion tons. The most serious soil loss occurs in 18 tributaries, located from Hekouzhen to Longmen of the Yellow River, covering an area of 78,600 km² with the soil erosion modulus from 5,000 t · km⁻² to 3,0000 t · km⁻².

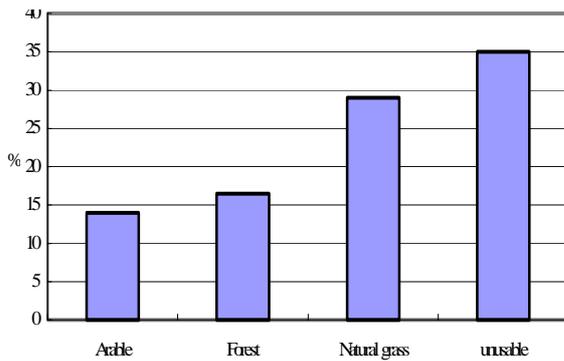


Fig.1 Percentage of Different Land Types

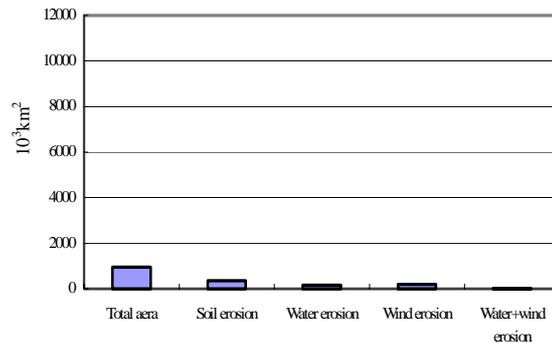


Fig.2 Area of Different Erosion

The serious soil and water loss has adversely affected the economic and social development, and people's production and life in China to a great extent.

(1) The area of arable land has decreased and land is degrading. During the past 50 years or so, China has lost over 2.66 million hectares of arable land due to soil and water loss, more than 66,000 hectares every year. Around 1 million km² of grassland has suffered from degradation, desertification and salinization, which is 50% of the national total grassland. Since the beginning of 1990s, a total area of 2,460 km² has been desertified every year.

(2) Sedimentation has made floods and water logging even worse. Sedimentation caused by soil erosion in the rivers, lakes and reservoirs has reduced the storage capacity of water projects and the flood carrying capacity of the natural river courses, which have made the floods even worse. Around 400 million tons of sediment, especially coarse sediment (diameter >0.05mm), settle in the Lower Yellow River every year, which makes the river bed rising by 8cm-10cm each year on the average and has formed the famous "perched river" resulting difficulties in flood control. One of the causes of the devastating basin-wide flood in the Yangtze River in 1998 was serious soil and water loss in the middle and upper reaches and ecological degradation, which sped up the concentration of rain runoff.

(3) Efficient water use is affected and drought increases. 3/5-3/4 of the rain water in the Yellow River basin is wasted due to erosion and ineffective evaporation. To reduce the storage capacity loss of reservoirs due to sedimentation, some reservoirs on the mainstream and tributaries of the Yellow River have to release a lot of water to reduce sedimentation. Every year, 20 billion m³ of water are used for flushing sediment into the sea to lower down the river bed in the Lower of the Yellow River.

(4) Ecological degradation aggravates poverty. Destroy of plantation reduces the conserving capacity of water and makes soil change into sand or rock and sand storm increases. In the meantime, as the soil layer is becoming thinner and the productivity reduces, poverty is becoming more serious. Over 90% of the poor in China live in the areas with serious soil and water loss.

Apart from natural, geographic and climate conditions, human activities are also the main causes for soil and water loss, including overlogging, overfarming and overgrazing, neglect of protection during construction and development. Irrational water development and utilization causes ecological and environmental degradation.

2 ACHIEVEMENTS IN SOIL AND WATER CONSERVATION IN CHINA

China is one of the countries suffering from most serious soil and water loss. Meanwhile, it is also among the countries with a long history of soil and water conservation and rich experiences in this field. Since the beginning of the 20th century, China has begun to explore the law of soil and water loss, which has laid basis for erosion control. Since the founding of

the People's Republic of China in 1949, the Chinese government has attached great importance to soil and water conservation and accumulated experiences of control with a small watershed as a unit, overall planning and integrated management based on years of practice. In 1991, the National People's Congress issued the "Soil and Water Conservation Law of the People's Republic of China", which made soil and water conservation legally binding. Between 1998-2000, the Chinese State Council approved and implemented "National Planning of Ecological Improvement" and "National Guidelines for Ecological and Environmental Protection", which outlined the master plan for soil and water conservation and ecological improvement for the early 21st century and incorporated soil and water conservation into the strategies of sustainable development and great development in the west. In recent years, the Chinese government adopted a proactive fiscal policy to utilize government bonds in large-scale ecological improvement projects. In areas with serious soil and water loss in the upper Yangtze River, the middle Yellow River and around the city of Beijing, such major ecological improvement projects as key soil and water conservation sites, transformation of sloping farmland into forestry, sand prevention and control have been implemented. Great achievement has taken place in soil and water conservation, as shown in four aspects.

At first, the key projects for soil and water conservation in the 7 main river basins, such as the upper reaches of the Yangtze River, the middle and upper reaches of the Yellow river etc., have been well implemented with great progress. In the areas with severe soil and water loss, such as the upper reaches of the Yangtze river, the middle reaches of the Yellow river and the ring area surrounding Beijing, a series of major engineering works for ecology rehabilitation have been put into practices, including transformation of sloping farmland into forestry, sand prevention and control etc. For the key projects, it adheres to take large rivers as the diaphysis and small-watersheds as the basic unit to implement integrated management for the mountain, water, forest and roads. Such projects have produced significant results. The amount of sediment discharged into the Yellow River decreases 300 million tons per year. The projects not only reduce sediment deposition in rivers, lakes, and reservoirs, but also improved agriculture conditions and ecological environment. It is supported by the local people sincerely. In the meantime, attention has been paid to allocate water for ecological use. Water transfer has been successfully carried out in the downstream and wetlands of the Tarim River and the Heihe River, which has played a positive role in ecological improvement, oasis rehabilitation and desertification control.

Secondly, the practice of improving eco-environment by the power of Nature has been implemented in the lightly eroded regions with low population density. In recent years, while harnessing of soil and water loss by the key projects is on the way, the new way to speed up step of soil and water conservation has been explored actively and great advancement has been made by the practice of improving eco-environment by the power of Nature in the areas of fragile ecology, less population density and slight erosion. The national pilot practice covers 128 counties. The prevention and protection practice was implemented in the "Resource of the Three Rivers" with an area of 300 thousands km². There are 894 counties implementing practice of mountain enclosure without cultivation and graze in an area of 520 thousands km². In the process to hasten eco-environment rehabilitation, the corresponding construction measures, such as small-watershed of optimal quality and high efficiency, water resource engineering, animal raising by enclosure, ecological immigration, and electric power to replace firewood, are strengthened. These measures resolve the problems of production and lives of the mass well and provide conditions for practice of improving eco-environment by the power of Nature in a large area. From the experiences in the past two years, practice of improving eco-environment by the power of Nature is not only successful in South China with plenty of rainfall, but also feasible in North China with less precipitation.

Thirdly, promoting soil and water conservation according to law has played an active role in the control of man-made soil and water loss. Through serious implementation of Law of SOIL AND WATER CONSERVATION, the soil and water conservation consciousness of the public has been promoted obviously. Especially the “three simultaneity” system was carried out in the development and construction projects, the soil and water loss in the construction process was decreased. It is required to conserve soil and water while starting the construction of roads, railways, irrigation works, mining and urban development to prevent the destruction of vegetation. This practice effectively controls the man-made soil and water loss and decreases the sediment flowed into the rivers, lakes and reservoirs.

Fourthly, new advancement in study of soil and water conservation has been achieved. The second national remote-sensing survey of soil and water loss completed in 2002, through which the current status and developing trend has been well mastered, providing a scientific basis for the macroscopic policy-making of the national eco-environment rehabilitation and The taproot theory and key technique studies including water use in ecology, development strategy of soil and water conservation are conducted. The middle and long-term development strategy and action plan of soil and water conservation in China have been proposed. 22 specifications related to the preliminary phase of projects, quota budget, etc. of soil and water conservation have been established, which form the main system of technique standard for soil and water conservation. Taking “3S” technology as a breach, the modernization of monitoring network and information system for soil and water conservation have been promoted. A large number of advanced and practical technologies, such as terrace construction by machines, water systems on slopes, check dams for building farmland, sluicing-siltation earth dams, water diversion for flushing sand dunes, rainfall collection, water-saving irrigation, plant fences, system of pig-raising, pond and fruit trees, optimal collocation of tree, shrub and grass, pre-warning of slope slide, etc., have been popularized according to the local conditions, which ensure the exertion of soil and water conservation benefit.

With practices in soil and water conservation for over half a century, a Chinese way of soil and water conservation has been formed as follows:

(1) Adhering the philosophy of keeping pace with time, adjusting the train of thought in work according to the situation actively, constantly exploring new approaches to speed up the control of soil and water loss. Based on the new requirement for the eco-environment rehabilitation from economy and social development and the improvement of living standard of the people, practice of improving eco-environment by the power of Nature has been implemented to speed up the process of control of soil and water loss and for the harmonious relationship between man and the nature, while the artificial control is intensified.

(2) Focusing on prevention and controlling soil and water loss in accordance with the law. Based on the “Soil and Water Conservation Law”, the Chinese Government has established a complete soil and water conservation legal system and a monitoring and supervision system. The policy of “focusing on prevention” has been adopted and legal supervision has been strengthened. It is prohibited to develop arable land on the steep slopes and encouraged to improve soil and water conservation of development and construction projects so as to avoid man-induced erosion.

(3) Scientific planning and integrated management on the basis of small watersheds. China has carried out soil and water conservation by establishing scientific plans and on the basis of small watersheds, bringing mountains, waters, farmlands, forests and roads under integrated management, optimizing combination of structural measures, biological measures and tillage practices and putting forward preventative measures in accordance with potential hazards to establish a multipurpose prevention and control system.

(4) Combining development and management to coordinate three major benefits. During

the process of conservation, the control of soil and water loss has been closely linked with the development and utilization of water and land resources, giving prominence to ecological benefit, emphasizing on economic benefit and taking social benefit into account so as to achieve coordination among these three major benefits. The public awareness in soil and water conservation has been further awakened while obvious economic benefits have been achieved in the process of soil and water conservation and ecological improvement.

(5) Optimizing allocation of water resources, appropriately arranging ecological water uses and coordinating the water used for production, livelihood and ecological purposes. Meanwhile, during soil and water conservation and ecological improvement, the bearing capacity of water resources should be taken into full consideration, which means areas with different water and land resources are suitable for different plantations.

(6) Improving conservation standards and efficiency on the basis of scientific and technological advance. China emphasizes on combining theory with practice and on combining science and technology with production in soil and water conservation to fully exhibit the leading role of science and technology. By increasing international cooperation and exchange, China has introduced advanced technologies, ideas and management models from foreign countries. China also attaches importance to the transfer of scientific achievements into production and extension of various kinds of practical technologies. Such methods as demonstration and training have been adopted to educate farmers to raise their consciousness of scientific management so as to improve the quality and efficiency of conservation.

(7) Establishing an operational system combining government activities with market economy. By enacting preferential policies, such as lease, contracting, joint ventures and barren land auctions, the government has stimulated the public interest to form a multi-entity, multi-channel and multi-level soil and water conservation mechanism, in which the entire society is actively involved in the control of soil and water loss.

Publicizing extensively to raise public consciousness of soil and water conservation. Organized by the government, guided by the media along with various educational channels, the "Soil and Water Conservation Law" and other related laws and regulations have been publicized to raise public consciousness of the hazard of erosion and the importance of conservation.

3 OBJECTIVES, TASKS AND MEASURES OF SOIL AND WATER CONSERVATION OF CHINA

The 21st century is an important era for the whole world to concentrate on harmonious development of economy and nature. The Chinese Government has regarded soil and water conservation and ecological improvement as an important basis for economic and social development in the 21st century, and clearly defined their strategic objectives and tasks. The main thought for soil and water conservation in the near future is: Sustainable utilization of soil and water resources and keeping ecological environment in favorable conditions through closely aiming at the three objectives, earnestly implementing four tasks, and conscientiously adopting eight kinds of measures in order to provide sustention and guarantee for the comprehensive construction of a relatively comfortable society.

On the three objectives The first is to reinforce the control of non-point pollution from chemical fertilizers and pesticides, the water resources protection and ecology improvement related to rivers, lakes and reservoirs, and efficient decrease in soil and water loss and sediment entering rivers. The second is to encourage the adjustment of rural economy structure prominently, to use land and water resources effectively and sustainably, and therefore to increase income of peasants when the agriculture production conditions are improved greatly. The third is to pay great attention to the improvement of environment quality for urban and rural residence, to promote harmony between man and nature, and to

build nice homesteads and to raise living standard of the people.

About the four tasks The first is to control soil and water loss via prevention and supervision. The prevention, protection and supervision management should be specially strengthened in areas of major sources of water supply, reservoir areas, fragile areas in ecological environment, integrated areas of energy and intensive exploration to decrease the soil and water loss from exploration and construction of engineering works to the minimum. The second is comprehensive management. The management of the areas with grievous soil and water loss in the upper and middle reaches of the Yangtze and Yellow rivers, the area of black soil in the northeast, and sand prevention and control around Beijing and Tianjing will be accelerated continuously, that the comprehensive renovation will be insisted on taking small-watersheds as units. More attention should be paid to the key and demonstration projects. The construction of check dams for building farmland would be encouraged greatly at places with favorable conditions. The third is about rehabilitation of eco-environment. In the remote regions with low population density, suitable rainfall and slight soil and water loss, the rehabilitation of eco-environment will be implemented through the practice of mountain enclosure without cultivation and grazing, transformation of slope farmland into forestry, relying on the power of nature, to promote the eco-environment rehabilitation in a large scale with less cost. The fourth is monitoring and prediction. Consolidating the setting up of monitoring and management information system for soil and water conservation to raise the level of survey, evaluation, monitoring and prediction of soil and water loss.

By 2050 the objective of soil and water conservation will be as follows. A healthy ecological system suitable for sustainable economic and social development will be established, the soil and water loss areas that are applicable for management will be brought under basic control, soil and water loss and desertification will be controlled fundamentally, tillable fields on slopes will be turned into terraces, land suitable for trees will be afforested completely, desolate grassland will be restored, so the ecological environment all around the country will be improved prominently. The soil and water loss incurred due to human activities will be eliminated and most parts of the country will enjoy beautiful mountains and wonderful rivers.

To achieve the strategic objectives and tasks mentioned above, China will adopt the following measures:

(1) Carrying out administration in accordance with laws, continuously improving the laws and regulations on soil and water conservation, and enhancing supervision of law enforcement. The provisions of the “Soil and Water Conservation Law” shall be implemented strictly and public awareness of soil and water conservation and legal consciousness will be raised through education and publicity to completely eliminate man-induced soil and water loss and to protect existing vegetations. Due attention will be paid to soil and water conservation in development and construction projects and the prevention and control of soil and water loss will be incorporated into the legal system.

(2) Zonal controlling under the guidance of demonstration. The Loess Plateau in the northwest will be managed on the basis of building high and stable production farmlands with focus on management of gullies and transformation of slope farmlands into forestry and grassland. For the black soil area in the northeast, cultivation while conserving soil will be promoted to protect and restore vegetation. The red soil hills in the south will be closed to increase the vegetation coverage and the energy supply problem in villages will be solved by replacing wood for fuel with electricity. In the earthen and rocky mountains in the north, slope farmlands will be rehabilitated to develop forests for soil and water conservation. In limestone areas in the southwest, farmland on steep slopes will be reused for forests to conserve soil and water and prevent desertification. In areas with sand storms, windbreak forests will be cultivated and protected by enclosure to prevent expansion of deserts. For grassland, fencing,

enclosure, grazing in turn and with an interim suspension period will be carried out and also artificial grassland will be built.

(3) Enhancing enclosure protection and extensively improving ecological environment depending on the self-healing ability of the ecology. According to the requirement of harmonious relationship between man and nature, human activities will be limited from over-demanding and impairing the nature. The ways of agricultural production and animal husbandry will be readjusted. In areas with fragile ecological system, animal husbandry will be prohibited to increase vegetation coverage, reduce soil and water loss and improve ecological system relying on the nature's power, especially the self-healing ability of the ecology.

(4) Developing ecological improvement projects on a large scale. The construction of major ecological projects in the upper Yangtze River, the middle Yellow River and the areas around Beijing and Tianjin cities will be continued and the transformation of slope farmland into forests will be strengthened. The protection of natural forestry will be improved. The inter-river basin water transfer projects and other water resource projects will be developed. The South-to-North Water Transfer Project shall be implemented as soon as possible to relieve the contradiction between water supply and demand in North China and improve the ecological environment. The inland river basins shall allocate necessary water for ecological use to restore oases and control desertification.

(5) Scientific planning and integrated management. Hills, rivers, farms, forests and roads will be planned together on the basis of small watersheds. According to the public's wishes, the three major structural, biological and agricultural measures will be combined to control soil and water loss and rationally utilize water and land resources. Through adjusting economic, industrial and agricultural structures, the government will help the farmers raise productivity and increase income. In this way, the soil and water loss will be brought under control, the economy will increase and the living environment will be improved to realize coordinated development among population, resources, environment and society.

(6) Enhancing scientific research of soil and water conservation to accelerate advancement of science and technology. Efforts will be made to seek effective methods of controlling soil erosion and increasing integrated production capacity of land. Training the public will be strengthened to publicize the science of soil and water conservation and to extend technologies. The monitoring and forecasting system will be developed with the use of new and high technologies such as 3S, to establish a national monitoring network and information system so as to increase the use of high technology in soil and water conservation.

(7) Improving and formulating preferential policies to establish an appropriate mechanism of market economy for development of soil and water conservation. The ownership of conservation results shall be clarified to protect the contributors' legal rights and interests. The government will encourage and support farmers and the whole society to participate in soil and water conservation.

(8) Strengthening international cooperation and exchange in the field of soil and water conservation to enhance mutual understanding and learn foreign advanced technologies, theories and management so as to improve China's science and technology in soil and water conservation.

In this new century, China will further implement the strategy of sustainable development and strengthen soil and water conservation and ecological improvement. China will develop its international cooperation and exchange in control soil erosion, raising overall productivity of land and improving ecology. Together with the international community, China is willing to make new contributions to the ecological improvement in China and even in the world.