Comprehensive control model of soil and water conservation in Pisha stone area

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Abstract: Base the research of landform, soil erosion and vegetation characteristics, the comprehensive control model of soil and water conservation is summarized in Pisha stone area. The dates shows that: The general idea of this area is to take the construction of gully dam system as the starting point and to strengthen the construction of gully dam system with the main project of gully control. In line with local conditions, we will actively promote the construction of forest and grass vegetation, return farmland to forest and grassland, and implement large areas of closure and control, so as to give full play to the self-repair function of the ecosystem.

1. Introduction
China is one of the countries with the most serious soil and water loss in the world. The total amount of soil and water loss is about $5 \times 10^9 t$ every year, among which the loess plateau area in the Yellow River basin in China is the most serious. Soil erosion and land desertification not only reduce the area of arable land and threaten the security of food supply, but also bring a lot of environmental problems. The loss of a large number of water and soil into the river will cause the blockage of the river, serious threats to the safety of people's lives and property\textsuperscript{[1-2]}.

Located in the loess plateau, the soft sandstone area is the core source of coarse sediment in the Yellow River and the most serious area of soil erosion. The sandstone is widely distributed in the area centered on the border area, covering an area of 16,700 km$^2$. Due to the region's dry climate, low rainfall, sparse vegetation, broken terrain, heavy wind and sand, heavy rainfall and its special terrain and surface composition, the soil erosion modulus in this region is as high as 30,000-40,000 t/km$^2$-a\textsuperscript{[3-5]}, which has been called "the most severe soil erosion in the world" and "ecological cancer of the
earth" by Chinese and foreign experts.

The soft sandstone in Yulin area is mainly sand-coated soft sandstone. The soft sandstone in this area is loose in texture, poor in structure, and low in cohesive force, poor in stability and weak in anti-erosion ability \(^{[6-8]}\). When there is no water, it is as hard as stone. In addition, due to the low local temperature, the thawing is very intense, forming a loose layer on the surface of the gully slope, with a thickness of 5~10cm. At the same time, the sandstone has a large slope, and the lack of plant roots and organic matter makes it easy to be eroded by rainfall and washed by runoff, forming a large amount of sediment \(^{[9-12]}\). Wind erosion is also severe, exacerbating the already fragile ecological environment.

Therefore, a wide range of topographical and geomorphic characteristics, soil erosion characteristics and vegetation type distribution characteristics were investigated in the sandstone area of Yulin desertification area. To carry out hydrologic erosion environment analysis in the sandstone area; it is very necessary to carry out investigation and analysis on erosion control methods and prevention techniques in the soft sandstone area, which is an urgent need for soil erosion control and ecological restoration in the soft sandstone area.

![Fig.1 Topographical features in sand-covered Pisha stone areas](image)

2. Results and analysis

On the basis of surveying the topographic and geomorphic features, erosion and vegetation characteristics of the sandstone in a large scale, the erosion characteristics of the sandstone under different underlying surface conditions were carried out.

2.1. Investigation on the types of treatment measures in sandstone areas

The soil erosion control measures in the sandstone area are mainly divided into biological measures and engineering measures.

2.1.1. Biological measures

It mainly includes protective forest belt, protective ridge, cliff protection forest, and gully bottom anti-erosion forest, economic forest, and wind-proof and sand-fixed forest belt, slope protection plants, sealing and breeding measures, sea-buckthorn flexible dam and so on.
2.1.2. Engineering measures
It mainly includes slope engineering (including slope ladder modification, horizontal ditch, fish scale pit, ditch edge ridge, ditch cut ditch, etc.), ditch head protection engineering, ditch engineering (including silt dam, tangka, gufang, small storage engineering, flood diversion and settlement, ditch management backbone engineering, etc.).

2.2. Investigation of several typical artificial vegetation in the soft rock area

2.2.1. Pinus tabulaeformis Forest
According to the survey on the vegetation in the soft sandstone area, pinus tabulaeformis is widely distributed in the soft sandstone area. 2 year old seedlings were selected for afforestation, and the plant spacing was 24cm ×100cm. Pinus tabulaeformis mixed with other shrub tree species, in the young period of pinus tabulaeformis, the secondary tree species grow fast, so that the soil is quickly improved, to pinus tabulaeformis young tree growth created good conditions. However, after the formation of pinus tabulaeformis forest, the growth of shrub species was often affected. The investigation results showed that the pinus tabulaeformis mixed with pinus tabulaeformis and the seabuckthorn mixed with pinus tabulaeformis had less than 4 clumps, and the high growth rate was less than 1m. The investigation also shows that the growth rate of pinus tabulaeformis in the slope and sandy slope is obviously better than that in the loess slope.

2.2.2. Seabuckthorn forests
Seabuckthorn is the pioneer economic and mixed species of soil and water conservation afforestation in semi-arid area. Its unique biological and ecological characteristics make it have a strong ecological adaptability. Seabuckthorn is a shallow root tree with developed horizontal roots, which can exceed 10m and can fully absorb water and nutrients from the soil. Although seabuckthorn is not a leguminous plant, its root system has root nodules, which actinomycetes can fix nitrogen from the soil air to promote growth and improve soil fertility. Strong drought resistance, cold resistance, resistance to barren capacity. Its root tillering ability is very strong, a single seabuckthorn 3 ~ 5 years after the emergence of many root tillering seedlings, so the seabuckthorn forest has the special advantage of quickly closed forest and cover the ground.

2.2.3. Caragana Microphylla
At present, caragana is one of the legume shrub species with the widest distribution and largest resource area in the caragana sandstone area. All the nine counties (banners) in the investigation area have been distributed, with a total area of 333,000 hm². Among them, Zengerqi has the largest area, about 133,000 hm². Its species has the outstanding advantages of drought resistance, barren resistance, easy survival, fast growth, long life, high biological yield, few pests, and grazing resistance. It is an excellent plant for water and soil conservation, wind protection, sand fixation and animal husbandry. In the caragana, the most prominent advantage of caragana is drought resistance and disease resistance. In 1999 and 2000, continuous drought occurred in the shallow sandstone area, and the artificial seabuckthorn forest on the slope was largely destroyed due to drought and insect pests.

2.3. Opinions on vegetation construction in sandstone area
(1) korshinskii was used as a breakthrough in biological control of sand caragana sandstone area
Korshinskii is drought-tolerant and widely adapted to various soil conditions in the soft sandstone area, especially in the loose sandy soil. Therefore, it is advisable to spread planting in the silt-covered sandstone area. In order to make full use of the grazing value of caragana korshinskii, it should be advocated that the caragana korshinskii should be enclosed by wheels, the stubble should be leveled at the right time, and the use should be reasonable. The utilization value of low yield sandy grassland can be improved by planting or planting caragana korshinskii.

(3) pinus tabulaeformis and apricot can be used as the main tree species in siltstone area
According to the investigation results, *Pinus tabulaeformis* can grow normally on the slope of the feldspar, with an average annual growth rate of 20 ~ 30 cm and an average annual growth rate of 20 ~ 50 cm. Therefore, *Pinus tabulaeformis* and apricot are the main tree species for afforestation in the soft sandstone area, but *Pinus tabulaeformis* is only suitable for afforestation on the gentle slope of the soft sandstone.

2.4. **Comprehensive management model of sand-covered sandstone area**

According to the specific situation of the soft sandstone area and the demand of the economic development, the general idea of the treatment and development in this area is: taking the construction of gully dam system as the starting point, we should intensify the construction of gully dam system, which mainly focuses on the construction of gully dam system. In line with local conditions, we will actively promote the construction of forest and grass vegetation, return farmland to forest and grassland, and implement large areas of closure and control, so as to give full play to the self-repair function of the ecosystem.

(1) Ecological restoration and *Caragana* resources construction were carried out

The arsenic sandstone area is sparsely populated and rich in wasteland resources. In addition to the construction of energy and heavy chemical bases and the acceleration of urbanization, the growth trend of the rural population has gradually slowed down. Despite the uneven spatial and temporal distribution of rainfall, the average annual rainfall is about 400 mm. The implementation of ecological restoration in this region will be one of the measures with the fastest speed, best benefit and lowest cost in ecological construction. At the same time, *Caragana* resources construction was carried out in this area, horizontal terraced fields were built on liangmao gentle slopes near villages, short roads and with irrigation conditions, and water cellars were built in villages and courtyards to provide drinking water for people and livestock and develop courtyard economy.

(2) Build tributary dam system with large and medium-sized silting depots as the framework and silting dam as the main body, but the dam construction materials need to be solved

According to the research results of dam system layout, in general, the ratio of backbone dam to silting dam is between 1:2 and 1:5, and the ratio of backbone dam to silted dam is large and that of medium and small-sized silted DAMS is small. Of course, the emergence of this situation is related to the development stage of the dam system, which has just developed from the first stage to the mature dam system, medium and small scale silt dam is still in the initial stage, is the main body of the dam system construction in the future. In the chimao gully with an area less than 3 km², a small and medium-sized silting dam is constructed to block mud and silt land and develop basic farmland. In the branch ditches with an area of more than 3 km², the construction of a ditch management project integrating water storage, sand barrier, flood control and silt to ensure the safe production of downstream dam land; It is difficult to control and the conditions are good to build large and medium-sized mud silo in the main ditch or the main stream of the gully control project. Reservoirs and ponds are set up in gullies with water sources to provide water for urban life, industry and agriculture.

(3) The integration technology of plant "flexible dam" and silting dam is adopted to realize coarse and fine silting

The "flexible dam" of seabuckthorn plants is arranged near the body of the silt dam, the tail end of the upstream and the upper part of the spillway entrance. Taking the plant "flexible dam" sand barrier project as the main body, the gullies warping dam, "constructed wetland" and "artificial beach" as the main components of the basic farmland at the bottom of the gully. Supported by the backbone dam and guaranteed by the micro reservoir, it forms a tributary ditch to intercept coarse sand, an "artificial beach" and a channel dam to intercept fine sand, and an "artificial wetland" and a channel dam between DAMS to increase the amount of natural runoff infiltration. The micro reservoir impounders all the remaining runoff, achieves the flood relief, impounders the coarse sediment, spillway the flood into the river, realizes the silt coarse discharge fine, improves the water and sediment condition and sediment composition that enters the downstream channel, maintains the river's ecological function.
(4) Erosion control technology in silty sandstone area

In the area covered with sand, liang, MAO and slope are mainly planted with shrubbery and intercropped with high-quality herbage, which can not only protect against wind and fix sand, but also serve as a grazing base. Caragana was planted in a strip perpendicular to the prevailing wind direction in fixed dune. Grass was planted between the strips. In the flowing and semi-flowing sand areas, sallow trees were planted in a strip perpendicular to the prevailing wind direction. Willow trees were the main crop and gully in the hilly land and gully with good moisture condition.

(5) Increase the management and protection work after construction, reduce man-made damage, and consolidate the governance results

According to the investigation, the soil and water conservation measures adopted at present have a low retention rate, especially the vegetation measures. Due to the climatic factors and human destruction, the vegetation survival rate is low, so it is necessary to strengthen the post-construction management and protection work to consolidate the control effect. In terms of water and soil conservation, we should further strengthen the publicity of relevant laws and regulations on water and soil conservation, improve the water and soil conservation institutions, ensure clear division of labor, clear responsibilities and rights, check the results of governance, and take timely remedial measures. Ensure that all measures are effective.

3. Conclusion

The construction of soil and water conservation is a big project with large investment and slow effect, but benefiting future generations. In most areas with poor rural conditions, due to the low living standards, some soil and water conservation measures are difficult to implement or destroyed after implementation, so it is necessary to pay enough attention to the work of soil and water conservation in terms of funds and publicity, so as to avoid the fluctuation of soil and water conservation measures.

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