Soil Erosion and Prevention Measures for Orchards in the Hilly Area

Fan Zonggui

Water & Soil Conservation Research Institute of Henan Province

Abstract: Since the reformation and opening to the outside world, great achievements have been made in the soil and water conservation controlling taking small watershed as the basic unit in Henan Province. The development of economic forest in the small watershed increases the economic benefit of comprehensive control and has made great contribution to shaking off poverty and getting rich for the masses in hilly areas. However, the existing problems in the management and unreasonable irrigation may easily result in soil and water erosion, make harm to the ecological environment of the forest, decrease the economic benefit and affect the sustainable development of economic forest. Therefore, to study the situation and prevention measures of soil erosion in hilly orchards, keep and increase ecological and economic benefit are key problems to be urgently resolved in the fields of soil and water conservation as well as ecological construction in the province.

To investigate and analyze soil erosion of the orchards, a representative small watershed controlling district Huoshaoyang Gully, is chosen for observation and investigation. Experiments are carried out through contrastive irrigation of flooding and permeating.

This article analyses the causes of soil erosion of the orchards and puts forward the following:

(1) Strengthening the protection of field bunds. Soil erosion can be prevented effectively by geological protection and scientific management in line with local conditions.

(2) Permeating irrigation is a good way to protect the hilly orchards from soil erosion.

Keywords: orchards, man-caused soil and water erosion, measures of prevention

1 The present situation of investigation and observation

In Huoshaoyang Gully watershed, the standard of soil and water conservation and comprehensive control is high with irrigation conditions. It is an experimental watershed for soil and water conservation and comprehensive control in the upper and medium reaches of Huanghe River in eighties of the last century. During the watershed comprehensive control, many fruit trees had been planted. It took a demonstrating role in the district's economic development.

1.1 The comprehensive control of the small watershed

The patterns for soil and water conservation and comprehensive control at Huoshaoyang watershed are: to develop economic forest on the plateau surface; to develop protection forest along the roads in the farm land and around the villages; to construct cut-off dams, drainage projects and develop protection forest around the gully origin places; to develop soil conservation forest on the gully slope; and to carry out soil conservation projects and protection forest along the sides of the gully. So far the controlled area in the watershed is 80% of the total. In 2000, the erosion module was reduced to 2,100 t/ (km^2 • year) from 5,310 t/(km^2 • year) before controlling. The annual income per captia in the watershed increased from RMB 265 yuan before controlling to RMB 2,015 yuan in 2000. At present there are 1,400 hectares of orchards in the watershed. It is the pillar of economic income of the peasants in the watershed.

1.2 Orchard management and irrigation

In Huoshaoyang Gully watershed, fruit trees are mostly planted on the platrige surface, terraced land with relatively large slope. In order to get loose soil for the roots growing while the fruit trees are growing, measures such as digging deep holes around the trees and intertilling are taken. That results in improper

management of field bunds.

The precipitation in the watershed is different. The rainfall can't meet the need of the fruit trees in their growing period. So the water in Jianli reservoir outside the watershed is introduced through canals to the farmland here for irrigation. The irrigation method usually adopted is flooding irrigation. Only by this way can the orchards keep normal production. But weeds are overgrown and intertillages increased. As a result, the serious soil erosion occurs easily.

2 Cause of soil erosion from orchards in hilly area

2.1 Precipitation

It is of continental monsoon climate, and lack of rain in winter and spring. Rainfall always happens from June to September that takes 60% of that in the year. Also the rainfall happens in the form of storm. The capacity of the soil conservation facilities in hilly orchards is designed according to the standards to resist the largest storm for 6 hours in ten years. According to the record of Soil Conservation Station in Shanxian County, there are 2 times of rainfall surpassed the design standard. One was in 1999, with the daily precipitation of 34.7 mm. After the rain, investigation was made in orchards of Huoshaoyang Gully watershed.20% of field bunds were damaged; total volume of 151,000 m^3 soil were eroded, equal to the erosion module of 3,000 t/(km^2 • a).

2.2 Man-caused movement

2.2.1 Lack of scientific management is the basic cause of the soil erosion in hilly orchards

Attention has been paid to the management of fruit trees. The management of field bunds and slops land is greatly neglected. In the management of orchards, deep holes around fruit trees, fertilization and intertillage are stressed, but maintenance of field bunds are neglected. So the facilities of slope protection and soil conservation are damaged. 3 years or 5 years later, soil erosion happen again because the protection facilities do not meet the designed capacity and standard. Investigations have been taken in the selected 840 hectares of controlled terraced field. The results indicate that the protection standard of the field bunds is reduced at different extent because of improper maintenance, and 10%-15% of the engineering are damaged, some of drainage is blocked. In case storm happens or flood irrigation is adopted, soil erosion will take place again.

2.2.2 Flood irrigation had aggravated soil erosion in hilly orchards

Flood irrigation with large amount of water will washout the irrigation trench in the field, wash away the loosen soil by intertillage, damage the field bunds and cause soil erosion again.

3 Observation and loss estimation of soil erosion

In order to know the loss amount of soil erosion in hilly orchards, fixed observation and survey have been made. Some sections are selected for observation of flood irrigation with large amount of water because flood irrigation is a popular irrigation method in hilly orchards throughout the province, flood irrigation may be suggested as the conditions of a heavy rain, and the timed survey can be easily done.

Wuhualing village is representatively selected in the watershed for observation. The observation site is located in an orchard on the former plateau farmland of the controlled watershed. The orchard area is 0.35 ha with the slope of 13.4° from southeast to northwest, The place is at right middle part of Huoshaoyang Gully. The longitudinal slope alongside the direction of irrigation is 1/300. The fruit trees are 5 years-7 years old. The variety of the fruit trees is mainly Hongfushi.

6 observation tests have been done from 1999 to 2001. The average soil moisture before irrigation, water volume used in the irrigation, average soil moisture after irrigation and soil volume of washing out (including surface washing lines and field bunds washed) after irrigation are separately measured.

The water volume used per ha/time for flood irrigation is 1,350 t—1,575 t.The average soil moisture 35 days after the irrigation is 7.7 per cent to 8.7 per cent. In case of continuous draught, the time

remaining water in soil is 35 days—40 days. Time of water remaining in soil is 5 day less. The average soil volume of washing out per ha • time is 10.2 m^3, roughly equaling to 1 mm of surface soil layer washed away. If 2 times irrigation are carried out in a year, the annual erosion module will be 2,652 t/(km^2 • a). That is of medium erosion.

4 Soil erosion and prevention measures for orchards in hilly area in the province

Among the controlled watershed in hilly area throughout the province, there are 271 thousand hectares of orchards. The conditions of soil erosion are much similar with that in the test region. That is of medium erosion or approximately medium erosion. According to the result of the observation, the annual soil erosion area will be about 81,300 hectares, the soil loss volume be 1.65 million m^3. It will be 13.9% of the man-caused soil erosion area. The situation is quite serious, but no enough attention is paid to. If it continues, not only the soil erosion in hilly orchards will be aggravated, but also the economic benefit of the orchards will be affected. It will be unfavorable to the sustainable development of economic forest. So the effective prevention measures must be taken.

We consider:

(1) Strengthening the protection of field bunds, biological protection measure in field bunds in line with local conditions shall be taken accordingly.

The protection of hilly orchards is very important. It may effectively prevent soil erosion. Improper orchard management may decrease flood prevention standard of soil and water conservation facilities, such as hilly trench and stripe land. Therefore scientific management of orchard must be strengthened, perfect field bunds must be kept. It is found in the investigation that more than 95% of field bunds and slope with biological protection (day lily and false indigo) are perfect. Biological protection is favorable to the ecological environment of the orchards as well as consolidation and increase of economic benefit.

(2) Permeating irrigation is a good method to prevent soil erosion in hilly orchards

Permeating irrigation will not result in soil erosion. Tests indicate that the annual soil loss per ha reduce by 20.4 m^3; average water volume used per time • ha is 330t,1,650—2,475 t water saved; time of water remaining in soil is 5 days longer; 49.5 man • day are cut down; RMB 4,840.5 yuan of economic benefit are increased. The change from flood irrigation to permeating irrigation is an effective step to prevent the hilly orchards from soil erosion.