Research Article

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# High Quality and Sustainable Development of Soil and Water Conservation.

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## ABSTRACT

Water and soil resources is the important resources of the national high-quality development. Water and soil loss affects the distribution and the productivity of forest, grass and crops, and ultimately the quality of life and high-quality sustainable development. China is the most serious soil erosion country in the world, especially in the Loess Plateau. After many years of efforts, soil and water conservation in China has developed rapidly, the surface runoff and soil loss in soil and water loss areas have decreased fast. However, with the improvement of people's living standards have been gradually improved, people put forward higher requirements for soil and water conservation. But now the effect of Soil and soil protection benefits cannot meet the needs of people's good life for soil and water protection in the new era. In this paper, through comprehensive analysis of relevant literatures, author think that in the new era, high quality and sustainable development of soil and water conservation should be as a new goal in order to carrying out high quality development and meet the needs of people's good life for soil and water protection in the new era. The theoretical basis of high quality and sustainable development of soil and water conservation is the new theory of soil and water conservation. It includes that the soil and water loss refer to the process of transferring soil and water resources from one place to another; the influences of soil and water loss on social and social high-quality development have positive and negative effects. Soil and water conservation is to use some methods or measures to reduce soil erosion to soil allowable loss requirements. At the same time, we must make efficient use of soil and water resources and minimize the loss of life and property to develops the economy and improves people's income. The soil and water conservation measure must adopt high quality and sustainable management. Only in this way can we ensure the high-quality and sustainable development of soil and water conservation and meet people's requirements for soil and water conservation for a better life.

**Keywords :** Soil and water loss; Soil and water conservation; Food security; ecological security; Soil and water conservation measure; high quality and sustainable development.

## INTRODUCTION

Water and soil resources is the important resources of high-quality development. Water and Soil Loss affects the carbon and nitrogen cycle of terrestrial ecosystem, ecosystem products and services, the ecological environment and economic development, and ultimately the quality of life and sustainable development of the public. Over the past hundred years, great progress has been made in the work of soil and water conservation in China with the unremitting efforts of the vast number of soil and water conservation workers. For example, the State Key Laboratory of Soil Erosion and Dryland Agriculture had established in Yangling, China; Guo has distinguished the concept of cover degree and cover rate of water conservation forest (Guo, 1998; Guo & Den., 2009, Guo 2020). The degree of vegetation coverage is the percentage of the total area covered by the vertical projection area of the canopy branches and leaves and the vegetation cover rate is the rate of high qualitied grassland or forestland area to the total land area in a region or a country. The degree of cover includes the effective cover degree , critical degree and Potential coverage (Guo, 2000a, 2000b) .The establishment of a large area of soil and water conservation vegetation in the area of soil erosion and the establishment of large-scale soil conservation projects such as water conservation

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forest (or vegetation), wind-proof and sand forest and water source conservation forest construction standards and their construction scale, the effective coverage rate of wind-proof sand forest, the effective coverage degree of water conservation forest and the effective coverage rate of water conservation forest(Guo,1996,1997,1998a,1998b, 1999; Guo, 2000a, 2000b, 2000c; Guo, & Den 2009); the theory Basics of soil and water vegetation, including the theory of soil water resources utilization limit by plants and the soil moisture vegetation bearing capacity (Guo, 2002, 2003, 2004,2014,2022) has been established; the establishment of a large area of soil conservation vegetation in the area of However, due to the lag of theoretical research, the construction standards of soil and water conservation engineering measures and vegetation measures are low, the spatial allocation of soil and water conservation measures is unreasonable, the management of soil and water conservation attaches importance to quantity and despises quality, and the efficiency of soil and water conservation is low, which cannot meet the needs of high quality development of soil and water conservation in the new era. Such incidents as drought, forest fires, extreme weather and precipitation, hurricanes and flash floods will lead to widespread erosion of soil and water conservation vegetation, collapse of dams and other accidental incidents, resulting in serious soil erosion, destruction of farmland, villages, roads and vehicles, affecting transportation, food and ecological security, and causing great losses to the state and society. In order to overcome these difficulties and promote the high -quality development of soil and water conservation in the new era and meet the requirements of the public for soil and water conservation in the new era, it is necessary to develop a new theory of soil and water conservation. through Comprehensive analysis of relevant literature, the new theory of soil and water conservation was put forward (Guo 2020a) .In order to better understand the new theory of soil and water conservation and carry out high quality and sustainable. The purpose of this paper is to introduce the new theory of soil and water conservation.

## RESEARCH METHOD

In the summer of 2019, the author was invited to teach the course of Soil and Water Conservation and Ecological Security to students majoring in Soil and Forestry Conservation and Desertification Control in Northwest A&F University, China. Due to the lack of suitable teaching materials and the need to cultivate the literature reading ability of graduate students, I arranged graduate student Wang to sort out and analyze the literature on soil erosion and soil conservation in the past 100 years, and initially proposed soil erosion and soil conservation, which will be published in 2020(Guo 2020a). Then, the literature on soil erosion and soil conservation from 2020 to 2023 has been collected and anylysed to improve and verificate the theory.

## SOIL AND WATER LOSS

The term Soil and Water Loss is a natural phenomenon, originated in China as a technical term in the early 20th century (Guan,1996). The term was applied to the Northwestern Loess Plateau of China in early 20th century. The forces forming soil and water are called Soil and Water Loss external forces. Soil and Water Loss external forces include water, wind and temperature (freeze-thaw), etc. The term erosion has long been used in geology, mostly to express the formation of external force flattening, and soil erosion first appeared in the book written by Kozmunk in 1909. It was then widely used and was introduced into China in the 1930s. Soil erosion refers to the whole process of soil and its parent material, as well as the destruction, stripping, transport and deposition of surface components of the land under external forces such as hydraulic, wind, freeze-thaw and gravity (Guan,1996). Water power is the force produced by the flow of water; a wind is the magnitude of the force the wind exerts on an object. Temperature is the sign of the average translational kinetic energy of the molecular motion, and temperature is the collective expression of the molecular thermal motion. At present, people's understanding of water and soil loss is not uniform. It has been argued that soil erosion refers to "the destruction and loss of soil and water resources and land productivity under the action of external forces, including surface erosion and soil erosion; most believe that water and soil loss is equivalent to soil erosion, i.e. soil erosion by hydraulic erosion, wind erosion or gravity erosion, resulting in soil dispersion, transport and accumulation processes. Now, we enter a new period of high-quality development. In order to promote the high-quality development of soil and water conservation in the new period, we should first unify the understanding of water and soil loss. The authors believe that water and soil loss is the process of soil and water resources transferring from one place to another, which includes generalized soil erosion and narrow sense soil erosion. Generalized water and soil loss refers to the process of carbon and nitrogen circle, land productivity and ecological environment change caused by the transfer of soil and water resources induced by external forces. Water and soil loss in narrow sense is equivalent to soil erosion (Guo 2020a).

## CONSEQUENCES OF SOIL AND WATER LOSS

Water and soil loss has obvious consequences on high quality development, which can be divided into positive and negative effects as follows:

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**Water and soil loss leads to the decline or even loss of soil fertility and land productivity in water and soil loss region.** The term soil fertility is the capability of soil to support plant production in agricultural contexts (Chen, et al., 2020). Serious Water and soil loss will affect carbon cycle and nitrogen cycle in agriculture ecological system and result in surface soil thinning of fertile soil in water and soil loss region, decrease of cultivated land area, decrease of soil fertility and decrease of crop yield (Walka, et al, 2020).

**Soil and water loss influence people's daily transportation**

Water and soil loss silts up rivers, lakes and reservoirs, destroys roads and farm land, destruct the village, and large amounts of sediment deposit in the lower reaches of rivers and estuaries, forming an alluvial plain and expanding the land area, see fig.1, which influence people's daily transportation. Floods, landslides, mudslides and other serious soil erosion siltation channels, lakes, reservoirs, see **figure 1**.

**Figure 1**

**Figure 1.** Water and soil loss destroys roads (the left photo above), farm land (the right photo above and bellow) and village (the left photo below) in China.

**Water and soil loss pollution water quality and affects ecological balance**

Water and soil loss accelerates non-point source pollution. In the event of heavy rain, strong surface runoff will pile up the surface garbage into the river, seriously affecting the water quality of the river. A typical example is the fact that the water quality of the Yangtze River is being polluted.

**Typhoons, haze, dust and dust storms affect people's health, travel and social activities.**

With the development of economy and society, people are more and more demanding on health, and travel and social activities are becoming more and more frequent, while typhoons, haze, dust-raising weather and dust storms affect flights and road traffic, and seriously affect people's rapid travel and social activities.

**Water and soil loss accelerates the formation of unique landforms and promotes the development of ecotourism.**

Soil and rock through hydraulic, wind and freeze-thaw and other external forces of the joint action, forming a number of

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magic, wonderful natural landscape, which accelerates the development of environmental tourisam and get rid of poverty and become better off. For example, Keshiketeng stone array scenic spots in the northeast of Keshiketeng county, Danxia natural scenic spots located in Yulin city and zhashui cave located in the Qinling Mountain and so on. The zhashui cave is the result of long-term dissolution of groundwater. Calcium carbonate in limestone forms micro-soluble calcium bicarbonate under the action of H2O and CO2. Because the limestone layer contains different lime quality and different erosion degree, it is gradually dissolved and divided into non-dependent, diverse, steep and beautiful peaks and cave with strange landscape, which promotes eco-tourism and local economic development. Hukou waterfall is still Hukou waterfall but now has become a tourist hot spot. Unique landform promotes development of ecotourism in China, there are a lot of people to enjoy the unique landform in Leisure time or holidays.

**Figure 2**

**Figure 2.** Water and soil loss promotes the formation of unique landforms and the development of ecotourism In China.

**Water and soil loss forms silt plain and expands land area in estuary area**

A large amount of sediment deposits in the estuary area, forming a silt plain and expanding the land area with increasing time, which increase nitrogen density in soil, soil fertility, land product and CO2 fixation. For example, the Chongming Island at the mouth of the Yangtze River basin and the Huanghe Delta at the mouth of Yellow River. At first, the Chongming Island was just a small sand dune, and as the sands hit and settled, the sand dunes grew larger and became an island where fishermen lived. Soil and water conservation workers should broaden their horizons, make best use of the advantages of water and soil loss and bypass the disadvantages of water and soil loss to meet the requirements of rapid and high quality economic and social development, especially to strengthen the prediction, prediction and prevention of serious soil erosion phenomena caused by typhoons, haze caused by strong winds, dust-raising weather and sandstorms (Guo 2020a).

## SOIL AND WATER CONSERVATION

Soil and water conservation refers to the use of certain measures and technologies to reduce the loss of soil and water to a certain goal, soil allowable loss, increasing land productivity and improving the environment. It is also necessary to make efficient use of the soil and water resources in the process of water and soil loss and to ensure the safety of the ecosystem and increase the ecological, economic and social benefits of the ecosystem, and minimize the loss of life and property. For example, introduction of flood irrigation with high sediment concentration to form high-quality farmland, and using the water source of the river, Haizi (Lake) and reservoir in the sand area, draw water by gravity or by machinery, Wash Sand Dune by hydraulic power, and carry sand to the place and form high-quality farmland, or use runoff and topography to promote Eco-tourism, such as Shapotou and Hukou tourist attraction in the China loess plateau.

Soil and water conservation measures can effectively conserve soil and water (Zhao, et al., 2019). Soil and water conservation measures include soil and water conservation engineering measures, soil and water conservation farming measures and biological measures for soil and water conservation. Other soil and water conservation measures, such as wind power and solar

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power generation, are also included to reduce near-surface wind speed and temperature and facilitate the growth of soil and water conservation vegetation, see, fig.3(Guo 2020a). In the restoration of vegetation, natural forces can be used to restore vegetation in no man's land; however, in areas where there is a population, artificial interference should be used to restore vegetation in order to make the vegetation ecosystem goods and services to meet the needs of human production and life.

**Figure 3**

Figure 3. Huanghe Delta at the mouth of Yellow River, China

Since 1950, China has made great progress in its work on soil and water conservation. A large area of soil and water conservation vegetation has been established in water and soil loss areas, and a large number of reservoirs have been built; some water and soil conservation measures such as water and soil conservation projects such as dams or levees have been set up along the rivers of the Yellow River and other soil erosion areas, which have made great progress in controlling water and soil loss below the allowable amount of soil erosion and promoting regional economic development. However, due to the lag of theoretical research on soil and water conservation, the construction standard of soil and water conservation measures is low and imperfect, and the spatial allocation of soil and water conservation measures is unreasonable. For example, silt storage dam for farmland building has played an important role in preventing floods, consolidating the return of farmland to forests (grass), safeguarding ecological security and food security, promoting the development of economy and social stability and so on. However, in the construction of silt storage dam, the problems of low quality of construction, serious disease-risk dam, poor management of reconstruction and so on, especially the large number of small dams, have not been paid enough attention to (Fu & Zhang, 2019). Therefore, it is urgent to strengthen the study of soil allowable loss on different underlying surfaces, formulate high quality and strict standards for soil and water conservation engineering and vegetation construction, and carry out spatial optimal allocation to obtain maximum soil and water conservation efficiency. The space optimal configuration is expressed by the spatial optimal configuration coefficient. Spatial optimal allocation coefficient means that in a water and soil loss area or watershed, soil and water conservation funds or measures may have different allocation methods, and different allocation methods bring different soil and water conservation efficiency, which is different surface runoff and soil loss. The optimal allocation of space refers to the allocation that bring maximum soil and water conservation efficiency (Guo 2020a).

## HIGH QUALITY AND SUSTAINABLE MANAGEMENT OF SOIL AND WATER CONSERVATION

In 1972, Dennis L. Meadows published a study on the "limits of growth" that clarified the importance of resources and the relationship between resources and population. The limit of growth shows the consequences of unlimited growth on the resource-limited planet, laying the foundation for sustainable development.

The International Union for the Conservation of Nature (IUCN) put forward the concept of sustainable development in 1980. In 1987, the United Nations World Commission on Environment and Development clearly defined sustainable development. Since then, sustainable development strategies have gradually been accepted worldwide, and many countries have begun to implement sustainable development strategies. International Tropical Timber Organization (ITTO) took the lead in developing guidelines for the sustainable operation of tropical forests in 1990. In 1992, the central issue of the United Nations Conference on Environment and Development, held in Rio de Janeiro, Brazil, was sustainable development, which emphasized that sustainable forest development was an important component of sustainable economic development. In 1992, the Chinese government submitted its report on China's environment and development to the United Nations Conference on Environment and Development, which laid out the basic position and views on China's sustainable development. In 1994, the Chinese Government made it clear that it would implement a strategy for sustainable development in its economic and social development.

In the field of soil and water conservation, it is necessary to implement the high quality and sustainable management of soil and water conservation measures in order to realize the high quality and sustainable development of soil and water conservation. For soil and water conservation engineering measures, it is necessary to improve the design standards and formulate corresponding emergency plans to prevent the occurrence of dam break and dam break caused by hurricanes, tsunamis and heavy rain caused by extreme weather. For example, in August 2019, affected by Typhoon No.9" Liqima ", heavy rain occurred in Weifang, Binzhou

and other places, Shandong Province, China. The heavy rain caused floods and destroyed a large number of agricultural production measures, grain fields, road and bridge culverts, housing and public buildings. The disaster caused widespread concern in the community. In the early morning of august 20th, 2019, due to heavy rainfall, a huge debris flow broke out in the yazigou valley, less than 300 meters from the dam of Wolonglongtan hydropower station in sichuan province. At that time, the staff on duty found that the dam water level rose, the water level difference before and after the barrier quickly increased, immediately stopped to avoid the peak, open the floodgate. When the opening of the three sluices is less than 1 meter, the swift and violent debris flow will break down the power transmission line of the working power supply, resulting in the interruption of the power supply of the sluice, the flood sluice cannot continue to rise, resulting in the rapid rise of water level and the occurrence of flood dam events. For the biological measures of soil and water conservation, according to resources use limit by plants, including spatial, soil water and Soil nutrient resources use limit by plants, the vegetation carrying capacity, mainly including spatial, soil water and Soil nutrient vegetation carrying capacity and the resources use limit by plants and the critical period of plant resources relationship regulation including the critical period of plant spatial, soil water and soil nutrient relationship regulation (Guo 2019, 2020b, 2021), it is easy to adjust the plant resources relationship based on the vegetation carrying capacity in the critical period of plant resources relationship regulation to realize the sustainable utilization of natural resources and the high quality and sustainable development of soil and water conservation(Guo 2022).

## IMPLEMENTATION EFFECT OF NEW THEORY OF SOIL AND WATER CONSERVATION

The new theory of soil and water conservation is a scientific theory. Because of the large area of soil and water loss area, people's understanding level of soil and water conservation is uneven, there are two completely different effects of soil and water conservation in practice. In the area where the new theory of soil and water conservation is practiced and late March to low April or early May), the rapid spraying of antifreeze or covering measures were adopted to reduce or even eliminate the harm of low temperature frost. Before and after May 20, spray 2000 times of high efficiency and low toxicity cyhalothrin to control solid insect harm; If long-term severe drought occurs in the critical period of plant water relationship regulation and the conservation density exceeds the vegetation carrying capacity of soil water, the plant water relationship in the critical period of plant water relationship regulation can be regulated by pruning according to the appropriate leaf amount in the period of soil water vegetation carrying capacity, and then the vegetative growth and reproductive growth relationship should be regulated in the period of period of plant resources relation regulation according to the suitable amount of leaf when plant density is equal to carrying capacity, and the relationship between leaf amount and quality fruit to obtain maximum output and economic benefits. Since the establishment of the National high-quality red plum Apricot Demonstration Base in 2017, the research, demonstration and promotion of high-quality production methods of red plum apricot have been accelerated.

In spring, the cropping of Caragana (Caragana Korshinskii) shrub on hillside soil and water conservation should be carried out to ensure that the canopy coverage is not lower than the construction standard of soil and water conservation forest (60%), and the soil water consumption in dry season should be reduced as far as possible under the premise of meeting the requirements of water and water conservation efficiency. In the growing season, when soil water resources fall to the limit of soil water resources utilization within the range of maximum infiltration depth, the plant water relationship enters the critical period of plant water relationship regulation, and the end of the critical period of plant water relationship regulation is the time the plant water relationship regulation fails. If the conservation density exceeds the soil water vegetation carrying capacity in the critical period of plant water relationship regulation, timely regulation of plant water relationship can ensure normal plant growth, prevent early deciduous leaves of Caragana due to drought and the disappearance of canopy intercession, so as to continuously obtain the maximum efficiency of soil and water conservation.

Gaoxigou Village in the hilly and gully region of the loess Plateau in northern Shaanxi Province, Mishi County, China, has built a barren mountain gully with broken surface, serious soil and water loss and barren land into terraced hilltops. The "small South of Northern Shaanxi" with pine and cypress in the high mountains, the soil loss is lower than the allowable soil loss. At the same time, the soil and water resources are efficiently used. Ecological tourism has been carried out and diversified management methods have been adopted. The per capita income in 2020 is 18,851 yuan, far exceeding the average level of the county (5,834 yuan), which has become a typical example of high-quality sustainable development of soil and water conservation in the area.

The government of Hangjin Banner uses the main trunk canal of the south bank of the Yellow River to draw water, and builds diversion gates, diversion canals, ecological levees and sluice gates to connect with the main trunk canal, forming a water cycle pattern in which water is diverted from the Yellow River and the artefact flows into the Kubuqi Desert and the backward water flows into the Yellow River. By introducing

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water from the Yellow River into the desert, it has reduced runoff, sediment and siltation in the middle and lower reaches of the Yellow River and diverted more than 200 million cubic meters of water in total, forming nearly 20 square kilometers of water surface and nearly 60 square kilometers of ecological wetland in the Kubuqi Desert. Plants grow well and some water birds come to live here, turning the desert into an oasis, which has attracted the attention of various countries. Developing ecological tourism has achieved good economic benefits. The diversion of water to control desertification has been imitated by countries around the world.

State Power Investment Group Beijing Electric Power Co., Ltd. innovatively proposed the concept of "photovoltaic sand control and ecological restoration". The Administrative committee of Dengkou Industrial Park in Bayannur City, Inner Mongolia Autonomous Region cooperated with State Power Investment in "photovoltaic sand control" to build the Dengkou photovoltaic sand control project. It not only attenuates solar exposure and reduces near-surface wind speed, promotes the growth of plants under solar panels, and achieves excellent sand control effect, but also sequestration carbon, obtaining green and clean energy, and improving economic benefits. It has been popularized in Gansu, Ningxia, Tibet, Xinjiang and other places. Build wind power stations in tuyere areas to reduce wind and sand damage.

In soil and water loss areas, high-standard farmland should be established according to landform and surface runoff erosion intensity. Construction of high-standard buildings and soil and water conservation projects can not only effectively avoid the harm of soil and water loss, but also obtain good ecological, economic and social benefits. For example, Hani rice terraces have been maintained for thousands of years. Guanyin Pavilion in Hubei Ezhou, which has stood on the Yangtze River for hundreds of years, and Dujiangyan and modern Three Gorges Dam, which have continuously given full play to the effects of soil and water conservation for 2,000 years, have integrated the comprehensive benefits of flood control, irrigation, water transportation and social water use (Guo 2022).

In areas without the guidance of the new theory of soil and water conservation and the implementation of high-quality sustainable management, once encountered hurricanes, sandstorms and rainstorms, there will be serious dam collapse, dam collapse, flood destroyed houses, roads and farmland, and other serious events affecting high-quality sustainable development, resulting in the destruction of houses, roads, levees and storage DAMS, and the abandonment of cars,see the fig.5 . Casualties and other serious events, such as the severe flood disaster in many European countries, the United States in 2021, Pakstan in 2022 and China's Henan, Shanxi and Shaanxi provinces in 2022 and Heilongjiang, Jilin, Liaoning, Beijing, Hebei and so on in 2023.

**Figure 4**

**Figure 4.** Solar panels reduce near-surface wind speed, temperature and soil evaporation, facilitating the growth of soil and water conservation vegetation(Dengkou. China).

**Figure 5**

**Figure 5.** At around 2 o 'clock on May 1, 2024, the Chayang section of Meida Expressway in Meizhou City, Guangdong , China, collapsed. By 14:00 on 2 May, 23 vehicles had been found down and 48 people had died.

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## CONCLUSION

At present, Chinese economic and social development of our country has entered a new period of high-quality development, and the social wealth has been improved unprecedentedly. In the new period, the public has put forward higher demands on the work of soil and water conservation, which requires the protection of air quality, life, property and health, and ensures the safety of food, ecology and transportation, so the work of soil and water conservation has entered a new stage (Li et al., 2019). In order to ensure the safety of people's lives and property and meet the needs of people's happy life in the new era, we are required to raise the level of understanding, dialectically and comprehensively view the consequences of soil erosion, take timely and effective measures to deal with serious soil erosion caused by sudden events such as mountain torrents, hurricanes, sandstorms and other serious accidents that affect the safety of public life and property. To ensure the sustainable use of natural resources, sustainable development of forest vegetation and sustainable agricultural production in soil erosion areas. Coordinate and promote comprehensive prevention and control of non-point source pollution, restoration of degraded ecosystems and improvement of living environment in soil erosion areas, and realize the concept of co-construction and co-treatment to achieve green mountains and blue waters and achieve rural revitalization and build a beautiful China, to meet people's yearning for a better life.

To meet the needs of increasing people's living standards for soil and water conservation work in the new era, we must make a new and higher goal and develop a new theory of soil and water conservation, that is to say, we have to unify understanding of water and soil loss, and fully recognizing the consequences of soil and water conservation, and then take advantage of water and soil loss, giving priority to the allowable soil loss, make the most of soil and water resources and determine high standards of soil and water conservation measures after taking into account air quality and soil pollution according to local conditions, and make a rational distribution of soil and water conservation measures when carrying out to ensure the sustainable utilization of natural resources in water and soil loss areas and the safety of ecosystems in order to realize the high quality and sustainable management of soil and water conservation projects and biological measures. In the future, it is necessary to strengthen basic research such as the relationship between different soil and water conservation projects and biological measures and soil erosion area soil allowable loss and air quality and soil pollution degree, largen the scope of soil and water conservation measures and strengthen the early warning research on risks such as mountain flood, landslide and debris flow caused by natural disasters such as typhoons and tsunamis in soil erosion area, and formulate high standard soil and water conservation measures on the basis of this research, and carry out spatial optimization of soil and water conservation measures to ensure the high-efficiency use of soil and water resources in soil erosion area and the safety of ecosystem, realize the sustainable development of soil and water conservation to achieve the improvement of soil and water conservation efficiency and meet the needs of the public for food, ecological security, road unblocked and ecotourism, and provide theoretical basis and scientific and technological support for high quality and sustainable development.

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There is not Competing Financial Interests

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