

Research and Harnessing Plan About Soil and Water Loss in Shanyang County in Hunan Province

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Abstract: The ShaoYang county of Hunan Province is an old revolutionary district and a district of poverty. Owing to all sorts of natural and human factor, the soil was suffered with severe water loss and soil erosion. The lost areas account for 37.7%, thereinto, light_lost areas is 41.2%, mid_lost areas is 37.7%; strong_lost areas is 0.5%; terribly_lost areas is 4.3%, extremely_lost areas is 0.5%. In order to concern this severe crisis the author composes this paper.

First, the basic condition in Shaoyang County is introduced. Next, it deeply studies the occurrence and development rule of the soil erosion from the original society till now, points out all kinds of reason and harm of soil and water loss. Then, the types of soil erosion and its correspond harness measurement is classified according to the present situation, and planning of defension and prevention is put forward. The planning period is 30 years, i.e. from 2001 to 2030. In the planning, forecasts are first made from 6 aspects: population forecast, soil usage forecast for food and produce, extend balance, soil usage forecast for vegetable and its produce and sale, usage forecast for forest for firewood, fruit forest forecast and its produce and sale, meadow and other non_produce soil forecast. Base on above forecasts, author raises in_system soil using plan and detailed adapting plan, changes the cultivate regime. Also, integrate harness method and quantization index for the present situation are described. Also, author detail arrangement of "according our own abilities, carry into execution by stages", and make the investment budget and benefit analysis: from the social benefit perspective, author discusses the water_accumulation and soil_reservation and erosion_decreasing benefit by creature measure and by project measure, and the improvement of the forest covering percentage, the increasing of the humidity and precipitation, the improvement of the ability of drought_fighting, etc. From the economic benefit perspective, author specifies the benefit of production increasing of all kinds of measures, and also calculates the total run_expense, yearly net benefit, time limit in year of sensitivity investment recycle and output_input ration etc. At last, three necessary guaranty measures for the implement of the project is presented.

1 Brief introduction of shaoyang county

ShaoYang county is situated in the south_west part of province Hunan, China ($110^{\circ} 59' 56''$ — $111^{\circ} 40' 14''$ E, $26^{\circ} 40' 36''$ — $27^{\circ} 6' 8''$ N), by the upper reach region of Ziji River, which is the first grade branch of Yangzi River. There are 22 villages and towns, 4 state_run sites, 636 village committees. It has a population of 924,100, thereinto, agriculture population of 843,200. It covers about 1,996.08 km² therein, paddy field 32,860 ha. (0.012 ha. per capita); terraced dry farmland 955.3 ha. (0.002 ha. per capita); slope plowland 11,155.3 ha. (0.012 ha. per capita). The total foodstuff production is 392,990 t, that is 467kg per capita, and the revenue per person is 860 RMBs. It is assessed proverty county by government.

2 Current situation of soil erosion and its harmness

Soil erosion in Shaoyang is the main root of its proverty; the total soil erotion area in this county is 75,311 ha accounting for 37.7% of the total areage of the county. The average erode modulus is

3,500 ton/(km² • year), ranks the forth in Hunan province. This land encountered great disaster due to the severe soil erodes.

(1) Reduction of land capacity and descending agriculture production

Soil erosion reduced the cultivate layer's thickness, consequently increasing the amount of runoff. Annual soil loss is now about 3,041,200 t. Assumed a cultivate layer of 15cm, it means the farmland loss is nearly 1,353 ha per year, wherein are 475 t of entire nitrogen, 198 t of entire phosphor, 3,691 t of entire ka, 50,940 t of organic material. So that the land turns barren, the soil's waterholding capacity and the production are decreasing. Wheat in dry land produces not more than 100 kg/mu; oil tea forest produces tea oil only 1.5 kg/mu, and ridge fir forest grows up less than 1cm one year.

(2) Accumulation of mud and sand, Suffering of downstream area

The lost soil cause non-smooth waterway and a mass of sediments in the lower reaches area. 500 hectare farmland and 2,000km² leat is dumped by sands every year. Because of the silt deposition, the storage capacity of 232 reservoirs in the county has decreased from 55,410,000m³ to 51,505,000 km³, with a capacity loss of 7.1%. Among all the 40,000 dewponds, 5,800 have been completely discarded due to the silt and another 10,500 have been almost discarded. Furthermore, the deposited silt makes a 4.5cm rise of the riverbedper year r.

(3) Enviroment deteriorate, zoology maladjustment

Since 1960, there is drought every year while there was every 5 years before liberation; flood also is once a year while once 4.5 years befor liberation. Last ten years, county seat had been flooded 35 times, i. e. 3.5 times per year. It was flooded 5 times in 1994. Storm emerged 217 times from 1960 to 1996, i. e. 6 times per year. In 1995, It emerged 15 times. Fauna also descreases sharply. Tiger, leopard, roe, jackal, otter such animals which still survive in fifties now had already vanished. Now in this county, voice of bird is scarily heard, snakes are hardly seen, while rat dominant and insect pest indulge.

Serious results alarmed the county government. From the end of 70's, some measures of conservation work are employed. In 1976, lumber export was ceased ; Shaoyang changed from a Lumber_export county to a Lumber_import county. At the same time, they began to seal the mountain plant trees and cultivate forest, in 1986, 11 sortie planes were used to make large area flying sew above 12 villages and towns. In 1989, government of county scheduled a plan to plant on all the barren hills in 4 years, and make the county green in 7 years. Since 1986, forestation areage add up to 8,000 ha. . But its ratio of grow up is less than 30%. Besides, some other measures were taken such as building check dam and trap trench, revising hillside cultivated etc.

3 Formation of soil erosion

3.1 Influence of nature factor

Shao Yang County has a complex landform. Dominated by knap, it also has many physiognomy types such as hill, hillock, hummock. More than 48% of land is slope land with 15°—25°, while 25.7% have a gradient greater than 25°. Limestone is the parent material of soil. It takes up 64%. With a acreage of 30km², water-eroded caves spread all over the county, so there exists serious water leakage. The secondary component of soil is incompact-structured river damp soil. Seasonal wind and circumfluence bring centralized rainfall and excessive rainstorm. Among one year, there are 15 days in which rainfall equals to or more than 50mm/day, and 23 days equal to or more than 25mm/day. Altogether, there are 161 raining days one year, total rainfall count to 1,274.1mm. Falling raindrops drop from the sky with great potential energy and kinetic energy, strongly impacting the ground. Also, forest vegetation is not so good, the forest shade density is not more than 10%, and the vegetation cover ration is less than 40%. All above create nature condition for soil and water loss.

3.2 Human-induced erosion

3.2.1 Influence of wars in history

Shao Yang County is military-important. Since ancient time, it's a battlefield. Early in XiHan dynasty, Fifth year of Wu Emperor, Ding prince of ChangSha was entiled here, lasted for 130 years. In

1288, Zhan YiZi revolted at Baicang, in 1859, wing king ShiDaKai beleaguer BaoQing (i. e. Shangyang). 1917, the army corps fought each other. Xiang army siege BaoQing, 1944, Japanese army flew into BaiCang. Continuous war almost destructed forest in this region.

3.2.2 Influence of political movement after liberation

In “big step, steel making” period, 640, 000m³ of lumber was burned out in Shaoyang county within one year. In “people’s community, large refectory” period, 700, 000m³ of lumber was burned in 4 years. In “simulate dazhai, turn greenery into field” period, big pieces of forest were destroyed. At the same time, canal was opened and plain was built. “Let the land of country move” i. e. cut_curve_take_straight project of Nan Water, FuYi river, and Tan river started one after another. 850, 000 workers act recklessly for several years, finally failed and gave up. Forest along turned to “loessial high slope”.

3.2.3 Influence of population

Current population of Shaoyang is 924,000; 2.09 times of the number of 1951 Plow land can’t meet the demand of quickly expanding population. So people make more plowland out from wasteland. Now there are 13,110.7 ha. Of droughty land, 65% of it is newly increased hillside cultivated. Besides, firewood usage increases a great deal; lopping quantity is greater than naturely growing quantity.

3.2.4 Influence of developing project

First is the constructing project. Now there are 15 developing area, plus railway and high way is under construction. Second is the development of resources. Mines of iron, manganese, coal, stone, sand, gold and factories of machine made red brick add up to 23, 000. They manage disregarding of soil and water loss, and make the hill and river broken up and sand all over.

4 Harnessing plan

4.1 Optimizes the agriculture structure; adjust the operation rule of field

The utilizing and management of field in ShangYang County still rest on a savagery status of “plough with sword and see with fire” and “extensive cultivation”. It apparently can’t fit the modern agriculture’s developing and need great adjustment. Agriculture is a large system, comes down to various aspects. We may use modern mathematics tools to make orientation and quantitative analysis, then establish math model, make multi_factor evaluation and multi plan comparison, and then choose the most reasonable, most optimizal plan. The detail method is as follows: first, forecast all index in the system, then according to the supply_demand balance principle establish multiple linear equation i. e. restrict variable, then establish the goal function which has the largest maximal benefit and the minimal soil and water loss according to the price parameter of each products and erode modulus parameter of all sorts of soil loss.

The linear programming model is as follows:

$$\sum C_i X_j \geq B_i (i=1,2,3,\dots,m) \quad m \text{ is the number of strict conditions}$$

$$X_i \geq 0 (j=1,2,3,\dots,n) \quad n \text{ is the number of structure variables}$$

The result group which makes the goal function $f(x) = \sum C_j \times X_j$ maximal(or minimal) is the most optimize result. Author gets the allocation plan of soil in Shaoyang County with this method (see the Table). The detailed process of calculation is slipped.

4.2 Utilize the forest zoology’s self-repair function, prevent and cure the water and soil loss

The forest plays a great role in rainfall distribution between soil water, overflow and evaporation. In addition, it can intercept rainfall, reducing rainfall erosivity, protecting soil from detaching and from overflow.

The radical measure of harness the water and soil loss is to restore the forest vegetation, it is also the most available and simplest measure in poor area. The key of repairing the vegetation is “wrap”. In order

to wrap, living energy problem must be first solved. Now author will discuss how to create the precondition according to the county's situation:

4.2.1 Popularize marsh gas

ShaoYang County is a agriculture county. Cattle, horse are often used to plow and family cultivation is the main economy source, so there is plenty raw material for marsh gas. One little gas pool of 6m^3 — 8m^3 can be held out only with dejecta and urine of three people, two pigs, one cattle and ten fowls/livestock. The productions of gas can guarantee the living source of three_people family and also solve the sanitation and environment problem.

4.2.2 Develop small water electricity instead of using firewood

In ShaoYang county there are four big rivers ZiJiang, Fuyi, NanShui, ShaoShui and more than 62 branches that are longer than 5km. The foreground is very wide. 300, 000 persons' living energy could be supplied if 60% of the water resources could be developed.

4.2.3 Extend and utilize the sun energy

The yearly sunlight hour in Shaoyang County is 1,595.1 hours. If we consider each day as 10 hours sunlight, then the yearly sunlight day is 160 days, accounting for the 44% of whole year. But the sun energy is not developed and used yet. If 50% farmer families i. e. 120, 000 families use sun energy to cook and burn, considering each family consume 5kg wood one day, so 216, 000, 000kg woods could be saved in one year, that will lessen wood supply pressure of 54, 000 ha.

4.2.4 Spread coal gas in good condition villages and spread woodsaving stove, coalsaving stove in bad condition villages. Besides, seal mountains to cultivate forest, turn plough field back into forest

4.3 Strengthen multi devotion, startup all kinds of power to harness

4.3.1 Enhance the government function devotion

Soil and water conservation is one basic national policy and government behavior. To do it well, goal and duty system in prefecture should be established, and officers should report how the situation is going to people's congress periodly, they will be evaluated, and be denied if his achievement is not good.

4.3.2 Enhance the fund investment

Since soil and water conservation is a public undertaking, other than the government enhances the devotion to the key project, there is an urgent need to enhance participation of local land managers, private sectors and scientists in developing long-term programs.

Government can make concession policy according to the law; launch groups, villagers, and investors to contract enthusiastically. The contract period may broaden to 10 to 15 years. In the contract period, taxes of special local product could be avoided or reduced. When allocate the benefit, the employee may get more economy benefit while employer get more social benefit. Employer may deposit the benefit in bank as startup fond of next project.

4.3.3 Strengthen the management

First utilizing all advertising tools to publicize the soil and water conservation legal, aware them of the national policy. Second, administrator according to the law, struggle with actions that violate soil and water conservation, deal with the irregularity cases as strict as possible, as soon as possible. To those manufacture of the likely occurrence of specific land degradation processes, examine their soil and water conservation plan strictly. With regard To those manufacture which are unable to harness water and soil loss, collect facility compensation fee and prevention fee, and act as an agent to maintain the outcome of harness.

5 Conclusion

The Plan had been accessed by experts from Water Bureau in Hunan Province: Yang shiwu, Huang qiangqiang, Wangyuesheng, Liu houfu, Pan youtang, Dai fengchen, Wang desheng, Hu yueming, Chen

guoyu, Longqixin. High praises were given, and the detailed comments are as follows:

(1) The Plan has three main features: substantial content, clear goal, and strong pertinency. By widely collecting the information on the social economy and natural condition and on-spot perambulation and measuring and calculating, it discovered and analyzed the problem, reason and harness of the ecological environment in Shao Yang county, provide a integrate goal and measures.

(2) The Plan uses scientific methods and gets reasonable results. It forecasts the future results according to dynamic request, arranges and adjusts the plan of soil using and harness of soil and water.

(3) The Plan classifies the county into emphasizing_prevented and protected region, emphasizing industrial_mineral region and emphasizing harness region. The classification is practical and realistic and the emphasis of each region is very clear.

(4) Shaoyang county has a servere soil and water loss, a deteriorate ecological environment, frequent calamity of flood or drought and the level of living standard is very low. Since the plan presents feasible solution, it can be regarded as the technical basis, we advice that it be included into the local people's economic develop plan and be carried out as soon as possible.