Design and Research of Wind Erosion in Sandy Land and Typical Sand Fixation Project in Small Watershed in Jiangxi Province

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Abstract. Due to the difference in climate, soil, region and geomorphology in north and south, there are certain characteristics in the design requirements of sand fixation project for a small watershed in Jiangxi Province in southern red soil region. It is quite different from that of northern China, so it should be designed according to the local condition of Jiangxi province. This paper enumerates the distribution, causes and characteristics of wind erosion in sandy land in Jiangxi Province. According to the principle of "advanced technology, reasonable economy, safety and reliability", sandy land treatment and restoration technology of typical Vitex trifolia in Jiangxi Province are selected for description. Suitable sand fixation engineering design for Jiangxi Province with prolonged service life, high comprehensive benefit, low cost and simple construction technology is formed. It has important technical guiding significance for promoting the construction of ecological Poyang Lake Basin and national ecological civilization experimental area, improving the effectiveness of sand control measures, protecting "one lake of clean water" in Jiangxi Province.

1. Introduction
Jiangxi Province is located in the south bank of the middle and lower reaches of the Yangtze River. The specific natural conditions and human activities lead to the characteristics of soil and water loss in Jiangxi Province, such as easy and frequent occurrence, wide coverage, large quantity and diverse forms [1~4], including a certain area of sand with the characteristics of desertification in the south of the wind erosion in sandy land. It has attracted people’s attention to that the desertification is an important ecological environment problem in arid and semi-arid areas. However, wind-sand activities also affect the land in wet and semi-wet areas, and the land degradation caused by wind-sand activities has not attracted much attention [5]. Wind erosion characteristics in northern China are quite different from those in Jiangxi Province because of its wide distribution and great harm. There are many engineering designs suitable for sandstorm areas in the north, but not completely suitable for Jiangxi Province. Therefore, sand fixation engineering design should be carried out in accordance with the characteristics of wind erosion in sandy land in Jiangxi Province. According to the characteristics of wind erosion in Jiangxi Province, this paper enumerates the distribution, causes and characteristics of wind erosion in sandy land. The typical Vitex trifolia sand treatment project in Jiangxi Province is selected to form a suitable design for the sand fixation project in Jiangxi Province with a long service life, high comprehensive benefit, low cost and simple construction technology.
2. Distribution of wind erosion in sandy land in Jiangxi Province

In semi-humid and humid zones of temperate, even in tropical and subtropical areas, as long as the surface composed of sand materials and the dry season and wind season are synchronous in time, under the condition of vegetation destruction and bare sand, wind-driven sand activities can be generated as a result of wind-sand activity. As a result, the landscape with undulating dunes emerged from the earth's surface, leads to a decline in biological production and in potential land productivity, and a desert-like environment on the earth's surface [5]. According to the fourth national desertification and sandiation monitoring statistics by the State Forestry Administration, humid and sandy land in the south of China is widely distributed with an area of 8800km², including 260 counties (cities and districts) in 12 provinces, including Jiangxi, Fujian, Guizhou, Zhejiang, Hunan, Hubei, Guangdong, Guangxi, Hainan, Yunnan, Sichuan and Chongqing. Although the total land area of desertification is not large, its population density is much higher than that of the northern sand area, plus its wide distribution range and unreasonable human activities. As a result, ecological imbalance will be caused. Production and life will be affected to a certain extent too.

According to the "Jiangxi Soil and Water Conservation Planning (2016-2030)" and the results of the review survey in 2013, the wind erosion area in Jiangxi Province is 132.81 km², accounting for 0.08% of the total land area, of which 34.26, 41.08, 49.48, 3.99 and 4.00km² are mild, moderate, intense, extremely intense and intense erosion areas, respectively [2]. According to the research results of soil and water conservation division and prevention and control layout in Jiangxi Province [2], the wind erosion area of Poyang Lake hilly plain farmland protection and water quality maintenance area is 110.26 km², accounting for 83.02% of the province's wind erosion area. There is a large amount of wind-eroded sand in the lakeside area of Poyang Lake and the area of estuaries of “Five rivers”, which are the main distribution areas of wind erosion in Jiangxi [2], including Duobao sand mountain in Duchang County, Wucheng Sandy Land in Yongxiu County, as well as Xinjiang district along the lower reaches of Ganjiang River, estuaries of “Five rivers” and other lakeside or riverside areas. The main basic functions of the three-level soil and water conservation are farmland protection and water quality maintenance; the social and economic functions of soil and water conservation include food production, comprehensive agricultural production, forestry production, lake area protection, water source protection, natural landscape protection, migratory birds and fish protection, land productivity protection, wind erosion area and human settlements protection in flood and waterlogging areas [2].

3. Genesis of wind erosion in Jiangxi Province

Poyang Lake is the largest freshwater lake in China and an internationally important wetland. It has important status in maintaining the water balance and ecological security of the Yangtze River. It is of profound significance to carry out research and protection of Poyang Lake [6]. The economy and society development of Poyang Lake Basin, soil erosion and other ecological environmental problems will become more serious, which also puts forward higher requirements for the harmonious development of human and nature. Jiangxi Province is one of the provinces with the most serious soil erosion in the south of China. Owing to the influence of natural and human factors, soil erosion situation is from bad to worse, sediment deposition is increasing. The ecological environment has been damaged to varying degrees. Sediment deposition along lakes and rivers and vegetation cover on farmland and mounds are destroyed, and soil and water loss year by year lead to the gradual loss of organic matter and clay particles in the soil, gradually forming wind erosion in sandy land.

According to the research on the formation of the sand hills (namely Shashan) on the shore of Poyang Lake by experts, it is considered that the hydrologic climate conditions of Poyang Lake are the important causes. Every year in the dry season, the strong winter wind blows up the exposed sand on the lake beach, and then carries it to the lakeside area to accumulate, slowly forming the lakeside sand hill seen today [7]. Because of the windy weather in winter and spring, the northwest wind erosion causes the northwest direction of sand dunes to form "wind sand gap". Fierce wind erosion leads to the phenomenon of "our setbacks caused by sand".

2
4. Characteristics of wind erosion in Jiangxi Province

The problem of land desertification with "desert-like landscape" in the sand hill area of Poyang Lake is different from the desertification in the arid area of north China in terms of causes, distribution, control, development and utilization [8]. Professor Zhu Zhenda defined the process of "sandy desertification" in semi-humid and humid areas of eastern and southern China as "land desertification process", and the land which appeared "desert-like landscape" was called "wind-sandy wasteland". Due to water erosion, wind erosion and human unreasonable use of land of natural and human factors, a unique landscape of "water village desert" composed of sand dunes, sand bars and sand hills has emerged [5]. Sand hill soil has a loose structure, low nutrient content, poor water and fertilizer conservation ability, and its landform type is characterized by fixed dunes, semi-fixed dunes and flowing dunes. Wind-sandy land is closely linked to farmland, villages and cities. Severe sandstorms can erode and bury farmland, leading to the deterioration of the ecological environment and poverty of the masses, intensifying the contradiction between people and land resources, and seriously affecting regional ecological and food security. Jiangxi Province is located in the middle and lower reaches of the Yangtze River, belongs to subtropical monsoon humid climate. Under the common drive of multiple factors, certain desertification phenomenon exists regionally in Jiangxi Province. Although the desertification area is small, the type is more complete, and sandstorm hazards are relatively serious, which is typical of desertification land in southern China.

5. Typical sand fixation engineering design

According to the research results of soil and water conservation regionalization and control distribution in Jiangxi Province [2], Poyang Lake hilly plain farmland protection and water quality maintenance zone with superior geographical location, which is a national demonstration zone for comprehensive development of the great lakes basin, a water ecological security zone in the middle and lower reaches of the Yangtze River, an important promoting area for accelerating the rise of the central region and an important platform for international ecological and economic cooperation. It is also a regional base for high-quality agricultural products, ecotourism, optoelectronics, new energy, biology, aviation and copper industries. In this paper, the ecological control of sandy land in a small watershed in this area is selected as a typical case to describe the design of typical sand fixation projects in Jiangxi Province.

5.1 General design principles

Based on the research results of soil and water conservation regionalization and control layout in Jiangxi Province, rehabilitation and reconstruction of vegetation in the sandy land should be emphasized and take the road of combining harnessing, developing and utilizing. In wind erosion areas, wind and sand control measures such as sand fixation afforestation (grass) are mainly adopted to strengthen the construction of farmland shelter, including forest network and forest belt, prevent land desertification and sand belt expansion, and protect the local ecological environment. Sandy land treatment measures focus on fixed and semi-fixed sandy land with a high groundwater level, large development potential and small fluctuation, and arrange in priority areas with severe wind erosion and dense population that have threatened the surrounding areas.

5.2 Basic design provision

(1) The small watershed sandy land ecological treatment project is an ecological construction project of sand prevention and control project, including measures of wind prevention, sand fixation and establish wind prevention and sand fixation belt.

(2) Sand fixation projects should be laid out in accordance with hazard prevention, local materials and economic rationality. Because of the scope and area of wind erosion area in Jiangxi Province is relatively small. It is quite different from that in the north. According to the practice of sand control in Jiangxi Province for many years, based on the principle of local conditions and economic rationality, the sand fixation project of this project should not include engineering sand fixation and chemical sand...
fixation, should include plant sand fixation and cultivating measures, mainly plant sand fixation measures.

5.3 Design of management and restoration project of *Vitex trifolia* of sandy land

In the application of sandy land control in Jiangxi Province, restoration technology of *Vitex trifolia* has obvious effects. Therefore, this paper mainly describes the restoration technology of *Vitex trifolia* of sandy land.

*Vitex trifolia*, *Verbenaceae*, *Vitex* genus, is a prostrate or sloping perennial deciduous shrub. It is a kind of plant that grows on lakeside, seashore, the fine sand bar, riverside and beach with the sand and has strong adaptability. The results show that it is resistant to drought, barren, salt and alkali and easy to manage. Especially in quicksand area, it has the characteristics of high overwintering and overwintering rate, strong germination ability, high tillering rate, rapid growth and large coverage. *Vitex trifolia* is suitable for growing in quicksand environment, so it is an important technical means for ecological restoration of lakeside sandy land in flowing sand dunes. After buried in quicksand, the stolon of *Vitex trifolia* can grow adventitious roots and extend around, effectively prevent the movement of quicksand and play a good role in sand fixation. In addition, a large number of litter leaves are returned to the sand every year to accumulate nutrients and promote the habitat change of flowing sand dunes.

Because of the emergence rate of sexual reproduction of *Vitex trifolia* and the poor heat tolerance of its young buds, the cultivation of *Vitex trifolia* generally adopts asexual propagation, such as cutting and burying. The cultivation method has the following steps:

(1) Land preparation before cutting

Land preparation can be carried out before the rainy season in February. Generally, the plough depth is about 30cm and the land is prepared in a strip with a distance of 1m. The purpose is to loosen and mature the soil and improve the survival rate and growth rate.

(2) Provenance selection

The selection of provenance for cutting of *Vitex trifolia* is an important link, which decides its survival rate and growth condition. The provenance was selected as 1~2 years of healthy branches, the tip end of which was 30cm removed, and the remaining branches were cut into 50cm long each branch, generally take the same day cutting.

(3) Cutting and burying propagation

In mid-March, rainy weather was selected and according to the specification of line spacing of 60 ×100cm. Cuttings 35cm deep holes, the thicker end of *Vitex trifolia* branches of 45° inclined inserted into the hole. At the same time, we applied barnyard manure 1kg~1.5kg, filled sand and stepped solid. The branches were exposed 5cm above the ground. Bury the strips and dig the holes 10cm and 20cm deep, apply barnyard manure 1kg~1.5kg per hole, lay them flat into the holes, then fill the sand and step them solid.

(4) Fertilization

There are for two kinds of fertilization in vine cultivation: base fertilizer and management fertilizer. Base fertilizer is put in with the planting time. Managed fertilization is divided into three stages. The first is germinating fertilizer. Before the vitex sprouts, in early March; the second time was the strong fruit fertilizer, the time is about the end of June before the *Vitex trifolia* begins to fall, *Vitex trifolia* fruit begins to ripen. It's about the end of June; the third is overwinter fertilizer. After harvesting *Vitex trifolia* seeds, it is about mid-October.

(5) Trim

Before the onset of winter, cut off the dead branches, old and shady branches of plant diseases and insect pests, and concentrate on treatment.

(6) Pest control

The main diseases and insect pests are leaf spot and *Icerya purchasi*.

(7) Control effect
From the effect of vine erosion prevention, the structure of wind-sand flow changed obviously after vine planting in sandy land, and the amount of sand adhering to stratum increased significantly, which made most of the sand grains settle on the surface and reduced the forward velocity of sand dunes. *Vitex trifolia* with 50% coverage can reduce the moving wind velocity of sand dunes at 50 cm and 100 cm height by 33% and 18%, respectively, but lower than the wind velocity of threshold sand under the underlying surface, so that the sandy land is free from wind erosion. *Vitex trifolia* plant can effectively enhance the wind velocity of threshold sand. Under the same coverage, sandy land with *Vitex trifolia* of the threshold friction velocity is higher than that in sandy land with grass, which proves that *Vitex trifolia* has stronger sand fixation ability. The annual sediment blocking capacity per plant of 5 years *Vitex trifolia* can reach 0.4~0.56m³.

6. Conclusion
Sand fixation project is a measure of small watershed management. However, there is a lack of research on the design of small watershed sand fixation project in Jiangxi Province. Owing to the differences of climate, soil and landform between the north and the south, sand control engineering design suitable for the sandstorm area in the north is not completely suitable for Jiangxi Province. Therefore, the design of small watershed control and sand fixation project in Jiangxi Province should be targeted according to the actual situation of Jiangxi Province. Therefore, this paper use typical design examples of sand fixation projects, makes certain exploration and research on the sand fixation projects suitable for Jiangxi Province with long service life, high comprehensive benefit, low cost and simple construction technology. It has great technical significance for improving the effectiveness of measures of sand control and prevention, the planning and design of soil and water loss control and soil and water conservation in Jiangxi Province and sandstorm area of red soil area of south China.

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