

General Description of Water and Soil Conservation in the Songhua River Basin

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1 The songhua river basin

The Songhua, one of the seven largest rivers in China, has a drainage area that lies within three provincial jurisdictions, Heilongjiang Province, Jilin Province and Autonomous Region of Inner Mongolia. The river originates from two sources, the Nen river and the Second Songhua. The two rivers meet near Songyuan where they form the Songhua River proper. From the confluence, the Songhua River flows easterly and eventually joins the Heilong (Amur) River, which is a boundary river between Russia and China. The total drainage area of the Songhua River is approximately 560,000 km², of which 300,000 km² area is in the Nen River watershed, 74,000 km² in the Second Songhua basin and the remaining 186,000 km² in the local watershed of the Songhua River main channel. There are many tributaries to the Songhua River system of which, 16 have drainage areas larger than 10,000 km².

There are two major floodplains in the Songhua River basin: one is the Songnen plain, another is the Sanjiang plain. The Sanjiang plain comprises nearly 2.0 million ha of wetlands, the largest wetlands in eastern Asia, and provides one of the most important breeding areas and migratory routes for waterfowl in that part of the world. The area also supports a large number of endangered species, particularly waterfowl.

2 Soil Erosion conditions in the songhua river

2.1 Problems of soil erosion

Soon after liberation, the Songhua river Basin had a water and soil loss area of 113,437.2 km², which accounted for 20.4% of the total lands in the Songhua river drainage area. By the end of 1985, it had a comprehensively controlled soil erosion area of 33,165.6 km², which accounts for 29.2% of the total soil erosion area early after liberation. In 1986, by applying remote sensing technology to research the area, we found that the soil erosion area had not been reduced, but had increased to 179,887.5 km², which accounted for 32.2% of the total lands in the Songhua river drainage area. This represents an increase of 58.5% over the amount determined soon after liberation.

The Songhua river Basin is an important production base for foodstuffs in China. Soil erosion is a major problem in this area because it occurs so rapidly and has such widespread effects.

The first problem is that serious soil erosion results in the formation of erosion gullies, which continuously remove valuable soil resources. Channel density is as high as 2 km/km²—3.5 km/km² in regions where erosion is caused by water. Based on statistics from Heilongjiang province, there are 140,000 erosion gullies dispersed over Heilongjiang province, resulting in the loss of 1,400 thousand mu of land (mu is a traditional unit of area in China; 1 mu converts to 666.67 m²).

Due to the continual development of erosion gullies, original farmland areas have been fragmented, total farmland area has decreased and soil resource productivity has been reduced.

The second problem is that soil erosion causes the layer of topsoil on farmland to become thinner and thereby lowers soil productivity. According to direct observation as well as data from research plots, erosion causes topsoil losses of about 0.5 cm—1.2 cm per year in the Songhua river Basin. The results of research in Heilongjiang province show that the amount of soil organic matter lost from blackland areas depends on the time since farming began. After 20 years of farming, nutrient levels will have fallen by a third, after 40 years they will have fallen by half and after 70 to 80 years they will have fallen by

two-thirds. About 1,047,000 hectares of the blackland region have been largely denuded of topsoil by water erosion. Topsoil loss inevitably results in a decrease in land productivity and in some cases the resulting land is rendered useless for farming.

The third problem associated with soil erosion is that sediment from eroding areas clogs rivers and decreases reservoir capacity, which in turn affects the usefulness of the reservoir and affects transportation.

Measurements show that 40,000 m³ of sediment are deposited in the Jinhe reservoir in Shuihua county each year. In 1975, a large rainstorm caused a railway signal and switch system to be covered by about 30 cm—40 cm by sediment. On August 13, 1987, a sudden rainstorm fell upon Huangshanzhun, a suburb of Harbin, causing a lot of slurry to come down the slopes. This resulted in the blockage a road of Hatong with 7,500 m³ of sand in an area 10 meters wide by 1,500 meters long. The result was a traffic jam that blocked more than 300 vehicles by 7 o'clock that morning, which had a serious effect on road transportation. At present, alluvial deposits in the Harbin segment of the Songhua river around Binzhou iron bridge have already formed tidelands and sandy beaches extending more than 3,400 meters and accounting for 4,900,000 m³ of sand. Previously there were eight bridge openings through which ships could pass, however now only two are useable. Formerly the water course was 1,500 kilometers long, but now it has been reduced to 580 kilometers, which seriously restricts Songhua river transport.

The fourth problem associated with soil erosion is that of wind erosion, which has become an increasing problem due to removal of ground cover. Wind eroded areas occupy 33,500 km² of the sand dune region, including 17,300 km² of areas of medium erosion, with a soil erosion modulus of 3,000 t/(km² • a). Although wind eroded areas are presently not too extensive, the problem is becoming increasingly worse. The amount of desertified land has reached 5,960 km² west of the Songhua river basin, where it is called Nenjiang sand (Songnen sand), making it the 14th largest desertified area in China. At present, desertified land is increasing by 100 km² each year. Wind erosion has seriously affected as much as 8 million mu in 21 cities or counties such as Tailai county, Dumeng county and LongJiang city. The result is increasing drought and more frequent wind in these areas. High winds occur on more than 20 days each year and as much as 2 million mu of crops must be replanted each year due to wind damage.

2.2 Classification of soil erosion areas

In the Songhua river basin, soil erosion areas are categorized according to natural conditions such as geography, the lay of the land, types of soil erosion etc. Other considerations such as administrative boundaries and erosion control measures used are also taken into account. The Songhua river basin can be divided into five regions:

Region I (mountainous region) has an area of 132,595.00 km², accounting for 23.81% of the Songhua river basin area. The region consists of wooded zones, some agricultural zones and pasturing zones. Water and soil loss is serious in farmland and some pasturing zones.

Region II (hilly region) has an area of 187,665.90 km², accounting for 33.70% of the Songhua river basin area. This region is mostly agricultural zone, and includes 18,664.5 km² of over 3° sloped farmland where a 0.2 cm—0.7 cm layer of topsoil is estimated to be lost each year. Erosion channel density is 1.5 km/km²—2.0 km/km² and the annual modulus of soil erosion is estimated to be 5,000 t/km².

Region III (undulating hilly region) has an area of 114,673.4 km², accounting for 20.60% of the Songhua river basin. This region's geography is undulating. Much of this area has been farmed for many years resulting in a low percentage of soil cover. Topsoil loss is estimated at 0.4 cm—0.7 cm per year, erosion channel density at more than 2.0 km/km² and the soil erosion modulus at levels as high as 7,000 t/km².

Region IV (sand dune region) has an area of 105,350.60 km², accounting for 18.92% of the Songhua river basin. Topsoil loss by wind erosion amounts to 0.6 cm every year and the annual soil erosion modulus is 6,000 t/km².

Region V (plains region) has an area of 16,537.0 km² accounting for 2.97% of the Songhua river basin. This region's topography is low-lying, with some waste areas.

3 Water and soil conservation objectives in the songhua river basin

Songliao Water Resources Commission (SWRC) has developed an extensive soil and water

conservation program for the Songhua River basin. The program to increase the soil and water loss controlled area by 73,410.4 km², bringing the total to 92,601.9 km² of controlled area. The controlled area will then account for 86.2% of the total soil and water loss area. The program includes a sloping field control project, a slope retaining project, a small-sized storage and a drainage project and service system (including soil and water loss supervision, an observational network, soil and water conservation scientific research). It is subdivided into 4 categories with 16 specific construction projects.

The program has estimated a total cost of 40.7 billion Yuan over its 20 years implementation life. The first stage of the program is estimated to be completed within nine years at a cost estimated at 15.2 billion Yuan. SWRC has identified a first stage priority area for consideration as a subproject under the ADB loan program. The priority project area covers a total treatment area of over 2,700 km² at a cost of 1.4 billion Yuan.

4 Soil erosion control measures and their development

4.1 Types of soil erosion control measures and their development trend

Below, there are some of the main measures used in soil erosion control.

4.1.1 Types of erosion control measures on slopes

- Torrent sediment traps, Big Pit and interceptor channels
- Plant barriers (buffer strips) and contour strip cropping
- Fish-scale pits
- Terracing of slopes
- Small Square Basins on slopes for planting fruit
- Trees for soil and water conservation
- Contour plowing
- Closing regions to allow recovery by vegetation and forest management

4.1.2 Types of erosion control measures in channels

- Sediment check-dams
- Ponds and embankments
- Peripheral bunds
- Reforestation of gullies

4.1.3 Tree selection

When selecting trees for soil erosion control in the Songhua river basin, the most popular species are Black Locust, Chinese Pine, Chinese White Poplar, Simon Poplar, birch, Elm, Mongolian, East-Liaoning Oak, Seabuckthorn, Korshinsk Peashrub, Shrub Lespedeza and Indigobush Amorpha,

4.2 Development trends in soil erosion control measures

At present, there are two trends in the development of soil erosion control measures in China, one being toward integration, and the other toward specialist measures. Integration means that conservation projects must be complementary to one another, if they are to bring about effective control. The success of these projects will depend on deploying control measures using small watersheds as single units. Specialist measures means using research methods to solving some special problems of soil erosion. For example, depending on local conditions, district conservationists may create Big Pits to guard against drought in the northern part of the Songhua river. This has been a successful technique in solving the problem of low plant survival in these areas. In some large regions of sloped land, soil conservationists have created Small Square Basins, which are specially constructed for fruit trees. At the present time, some orchards have been built in mountainous areas using this method. Comparison of the Small Square Basin technique with level terracing shows that this kind of site preparation can reduce labour by about 40%, improve water storage capacity and increase fruit tree survival and productivity. In dune regions,

the type of conservation measure used is determined by the soil characteristics. In some regions with loose soil, tree seeds are placed in soil pouches made from fiber bags, which are then used to build check-dams in gullies, resulting in excellent erosion control.

4.3 Effectiveness of erosion measures

Some slope erosion control measures have already been introduced. These erosion control measures have been widely applied and have been very effective in the Songhua river basin, although some measures can only be applied in specific regions. For example, the Big Pit technique can only be applied in northern areas where there is a thick soil layer and where it is very dry, such as Xingan Meng region. By contrast, fish-scale pits can only be applied in forest areas where the soil layer is thin and rainfall is high. In the selection of tree species, drought-resistant arbor and arbuscle are often used in the northwest areas of Songhua river basin, because they survive well and rapidly produce tree cover. In the southeast, arbor is often used, as it can improve the environment and also be used as a wood supply.

To control erosion on sloped land, farmland on slopes over 15 degrees shall be gradually brought out of cultivation, and instead will be planted with trees. Farmland on slopes between 5 and 15 degrees will build terraced fields. Farmland on slopes between 3 and 5 degrees will build buffer strips or use contour strip cropping and farmland on slopes below 3 degrees will use contour plowing. In some regions with a suitable climate and a soil layer more than 50 cm—60 cm deep, orchards or other varieties of cash trees can be planted. The use of these techniques has been successful in most regions of the Songhua river basin.

In some gullies with headward erosion, building check-dams and peripheral bunds can prevent runoff into the gully, while at the same time trees can be planted within the gully. In gullies with a constant U-shape, the main control method is the planting of trees. There are various kinds of check-dams used in the Songhua river basin. Different check-dams are used depending on local conditions, Stone check-dams being used in Hill regions, Earth check-dams used in blackland areas of the Undulating regions and Fiber bag check-dams used in Sand dune and loose soil regions. Under proper management, gully control measures can control gully erosion and stabilize the bed of the gully in two years.

5 Difficulties encountered in erosion control measure implementation

The greatest difficulties encountered in the implementation of erosion control measures are economic ones. On the one hand, successful control measures require definite investment, but on the other hand, in the short-term, farmers may actually lose income when control measures are first implemented. The result is that some farmers are unwilling to carry out control measures for soil and water conservation. For example, because building terraces on a sloping field greatly disturbs the topsoil and reduces the total amount of farmland, it reduces the farmer's harvest in the short-term. Since building terraces also requires much investment, it becomes difficult for the farmer to make the conversion from sloped to terraced field. Other soil erosion control projects also have problems associated with intrusions upon farming land, high investment and management difficulties.

The second set of difficulties involves the shortage of necessary management and maintenance problems which can result in control and destruction occurring at the same time, with the result that soil erosion control measures are ineffective.

The third set of difficulties involves the shortage of trained village conservationists. Many conservationists lack basic training and therefore can often not properly carry out control measures according to design. At present, since the government has attached such importance to soil and water conservation, and has set up a prevention and supervision system, the aforementioned difficulties are being overcome.

6 The significance of comprehensively controlling soil erosion in The Songhua river basin

Through soil and water conservation, the general environment can be improved. As plant growth increases, more shelter is provided for wildlife. The same trees, grasses, and shrubs that are planted can

also help to beautify the countryside. In past years, many watersheds have been reinvigorated through comprehensive control so that pheasant, hare, fox and rare bird species, which had disappeared before control, have reappeared. In one or two regions even large animals such as the wolf and the Siberian tiger have reappeared. Soil and water conservation also has an important role to play in the conservation of biodiversity. Accomplishing comprehensive control within small watersheds is in some way like establishing a mini-nature reserve, and many small watersheds combined together can provide corridors for wildlife migration. As these forest and grassland areas progressively develop, more and more rare wildlife species will become protected within them and will begin to multiply.