



Surrounding Environment and Water Quality Control of the Shangji Town Water Source in Xichuan County

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Nat. Env. & Poll. Tech.
Website: www.neptjournal.com

Received: 12-10-2015
Accepted: 16-11-2015

Key Words:

Water quality
Rocky desertification
Soil and water conservation
Environmental protection

ABSTRACT

The water which is diverted from the Danjiangkou reservoir's Taocha watergate on the middle route of the South to North Water Diversion Project is devoted to solving the water shortage of more than 20 large and medium-sized cities such as Beijing, Tianjin, Shijiazhuang, but there exists a grave rocky desertification problem in Xichuan, which directly affects not only the actual income of the South to North Water Transfer Project, but also the production and life of the people nearby and social stability. Therefore, this research started from improving the environment and water quality control in Xichuan via scientific methods and means of management to improve Xichuan's environment. First, a brief introduction is given to Xichuan's existing problems, second, analysing the causes of rocky desertification, finally, suggestions are given on the rocky desertification control based on the specific circumstances of the Shangji town.

INTRODUCTION

The Existing Problems and their Harm

There is a rocky desertification area of about 900 thousand mu in Xichuan County, including a severe desertification area of about 300 thousand mu and a moderate and mild desertification area of 500 thousand mu, accounting for nearly a quarter of the county's total land area of 4.23 million mu. The average soil erosion modulus per year is 41 tons/hectare, mainly distributed around the Danjiangkou reservoir, and the valleys of the Danjiang river, the Guanhe river, the Taohe river, the Qihe river and the Taohe river. Because of the rain wash year by year, rock is exposed to the surface, the soil is thin and less nutrient, the vegetation coverage rate is low.

All this will directly affect the efficiency of the middle route project. The Danjiangkou reservoir basin in Xichuan is 2,616 square kilometres, accounting for 56.9% of the total watershed area. The rocky desertification in Xichuan County has caused serious soil erosion that a large amount of mud and sand flow into the Danjiang Reservoir. As a result, the reservoir water has become turbid, and nitrogen has exceeded the standard, on the other hand, the reservoir sedimentation will seriously affect the quality of water and the reservoir life.

The rocky desertification area is prone to flash floods, landslides, mudslides and other natural disasters during heavy rainfall. In rocky desertification mountain areas, soil is thin and rock is exposed, not only the water storage capacity is low, but also the water leakage is high, so it is very

easy to cause droughts, and heavy rainfall lead to serious loss of water and soil. Thus the survival problem, population problem, and the energy problem are unavoidable in rocky desertification areas.

THE STATUS OF THE SHANGJI TOWN XICHUAN COUNTY

Hydrological Conditions

Xichuan County's Danjiang river and its tributaries belong to the mountainous rivers characterized by the depth, steepness and great flow changes. The river water falls and rises greatly during rainfall, so does the Laoguanhe river flowing through the Shangji town. Table 1 shows the water flow rate changes of the rivers in recent years. It can be seen from the table that the Guanhe river's maximum peak discharge is 6030 cubic meters/sec in 1958, while the minimum flow is 1.2 cubic meters/sec in the same year which is only 1/5025 of the maximum flow rate. Hence, heavy rain leads to floods and disasters.

The water resources of the area mainly include surface water and groundwater. Surface water refers to the surface water flow to and from the region. The town is a mountainous one, the slope of the ground is big, the vegetation is poor. There will be flash floods once heavy rains occur, resulting in large amounts of water waste and water shortage. So the water resource is particularly rich in this area. Because its water is to be used for the cities in the north, the water quality requirements are relatively strict, and the water quality must be ensured. According to the classification standards of water functions, the water quality of the region

must reach the class III standard, and approach class II. The water quality situation of the region is given in Table 2.

As can be seen from Table 2, among the indexes of water quality in the region, only the total nitrogen content does not meet the requirements, all the other items reach class III or above. Nitrogen can be accumulated in the soil with the mountain rainwater flowing down, eventually leading to the total nitrogen content higher than that of the mountain top, so it is necessary to carry out rectification of the land on both sides of the river. That means soil fertility, at the same time, trees should be planted on both sides of the river to fully absorb the nitrogen in the soil. Just as filtering, the nitrogen in the water is left. After long-term governance, the Danjiang river water quality can reach the required standard.

Geological Conditions

In the sample collection of soil and rock, the GPS was used to determine the specific information and height of the sampling locations. The samples are random, and mainly collected in the different mountain places at the same height. The places for soil and rock samples are typical. The samples collected from the same location were mixed up. Finally the samples were sent to the fertilizer station for inspection. The test results of the soil sample are shown in Table 3.

From the test results, it can be seen that with the change in the different altitudes, elements vary. In the rocky desertification areas, nutrient elements in the soil will lose under the erosion of rainwater, for example, soil nitrogen and phosphorus content. The content of organic matter in soil not only reflects the presence of animals and plants in the region, but also the survival of plants. The table shows that the region is suitable for plants to survive.

The analysis of rock composition shows that a large amount of calcium oxide exists in the rocks with a proportion of over 50%. It is obvious that they belong to the limestone. The rocks has the characteristics of density, and are prone to erosion.

Vegetation Conditions

The distribution of vegetation is the comprehensive effect of hydrological conditions and thermal conditions. The Shangji town has good water resources, and the area belongs to the temperate continental climate, vegetation types are various. At present, many trees have been planted in the area such as pine, fir, platycladus, but the vegetation coverage is very low, about thirty percent.

CAUSES OF ROCKY DESERTIFICATION

Natural Factors

Natural factors are the basic conditions for rocky desertification formation. First, the rock formations, the rocks in this area are rich in carbonates, and easy to form leaching (Zhu & Li 2004). It is hard for water and soil conservation as there are many steep mountains, the soil and water are easy to lose. The lack of a transitional layer between the substrate rock and the upper soil reduces the adhesive force greatly between the two, which leads to soil erosion and rock desertification (Fan et al. 2011). The rainfall is uneven in this area, and it is concentrated in summer. The summer rain will aggravate the formation and development of the rocky desertification.

Human Factors

Great soil and water loss is the main cause for the formation of rocky desertification, but the contradiction between human and land is the biggest problem existing in the rock desertification control. With the improvement of science and technology and the growth of population, the demand for nature is also unceasing, which has caused great changes to the environment. Therefore, human factors are the main factors for karst rocky desertification formation.

Excessive lumbering: Karst areas are underdeveloped, daily life energy mainly relies on firewood, the shortage of coal and electricity energy is the main reason for the destruction of vegetation.

The irrational farming methods: In karst mountain areas, the traditional method of agricultural production is used, and the harvest is poor (Han 2010).

Excessive reclamation: Cultivated land in karst areas is scarce, the farmers destroy forest or grassland to expand cultivated land, and to increase grain output. The soil becomes more barren, the forest is dwindling, quickening the process of karst rock desertification.

Deforestation: The local people cut down mountain plants on a large-scale. Coupled with the natural disasters, water and soil loss increases at an unprecedented pace.

Random grazing in these regions: The local people scatter their cattle around, not only destroying the vegetation, but causing soil erosion. Presumably, a sheep can eat up 10 mu of vegetation of 3-5 years old each year.

Unreasonable mining of mineral resources: The place has a lot of mineral resources, especially jade, marble, iron ore reserves are abundant. Driven by financial interests, the mining of these deposits has caused irreversible damage to the vegetation.

ROCKY DESERTIFICATION CONTROL SUGGESTIONS

Prevention and control of rocky desertification must be started from many aspects. First, it is a good job to close the

Table 1: Xichuan County's main hydrological characteristics.

River names	Wide riverbed (m)	Riverbed Deep riverbed (m)	Bottom slope	Maximum flow		Minimum flow		Notes
				cm/sec.	Year	cm/sec	Year	
Danjiang	500~1200	6~10	1/500~1/1000	5680	1958.7	1.36	1970.2	Jinziguan station
				10800	1958.7	16.1	1960.6	Baidutan station
Guanhe	250~800	5~7	1/300~1/600	6030	1958.7	0.45	1979.6	Xixia Huangwan station
				6760	1958.7			Shangji research

Table 2: Surface water control index and local water quality.

No.	Item	II	III	Laoguanhe river
1	Water temperature (°C)	Man-made water temperature limits: Average highest water temperature ≤1; Average lowest water temperature ≤2		-
2	pH value (non-dimensional)	6~9		7.88
3	Dissolved oxygen ≥	6	5	7.27
4	Permanganate index ≤	4	6	2.89
5	Chemical oxygen demand (COD) ≤	15	20	13.28
6	Biochemical oxygen demand for five days ≤	3	4	2.53
7	Ammonia nitrogen ≤	0.5	1.0	0.24
8	Total phosphorus (in unit of P) ≤	0.1	0.2	0.05
		(lakes, reservoirs 0.025)	(lakes, reservoirs 0.05)	
9	Total nitrogen (lakes, reservoirs in unit of N) ≤	0.5	1.0	1.67
10	Copper ≤	1.0	1.0	0.25
11	Cyanide ≤	0.05	0.2	0.07
12	Volatile phenol ≤	0.002	0.005	0.0014
13	Petroleum ≤	0.05	0.05	0.01
14	Anionic surfactant ≤	0.2	0.2	0.085
15	Sulfide ≤	0.1	0.2	0.12
16	Fecal coliform (L) ≤	2000	10000	3000

Table 3: Shangji Yanshan mountain soil sample test report.

Sampling place	Total nitrogen (%)	Total phosphorus (%)	Total potassium (mg/kg)	Available phosphorus (mg/kg)	Slowly available potassium ; (mg/kg)	Available potassium (mg/kg)	Organic matter (%)	pH value (pH)	Water content (%)	Altitude (m)
Shangji Yanshan mountain top	0.243	-	-	35.8	824	248	1.24	6.3	-	261
Shangji Yanshan mountain side	0.220	-	-	33.2	788	316	0.97	6.2	-	215
Shangji Yanshan mountain bottom	0.805	-	-	28.0	532	140	2.04	6.2	-	196

hillsides to facilitate afforestation, return farmland to forest, and change the local people's ways of production and life. If necessary, ecological migration can be implemented; at the same time, preferential policies should be set up to support, encourage enterprises and institutions, individuals and private economic organizations to take part in the rocky desertification treatment; the adjustment of energy structure in rocky desertification areas can also reduce energy consumption of forest resources. In this way, rocky

desertification occurrence and deterioration can be fundamentally controlled.

Strategies and Measures for Rocky Desertification Control

In order to prevent and control rocky desertification, and to curb the spread of rocky desertification in karst area as soon as possible, the following countermeasures and measures need to be taken to improve the ecological environment.

1. To strengthen the leadership and the responsibility: The rocky desertification control should be regarded as part of the local economic and social development, and one of the chief issues of the local governments at all levels.
2. To strengthen the legal system for strict protection: For the prevention and control of rocky desertification, it is vital to solve the root cause and employ prevention measures and scientific management. To enhance the construction of the legal system to ensure law enforcement.
3. To establish a special fund: The state should see the prevention of rocky desertification in the overall framework of national ecological construction, and make the implementation plan as soon as possible. Special funds should be set up to start the rocky desertification project.
4. To enhance science and technology support for scientific treatment: Research work should be carried out to take appropriate measures to control rocky desertification. The existing mature technology and methods should be applied to promote the spread of new technology, new methods and new techniques.
5. To perfect the monitoring system: The dynamic monitoring system should be implemented. Monitoring the occurrence of rocky desertification areas should go on in a five- year cycle to grasp the changes and trends of rocky desertification (Pan 2012).

Forest Vegetation Construction

The basic issue of rocky desertification control is soil and water conservation. In order to do soil and water conservation work, the primary task is afforestation and reforestation. Only the construction of forestry vegetation can bring about the comprehensive control.

Artificial afforestation: Artificial afforestation is to scientifically plant trees according to the activities of trees growth adaptability and growth rules. For the afforestation, the first thing is to choose the right tree species based on the local ecological environment, and to make tree species and natural conditions achieve the harmony (Zhu 1997). At the same time, an objective evaluation of the production potential of afforestation areas should be based on the past information to choose the most suitable and adaptable tree species. The single species should be avoided to reduce unnecessary loss due to the diseases or insect infestation.

Returning farmland to forest: Reforestation is another key forestry vegetation construction task, and also a key step for rocky desertification control. As the main factor affecting the natural environment, reforestation should play a key role in the process of rocky desertification control.

The government should exert its power in the implementation of returning farmland to forest. The farmers should

get appropriate subsidies for the conversion of cropland to forest as a reward, which will stimulate them. In selection of plants, cash crops should be the key choice such as walnut, chestnut etc. The government can provide special lectures for the farmers in order to improve the yield of fruit trees. Seeing the benefit, the farmers will indirectly give convenience for rocky desertification control.

Closing hillsides to facilitate afforestation: Closing hillsides to facilitate afforestation can only be used as a supplementary measure. The local forest ownership and the local people's life styles should be fully considered to select the appropriate area and mountain range for afforestation. At the same time, specify the banned time and mountains, and make the system of rewards and penalties.

Closing the hillsides to facilitate afforestation should be based on the local actual conditions to adopt a flexible system. Closing hillsides to facilitate afforestation is only a means, the objective is to plant trees. In this process, weeds, shrubs should be cut. The closing process should be monitored at any time to find and solve the problems.

Small Irrigation Works' Water Conservation Measures

Small irrigation works' water conservation measures is to build water projects for the soil and water conservation. This kind of project is small, but numerous, they can also play a huge role in practice. Small irrigation works' water conservation measures mainly include: terraced fields, water storage projects, diversion canal renovation, all these can play a role in rocky desertification control (Zhang & Wang 2007).

Water storage projects are generally composed of the rain fields, water cellars and auxiliary facilities. Rainwater is collected in the rain field, then diverted via the canal into the cellar for future use. In order to prevent debris, a fence is set up in the cellar entrance. The terraced fields can be used to collect rainwater. Water cellars can be built on both sides of the fields. The number and capacity of water cellars will be decided based on the actual conditions. If the terraced field span is big, there should be more water cellars; if the rainfall is heavy, the volume of water cellars should be expanded (Zhang & Wang 2007).

The main function of a water diversion canal is to transfer the water in the rain fields to the sandy fields. The canal can be built on the side near the mountain for convenient water flow. Sand pools are an important part of the water storage projects. That the slope rain water generally contains large amounts of sand, makes sand pools necessary. The amount of rainfall and the water sediment should be taken into account in the design of sand pools.

In the dry seasons, rainfall is insufficient. When water is needed, the valve of the cellar can be opened for water to

flow down for irrigation. The water can also be pumped to higher grounds for irrigation. The main function of water storage projects is to collect rainwater and prevent water loss so that the waste of water resources can be reduced.

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