

## **On Soil-Water Conservation and Ecological Environment Security**

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**Abstract:** Soil erosion-destroying soil and land resources, disrupting water resource balance, intensifying flooding, waterlogging, drought and sandification hazards, and deteriorating human existence environment—is the chief root of disrupting ecological security. In the mountainous and hilly areas of southern China, the degree of ecological environment deterioration is closely associated with many factors such as the erosion stage, condition of eroded soils, degree of vegetative cover, erosion type, etc., among which the condition of eroded soils is the most important.

Soil and water conservation, involving expanding the vegetative cover, controlling soil-water loss, preventing and controlling silt hazards, rationally utilizing soil-water resources, improving soils, building up soil fertility, planting trees everywhere and making the country green and more beautiful, can effectively guarantee the ecological security, which is the principal part of the ecological environment establishment.

The environmental problem of the West has already influenced the ecological security of the region, and is threatening the implement of the development and the sustainable development strategy of the West. In the development, only by strengthening the work on soil-water conservation, can the ecological security in the West be guaranteed, and the dual goal of developing the West and establishing a sound ecological environment be achieved.

### **1 Great significance of protecting ecological environment security**

The nation's ecological security means that the existence environment needed for national ecology and development should be protected against any disruption and threat. Once the ecological security is disrupted, not only the economic and social development is influenced, but also the basic conditions for human existence are immediately threatened. Therefore, like military security and political security, the ecological security is an important component of our national security; moreover, it is the basis and carrier of the other aspects of security (State Department of People's Republic of China, 2000). Our government has made a decision on guaranteeing national ecological security as a strategic objective, dealing with the work on ecological environmental protection from the high plane of Chinese nation's rise or decline, surviving or perishing. Protecting the ecological environment security is of great practical significance both in carrying out our sustainable development strategies in the 21st century and in developing the West of our country.

### **2 Soil erosion is the chief root of disrupting ecological environment security**

The environmental deterioration problems characterized primarily by soil erosion has already influenced the ecological security of our country, and constituted a threat to our national economic construction and sustainable development. This is mainly shown in the following aspects:

#### **(1) Destruction of soil and land resources**

Soil is the indispensable carrier for transformation and exchange of biological energy. Under conditions of modern production technology, soils are valuable natural resources that cannot be replaced by anything in agriculture, forestry and animal husbandry. But unfortunately, soil erosion has ceaselessly thinned soil layers, reduced soil fertility, and destroyed large quantities of soil resources. Thus, on the productive loessial plateau of northwestern China, most of the topsoil has been lost by

erosion, the organic matter content commonly is below 1%. In severely eroded mountain-hilly areas in the south, soils whose A horizon has been completely lost by leaching account for 20%—40%, and the organic matter content reduced to 0.5%, or even less than 3%. According to investigation and research, in areas where soils have not been subjected to erosion the value/cost ratio is 4:1, while in areas where soils of A and B horizons have been lost by leaching the value/cost ratio is only 0.4:1. That is, inputs being the same, the economic benefit of the latter case is only 1/40 of the former. Under conditions where the soil has been severely eroded, it will be far more difficult to remedy and utilize it; this means that much more manpower, material and financial resources, and much more time will be required. When the soil is completely eroded, it will lose its productivity and become a deserted barren land. In arid and semiarid regions of northern China, there is sandification and desertification caused by wind erosion. In the mountain-hilly areas of southern China, the 'red deserts', 'white sand hills', and 'stony desertification' caused by water erosion are examples of evil consequences brought about by soil erosion.

(2) Disrupting water resource equilibrium, and intensifying drought, waterlogging and silt hazards

The soil itself is a gigantic reservoir. As the soil is subjected to erosion, its layer becomes increasingly thinner, its storage capacity reduces, and the amount water stored in it decreases (Shi, 1996; Shi, 1999). According to the calculation of soil field capacity and runoff volume, the field capacity of a soil decreases with an increase in erosion degree, whereas the runoff volume increases with an increase in erosion degree. Under conditions of equal amounts of rainfall, the soil field capacity of the severely and very severely eroded soil is 1/4 and 1/10 respectively of the un-eroded soil, while the runoff volume is correspondingly 4 times and 5.3 times greater than that of the slightly eroded soil (Shi, 1996). In the case of bare rock, nearly all of the rainfall flows away in surface runoff. With water lost by leaching, the soil moisture content and the total amount of water stored in the soil diminish, and so an imbalance takes place between the soil moisture supply and the water demand of crops, resulting in an agricultural aridity. At the same time, the decrease in soil infiltration water and the increase in surface runoff lead to an imbalance between surface water and groundwater, bringing about a hydrographical aridity (Shi, 1999).

Soil erosion both has given rise to losses of the soils and water storage capacity in the upper and middle reaches and brought the corresponding amounts of silt and floods to the lower reaches of rivers, so the soil erosion has dual effects of flooding and waterlogging. Eventually, the environment has become less resistant to natural calamities, and floods and waterlogging are more likely to occur, along with such phenomena as low discharge of rivers, high water level, and maximum flood peaks. Under conditions of equal rainfall, it has become more likely for floods and waterlogging to occur, with their frequency and severity increasing.

(3) Aggravation of land sandification and desertification

Wind erosion of soils is the principal agent that causes land sandification and desertification. In China there are 1.88 million km<sup>2</sup> of wind eroded land area, which is also the major regions where soil sandification and desertification occur. Over the past few decades, soil wind erosion has increased our sandification land area year after year.

**Table 1 The Expanded area of sandification land since 1950's**

Year	Expanded area of sandification land (km <sup>2</sup> /a)
1950—'60s	1,560
'70—'80s	2,100
'90s	2,460

Land sandification and desertification is the major factor causing sandstorms in the northern parts of China. With the expanding of sandification land area, the frequency of sandstorms is increasing year by year. Both are in a trend of synchronous development.

**Table 2 The times of sandstorm occurrence since 1950's**

Year	Times of sandstorm occurrence
1950s	5
'60s	8
'70s	13
'80s	14
'90s	23
2000	Over 10

In the western parts of China, including the loess plateau, deserts, and gobi, there are vast areas covered with loose surface materials where the soils are very sandy in texture, and loose in structure. Since the soils have a poor resistance to erosion and washing, wind erosion and water erosion are apt to take place. This has also provided a material basis for the occurrence of sandstorms.

(4) Deteriorating the environment of human existence

The soil and green plants are two important protective screens for the ecological security. Destroying the vegetative cover and spoiling the soil will lead to deterioration of the ecosystem (R.M.May, *et al.*, 1980). Therefore, plant and soil are two important weights to keep the 'ecological balance' steady; they are also the important indicators for measuring the severity degree of ecological environmental deterioration (Shi, 1995; Shi, 1991). According to research statistics, in the mountain-hilly areas in southern China the severity degree of ecological environmental deterioration is closely associated with many factors, such as the erosion stage, condition of eroded soils, the vegetative cover rate, the erosion type, etc., among which the condition of eroded soils is the most important.

**Table 3 Relationship between soil erosion and ecological environment deterioration**

Erosion stage	Eroded soil	Plant cover (%)	Erosion type	Ecological environment
1st	Complete profile of soil	> 75	Slight erosion	In good state
2nd	Partially eroded in horizon A	60—75	Sheet erosion chiefly, with rill erosion	Slightly disrupted
3rd	Mostly eroded in horizon A	45—60	Shallow trench erosion chiefly	Moderately disrupted
4th	Horizon B commonly ex-posed, somewhere horizon C exposed	30—45	Shallow & gully trench erosion	Strongly disrupted
5th	Horizon C commonly exposed	< 30	Gully trench erosion chiefly (or the collapsing hill erosion)	Severely deteriorated

In tropical and subtropical China, long years of severe deforestation, reclamation and cultivation of steep mountainsides have aggravated soil erosion. In many areas there are bare mountains and hills, presenting an ecological landscape in a sharp contrast to the bioclimatic zone. On the loessial plateau countless trenches and gullies have been formed due to the soil and water losses by leaching. In the lower reaches of the Yellow River there is an over-800 km-long 'suspended river', which poses a great threat to the people and their property of vast areas including the North China Plain, Beijing, Tianjin, and Tangshan, seriously affecting the environment of human existence.

As can be seen from the above, soil erosion has been the essential factor disrupting the balance of the ecosystem in nature. It is constantly deteriorating the space suitable for people's work and life, and bringing poverty and social crises to man. Historically, the rise and fall of many dynasties often are

closely associated with their soil resource depletion caused by soil erosion. In the world of today, still tens of thousands of people have been driven to become victims of 'ecological calamities' due to environmental deterioration. Historical strategies at all times and in all countries merit attention.

### **3 Soil-water conservation is the strategic measure to guarantee nation's ecological security**

#### **(1) Intensify soil-water conservation, and safeguard ecological protective screens**

Intensify the work on soil-water conservation by devoting great efforts to planting trees and growing grass to broaden the green plant cover; controlling erosion losses of soil and water, preventing and controlling sand hazards, rationally utilizing soil and water resources, protecting and improving soils, and increasing land productivity-these can effectively guarantee the ecological security. In every field of production and construction, care must be given to two screens of ensuring ecological security, and to the coordination of economic development and environmental protection. Through the work on soil-water conservation, we should try every possible way to protect the soil and green plants, which has a great strategic significance to the ecological security.

#### **(2) Control river sediment, and prevent floods and waterlogging**

Areas of soil-water erosion are the major sources of sediment. In the upper reaches of the Yangtze River the total erosion volume amounts to 1.56 billion tons/year, with an average annual silt discharge of 530 million tons. Silt mainly comes from severely water-eroded districts; over 70% of total silt is discharged from the rivers of Jinshajiang and Jialingjiang. From the starting of the 'Changzhi Project' to the end of 1999, within the area of over 2,000 small catchments in the upper and middle reaches of the Yangtze River altogether 63,000 km<sup>2</sup> of eroded area were preliminarily brought under control. After completion of the first and second stages of the project, the forest-grass cover rate has increased accordingly in more than 500 small catchments. As the area of the sloping cultivated land decreased by 38.3%, the cultivated sloping land of over 25° was reduced by 74.3%. As a result, the erosion volume was decreased by 74%. On the loessial plateau, by 1998 various items of work on soil-water conservation had been done in different districts that covered an area of 160,000 km<sup>2</sup>. Each year since 1970s, the water conservancy facilities as well as soil-water controlling measures have, on average, reduced 300 million tons of silt discharged into the Yellow River, thus making contributions to the river calmly running its course over the past few decades. Therefore, only by strengthening the work on soil-water conservation, reducing sediment and increasing the rivers' ability to drain off floodwaters can we once and for all eliminate floods and waterlogging and make sure that the major rivers will always benefit future generations.

Soil and water conservation helps the environment increase its resistance to natural disasters and reduce the frequency and losses of disasters, and under given conditions, it may even prevent the occurrence of calamities. Thus, in the extraordinarily serious floods in 1991 and 1998, in those catchments where problems of soil-water conservation had been tackled in a comprehensive way, fighting the flood was much more effective and the losses of the disaster were less serious. Various practices of soil-water conservation intercepted the runoff following the rainfall, markedly reduced the discharge of rivers at flood peaks, effectively protected agricultural production locally, and minimized the loss caused by the floods, thereby forming a sharp contrast to neighboring areas where nothing had been done on soil-water conservation though natural conditions were similar.

#### **(3) Soil-water conservation is the principal project of ecological environment construction**

In our country there are vast areas of mountains and hills, arid and semiarid regions are very extensive, and the ecological environment is rather weak, so soil erosion has become the major cause of ecological environment destruction, and ecological environmental protection has been the number one problem in our country. In order to solve the problem of ecological environment deterioration once for all, we must take the task of soil-water conservation as a point of tangency to improve the ecological environment. In the Nation's Ecological Environment Construction Program, soil-water conservation has been specified as the principal project of ecological environment construction, fully reflecting the important position of soil-water conservation in the ecological environment construction. As required by the Program, by the year 2030 over 60% of the soil-water erosion area (that can be controlled) in the whole country should be brought under control; then the situation of ecological

environment deterioration will be markedly improved. And by 2050, all of the soil erosion area should be largely brought under control. Then there will be a great improvement in the ecological environment in China, our natural resources will receive further protection, and the productivity will further develop.

#### 4 Development in the west, and ecological environment problems

Because of its peculiar arid climate and geographical conditions, the ecological environment in the West is very weak. Over the past thousands of years, with the steady growth in population, the demand for land and resources has exceeded the bearing capacity of the environment, the ecosystem has been continually destroyed and deteriorated, and so the originally weak ecological environment has become even more fragile. Under such habitat conditions, the stability of the ecosystem is very low, the environmental capacity and the land bearing capacity tend to reduce, and the environment is more susceptible to outside interference. In cases where the land is used improperly, or where natural resources are tapped under inadequate protective measures, the environment will bear more pressure, and the environment deterioration will further aggravate.

The ecological environment problems have already influenced the ecological security of the region, and are threatening the development in the West and the implement of the sustainable development strategies of the region. The existing problems include: aridity and low rainfall, shortage of water resources, the sparse vegetation, severe wind and water erosion, land sandification and desertification, frequent sandstorms, soil salinization and alkalization, diminishing of oases, drying up of lakes and wetland, disconnection of watercourses, etc. In carrying out the great development in the West, it is very important to take the soil-water erosion (including wind erosion) control and the ecological environment improvement as a point of tangency, to return farmlands to planting trees and growing grass, and devote great efforts to establishing vegetative cover. In the construction of major projects, the competent departments at all levels and various enterprises or firms should pay special attention to the weakness of the ecological environment in the West, strictly implement the laws and regulations on soil-water conservation and ecological environment construction, attach great importance to the environmental capacity and its bearing capacity, cherish and protect the water, land and biological resources, and realize from a strategic high plane the importance of ensuring the ecological security. Only by guaranteeing the ecological security can we facilitate and promote the development in the West, and win the double goal of both development and ecological environment construction.

#### Acknowledgements

The research was funded by the National Natural Science Foundation of China (No.49971039) and NKBRSF (No. G 1999011810) .

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