



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Study on Ecological Remediation for Water and Soil Conservation of a Small Watershed

Chunjuan ZHANG^{1*}, Xueying HE²

1. School of Hydraulic Engineering, Yangling Vocation and Technical College, Yangling 712100, China; 2. Water Resources Bureau of Yangling District in Shaanxi Province, Yangling 712100, China

Abstract Taking the waterhead area of the middle line project for diverting water from the south to the north, Hanjiang watershed in Shiquan, as an example, ecological remediation of the small watershed was studied from aspects of necessity, practicability, plans and aims. The ecological restoration for soil and water conservation in Hanjiang River basin can not only control soil erosion and effectively protect water resources to provide clean water for people living in the lower reaches of Hanjiang mainstream, but also increase farmers' income and protect environment, which is both typical and exemplary.

Key words Small watershed, Ecological remediation, Shiquan section

Located in the south of the central Shaanxi plain, Qinling and Bashan mountainous area is an important region in Shanxi Province that is rich in agricultural and forestry products as well as non-ferrous metals, and it is also the national engineering area of soil and water conservation in Danjiangkou Reservoir area (the waterhead area of the middle line project for diverting water from the south to the north) and its upper reaches. Qinling and Bashan mountainous area has complex geological conditions and frequent natural disasters like soil erosion, flood and mudslide, which have not only brought about great damage to personnel and property, but also caused serious water environmental damage to the waterhead area of the project for diverting water from the south to the north. Therefore, it is of important significance to study ecological restoration for soil and water conservation in Hanjiang (Shiquan section) watershed in Qinling and Bashan mountainous area^[1].

1 General situations of the watershed studied

1.1 Geographical position Shiquan County is situated in the middle of southern Shaanxi, bordering on Qinling Mountain in the north and Bashan Mountain in the south. The length of Hanjiang River flowing through Shiquan County from west to east is 58.5 km, with the watershed area of 1 021.63 km², showing that the river is between the two mountains. Moreover, 210 National Road and Xi'an – Hanzhong Highway can be found here, and Shiyan – Tianshui Highway and parallel Yangpingguan – Ankang Railway extend across Hanjiang River from east to west. The distances from the county town to Xi'an, Ankang and Hanzhong cities are 168, 80 and 165 km respectively, and the county town is located at the western gate of Ankang, bordering on Xiangyu in the east,

Baocheng in the west, Guanzhong in the north, and Bashu in the south, which has become one of important transport hubs of Shaanxi, Sichuan and Hubei provinces. Meanwhile, the first hydropower station Shiquan Hydropower Station in Hanjiang mainstream was built here, and the reservoir area of Xihe hydropower station with unique landscape is the core of the watershed.

1.2 Landscape The region has complex terrain, that is, the offshoot of Bashan Mountain is located on the south of Hanjiang River, while Qinling hinterland is situated on the north of the river; altitude is high in the north and low in the south, and Yunwu Mountain in the north has the maximum altitude 2 008.9 m, while the southern Shiquanju has the minimum altitude 332.8 m. In addition, mountains are high in the region, and there are 396 rivers, ditches and streams. The density of river network is 1.14 km/km², and major rivers include Raofeng River (with a drainage area of 400.19 km²), Zhongba River (with a drainage area of 80.08 km²) and Fushui River (with a drainage area of 73.29 km²).

1.3 Climatic characteristics The region is the humid monsoon climate zone on the edge of northern semitropics, with distinctive four seasons, abundant rainfall, enough heat, moderate and humid climate. Rainfall concentrates in the flood season, and flood and summer drought occurred frequently. Annual average temperature is 14.3 °C, and annual mean precipitation is 877.1 mm, while average precipitation from July to September over past years accounts for 52% of that of the whole year.

1.4 Social and economic conditions There are 11 towns and 139 villagers' committees, 8 residents' committee. Among them, there are 47 mountain villages with altitudes of above 600 m. By the end of 2009, total population of the project area reached 130 300, and arable land area per capita was 0.013 hm², while farmland area per capita was only 0.067 hm². Agricultural planting is the leading industry in the mountain area, and chief crops include single-season rice and corn, interplanting potato and minor cereals. Part of economic income is from planting mulberry to

Received: November 29, 2012 Accepted: January 12, 2013

Supported by the Foundation for Scientific Research of Yangling Vocation and Technical College (A2010001).

* Corresponding author. E-mail: ylzchcj@163.com

breed silkworm and breeding pigs, while main source of economic income is labor export.

1.5 Natural resources The area is rich in water resources. Among them, the quantity of local water produced by itself is only 0.26 billion m^3 , while 0.56 billion m^3 of foreign water flows through here, and the amount of passing-by water in Hanjiang mainstream is 2.142 billion m^3 , totaling 2.962 billion m^3 . Additionally, among mineral resources, non-metallic minerals like quartz, vanadium-titanium magnetite, stone coal, marble and limestone are the richest in the region.

1.6 Status quo of soil erosion Total area of the watershed is 1 021.63 km^2 , and 627.94 km^2 of land has suffered from soil erosion, accounting for 61.5% of total area. Annual average erosion modulus is 2 748 t/km^2 , and surface and liner erosion are common water erosion types, while gravitational erosion like landslide and collapse caused by rainstorm in some areas. Soil erosion mainly concentrates large areas of sloping land, barren hills and forestland.

2 Necessity and feasibility of ecological restoration for soil and water conservation

2.1 Necessity The implementation of "Danzhi" project marks the advancement of soil and water conservation towards standardization, legalization and normalization, and serious soil erosion has been relieved to a certain degree. However, due to large control tasks, little investment and lack of young and strong labor who works in cities, it is difficult to make the masses work standard and conduct large-scale organization, directly affecting the project in quality and quality, so it is difficult to realize expected control benefit. Soil and water conservation is a long, formidable, comprehensive and social work, and to maintain control achievements and ensure sustainable development, the government should support the project through investment. Ecological restoration is an effective method with little investment^[2-5].

2.2 Feasibility On the one hand, there are prerequisites for vegetation growth and restoration, such as suitable climate characteristics and rainfall. On the other hand, local government pays more attention to ecological construction and development of ecological industry. To ensure the smooth implementation of "Danzhi" soil and water conservation project and each construction task, completely improve agricultural infrastructure conditions, increase farmers' income, and protect water quality of Hanjiang River, the pattern of economic development has formed initially in the county, mainly developing ecological tourism (such as tourism development of Hanjiang ecological landscape and leisure farm park in the suburbs) and ecological industry (such as mulberry, green tea, raw lacquer and woody oil). Combining with ecological migrants from villages in high mountains, a city-level experimental zone with the integration of urban and rural areas, "Yangliu New District in Raofeng River basin", has been built, while tertiary industry has been developed, and skill training of farmers and labor export have been carried out, which promotes the migration of substantial rural labor that can relieve land pres-

sure. In addition, the level of productivity has improved, and agricultural production mode has transformed from traditional extensive management into intensive management, while deep-seated problems like excessive dependence and occupancy of land resources have been addressed. Besides, the key technology for ecological restoration has been carried out in "Danzhi" project, and the masses' ecological awareness has increased, building a good atmosphere for ecological restoration.

3 Plans of ecological restoration for soil and water conservation

Ecological restoration of the water source aims to decrease soil erosion and protect water quality, on the premise that the improvement of people's living standard and development of production should be realized in the project area. With high mountains and steep slopes, thin soil and thick stones, heavy and concentrated rainfall, the region suffers from moderate soil erosion, so the plans for ecological restoration should be carried out according to local conditions.

3.1 Mountainous areas with altitudes of above 600 m There are 47 mountainous areas with altitudes of above 600 m, where soil erosion has become increasing serious because of high mountains and steep slopes, scattered population, lagging economy, bad natural and production conditions, traditional farming mode. In the areas above, we should implement ecological migration, increase infrastructures and land remediation in the new sites of migrants, conduct modern agricultural technical training, change traditional cropping and planting modes, maintain the achievements of returning farmland to forestland or grassland, and strictly forbid people from reclaiming steep slopes.

3.2 Raofeng River basin Raofeng River road district has an area of 400.19 km^2 , and low mountains and hills are common. Due to dense population, national highway extending along the river, and excellent location, it is the political, economic and cultural center of the basin, and should be supervised especially because of frequent human activity. In agricultural production, the industry planting silkworm to breed mulberry is in a dominant position, and major land use types are young forestland and shrub land, with small canopy density. Ecological construction just started, so the ecosystem is very vulnerable and has poor ability to hold water, soil and fertilizer. Therefore, we ought to strengthen supervision and law enforcement and check soil erosion caused by human factors. Biological measures should be applied to slopes, and suitable engineering measures should be adopted. In dam district, basic farmland protection and pollution prevention should be implemented, and ecological and efficient agriculture should be popularized. Besides, the amount of pesticide and fertilizer applied to farmland should be reduced, and domestic sewage and garbage should be treated before being discharged to decrease COD discharge. Meanwhile, we ought to develop soil and water conservation in suburban areas using location advantages, strengthen sightseeing garden construction for water and soil con-

servation, and develop water protection industry to promote local economic development.

3.3 Reservoir area Located in the reservoir area of Shiquan and Xihe Hydropower Station, southern district (Xihe, Yundou, Houliu and Zhongbei towns) and reservoir area are ecotourism areas in Hanjiang River basin (Hanjiang reservoir area, Yanxiang Cave and Zhongba Grand Canyon), and mountains are high and slopes are steep along the river, while steep slope reclamation and downslope cultivation were very serious in old days. After ecological management in recent years, large areas of water conservation forest and economic forest (mulberry, tea and citrus) have formed through greening and returning farmland to forestland. Soil and water conservation work should focus on strengthening closed forest, and engineering measures need to be implemented in some areas, so as to improve ecological protection in the tourism districts. In addition, during the control process, we should combine sloping land control and ecological restoration, backbone water conservation project and small water conservancy project, as well as soil and water conservation ecological construction and development of agricultural and tourism economy, so as to control soil erosion and restore ecological environment. Afterwards, rural travel and tourism industry can be developed gradually based on the plans above.

3.4 Other measures Ecological compensation mechanism system should be improved to make people's production and living conditions, and farmers' income should be in accordance with local economic growth. The long-term ecological compensation mechanism of water head sites is established to address the overall balance between water head sites and water use areas based on value theory^[6-7].

4 Targets of ecological restoration for soil and water conservation

On the whole, ecological restoration for soil and water conservation aims to significantly improve agricultural production conditions, increase farmers' income, and make rural environment clean and beautiful, so as to lay solid ecological foundations for building a moderately prosperous society in the watershed^[8].

4.1 Goals of controlling soil erosion Keeping in step with the construction of Danzhi project in Shiquan section of Raofeng River, it is expected that land utilization rate will be improved, and rural infrastructure will be improved through adjustment of land use structure and planning of dominant and distinctive industry after two years of controlling; through popularization of ecological and organic agriculture and high-yield technology, the amount of fertilizer and pesticide applied to farmland will be decreased to control non-point pollution in the basin; prevention and supervision system will be improved to control soil erosion caused by human factors; through comprehensive control and ecological restoration, all tasks to control soil erosion planned should be finished, preventing silts from entering the reservoir area of Xihe Hydropower Station in Hanjiang River mainstream.

4.2 Targets of ecological construction In ecological construction, villages and courtyards should be beautified, that is, trees and hedgerows should be planted along main roads, and economic garden with cherry and grape should be built in a yard, and 2–5 ponds used to collect garbage should be built in courtyards within 100 m. Meanwhile, large-scale demonstration gardens of ecological and efficient agriculture and industrialized agriculture should be developed in table land, and ecological control of grooves and river channels in mountainous areas should be improved. Besides, we ought to make water conservation projects safe during the flood season, and control soil erosion caused by human factors, building new distinctive mountainous rural countryside.

4.3 Development goals of rural economy Based on the adjustment of land use structure in "Danzhi" project, some sloping land with the slope of 5°–15° should be transformed into highly standard farmland, laying foundations for developing industrialized agriculture or efficient agriculture, while other sloping land will be built into economic and fruit forest terrace. Meanwhile, cherry, grape and other economic fruits will be planted around roads and gardens, and closely planted mulberry garden will be built to make farmland area per capita reach above 0.15 hm².

5 Conclusions

The ecological restoration for soil and water conservation in Hanjiang River basin can not only control soil erosion and effectively protect water resources to provide clean water for people living in the lower reaches of Hanjiang mainstream, but also increase farmers' income and protect environment, and it is typical and exemplary.

References

- [1] ZHANG CJ. Small watersheds comprehensive management measures in Qinba Mountain in Shaanxi Province[J]. Shaanxi Journal of Agricultural Sciences, 2012, 58(1): 171–173. (in Chinese).
- [2] XIE J, LIU M, CHENG WQ, *et al.* On relationship between new rural construction and water conservancy development[J]. China Rural Water and Hydropower, 2008(7): 45–47. (in Chinese).
- [3] ZHANG SE. Practice of small watershed management for constructing new rural[J]. China Water Transport, 2009, 9(4): 64–66. (in Chinese).
- [4] WANG LM, HU WJ. Integrated treatment of small watersheds and new socialist countryside construction[J]. Soil and Water Conservation in China, 2010(8): 35–36. (in Chinese).
- [5] XIE J. The vision of agricultural non-point source pollution control based on the comprehensive management of small watershed[J]. China Resources Comprehensive Utilization, 2009, 27(12): 22–23. (in Chinese).
- [6] ZHOU P, WEN AB, HE XB, *et al.* Discussion on comprehensive control mode of eco-clean small watersheds in TGP reservoir area[J]. Yangtze River, 2010, 41(21): 85–88. (in Chinese).
- [7] LI RH, PAN XQ, JIN JS. Small watershed management research status at home and abroad[J]. Technology of Water and Soil Conservation, 2010(3): 32–34. (in Chinese).
- [8] WANG HB. Integrated management of Dapingzi small watershed making contribution to development of key treatment projects of soil and water conservation in the upper Yangtze River projects[J]. Soil and Water Conservation in China, 2010(4): 6–7. (in Chinese).