The Present Status of Erosion in Hunan of China and Control Measures

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Abstract: Erosion in Hunan province is serious, because of fragile eco-environments, comparative backward economy and developing society. Combining assaying causes, the paper enumerates the features of erosion in the region at present, by means of collecting information, looking into on set and data analyzing. First, erosion in Hunan is heave and of various kinds. Second, natural erosion is weakening while human-induced erosion is intensifying. Three, as a whole, the area of erosion has decreased in an extent while the intensity of it has not dropped obviously. The above condition is universal in the mountainous and hilly areas of southern China. According to this, Corresponding measures must been made. With the above, it is imperious to intensify the administrative status in charge of the existing soil and water conservation unit. Subsequently, it is necessary to call for more investments and assistances for environment and development of backward mountainous hilly region. In addition, various ways should been taken, including broad social propaganda, special technological education and effective checking mechanism to administrative official, to raise the awareness of whole society on soil and water conservation and environmental protection. Moreover, scientific and technological research should be reinforced to optimize biological and technological measures.
Keywords: erosion, hunan, fragile eco-environments, human-induced erosion, soil and water conservation

1 Introduction

Hunan province is located in the middle-south part of China and the middle reach of Yangzi River, which spans 108°47′ –114°15′ E, 24°39′ –30°08′ N, where geographically represents the sub-tropical moist seasonal climate zone. The total area amounts to 211,829 km^2, including 14 cities and prefectures. The population is about 65.62 million in 2000 and the density of population is 309.82 person/km^2[1]. Hunan province is one of provinces in the upper and middle reaches of Yangzi River that erosion is serious, though the climate here is warm and humid so that vegetation grow well whole year. The condition results from the background below, which is universal in the mountainous and hilly areas of southern China:

First, eco-environments are fragile, which is prone to erosion. Hunan province is a mountainous and hilly province, where mountains and hills comprise 66.2 percent of the total area. By the affection of monsoon and topography, rainfall and rainfall intensity here are high and heavy storms are frequent, where the average annual precipitation is 1,427 mm, and more than 70 percent of which concentrates during April to September, and the day reckon of storms exceeding 50 mm/d is 3—6 days. Soils here have developed on a base of granite, limestone, sandstone, and shale of Tertiary and Quaternary age, which common feature of the soils is that they have a low water-holding capacity and are susceptible to erosion, where the dimension of the soil that susceptible to erosion is about 102,800 km^2, comprising 52.6 percent of the total area[2].

Second, the economy is backward, especially in mountainous and hilly areas, so that investment capital is lacking, and awareness of the need for environmental protection is weak, and socioeconomic activities are unfavorable. Under the pressure of survival or pursuit of short-term economic profit, overexploitation of forested steepland and cultivating in steepland and excessive exploitation of forest

and mining etc. becomes common, which strengthens the erosion here. The per capita Gross Domestic Product is 5,639 yuan, reordered seventeenth in all provinces of China. There are still 31 poverty counties and cities where per capita annual net income of rural households is only 1,000—3,000 yuan, where the population is about 15.3 million[1].

Three, the whole society is developing, which has promoted the erection and recovery of eco-environment that may lessen erosion, but has strengthened also the resource exploitation and the capital construction that may give rise to new human-induced erosion. In the mid-1980s, the decision was made in Hunan that Undeveloped Land Usable for forestry Be Revegetated in Five Years, Hunan Be Afforested in 10 Years, and Soil and Water Conservation Projects Be Undertaked. Since the 1990s, through the implementation of a series of key projects, the desolate mountains usable for forestry in Hunan had been eliminated in 1993 and the goal for new forest coverage rate had been achieved in 1997. The average annual growth rate of total investment in fixed assets from 1991 to 1995 and from 1996 to 2000 is respectively 33.4 and 15.27[1].

We have chosen our study area herebecause Hunan province is representative of the mountainous and hilly lands in southern China. By means of collecting information and looking into on set and data analyzing, we have attempted to expound the characteristics and causes of the present situation and suggest techniques and procedures for improving it.

2 Results

In accordance with investigation and analyzing, we have enumerated the characteristics of the present situation of erosion in Hunan as follows:

First, erosion in Hunan is heavy and of various kinds. According to statistics of the Water Conservancy Department of Hunan Province, the eroded area upwards of slightly eroded one was 47,100 km^2 at the end of the year 1989, comprising 22.3 percent of the total area. Among which, 46.7 percent is slightly eroded, 31.0 percent moderate, 17.3 severe, 3.9 very severe, and 1.1 poignant (Fig.1). By type of eroded shape, 96.2, 3.3 and 0.5 percent was surface, gully, and landslip erosion, respectively (Fig.2). By type of land, 11.2, 64.7 and 24.1 percent was cultivated land, woodland and barren or the land that is difficult to be used, respectively (Fig.3). The gross amount of the annual erosion in Hunan is about 150—170 million ton. The annual erosion module is about 3,000 t/(km^2 • a)—5,000 t/(km^2 • a). Besides there exist not obvious erosion in Anxiang, Nanxian and Yuanjiang, which located in utter lake region, almost in all countries and cities, there exist erosion in differ extent. Erosion is most severe in Wuling mountainous areas of northern-western Hunan and the red soils hilly areas of middle Hunan, where the average annual erosion module is about 4,500 t/(km^2 • a)—5,000 t/(km^2 • a). The next is a partial mountains and hills of southern Hunan and eastern Hunan where gully, landslip erosion and human-induced erosion by mining are also very severe. The average annual erosion module here is about 4,200 t/(km^2 • a), It is especially high in Guidong, Yizhang, and Rucheng etc. at 10,000 t/ km^2[2].

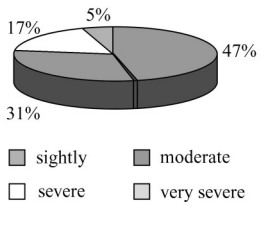

Fig. 1 Percent of area by erosion extend

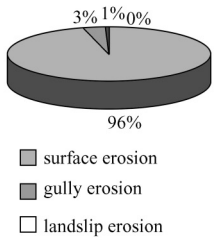

Fig. 2 Percent of area by erosion shape

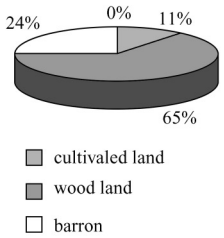

Fig. 3 Percent of area by the type of used land

Second, natural erosion is weakening while human-induced erosion is intensifying (Fig. 4). Since the 1990s, a series of measures have had a positive influence in natural erosion control and environmental improvement, such as hillsides were closed to exploitation to facilitate afforestation, cultivated land was planted to trees, fields were terraced, dikes were made to channel small rivers, nature reserves were built,

and eco-agriculture was practiced etc. For example, the forest coverage rate has been increased in Hunan from 36.6 percent in the end of 80's to 52.44 percent in 2000[1]. Meanwhile, with social and economic development, the rural population began to decrease and, with that, the use of trees for fuel dropped and grazing intensity in the mountains declined. According to our recent survey, the percent of the rural population that has off-farm income is generally more than one third of the rural population in mountainous areas. Less than 10 percent of the tree cutting is for fuelwood, in most of the area. The percentage of the rural population that raises farm cattle is less than 20 percent. All of these changes contribute to an increase in the natural vegetation and a reduction of erosion. People living in places where erosion is not serious see that forest vegetation is thickening, water is clear, and more wild animals and fish are present. But under the combination of a weak economic base and poor management, man-made soil erosion is becoming worse, with the increment of road construction in the backward hilly and mountainous areas, house construction and illegal mining. For example, in the Yongzhou region located in the mountainous and hilly areas of southern Hunan, from the 1980s to the 1990s, total investment in fixed assets increase from about 3,736 to 28,440 million yuan[3]. The numbers of people engaged in mining throughout the year and the mining area itself have both doubled. Furthermore, hand labor has been replaced by machinery, which leads to more mins and severe erosion. By the investigation in Hengyang, Zhuzhou and Loudi regions, new increasing area of erosion because of town development, transport route construction and mining is 1,200 km^2 since 1991, increased averagely by 171.4 km^2 every year. Besides, in some places, overemphasis on development of mountainous and hilly land and ignorance of soil and water conservation practices and environmental protection leads to new human induced erosion. According to statistics incompletely, by 1998, there were 2,133.33 thousand ha of mountainous and hilly land developed, and about 60 percent of which have turn up erosion[2].

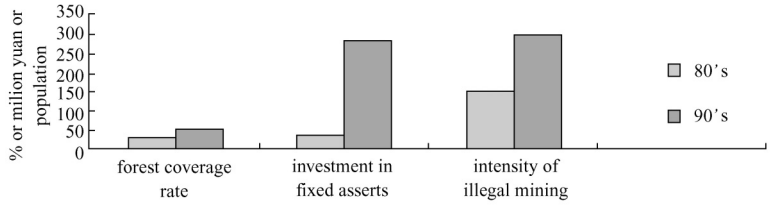

Fig. 4 Change of factors on erosion

Three, as a whole, the area of erosion has decreased in an extent while the intensity of it has not dropped obviously. Generally speaking, with the increase in the plant cover in the 1990s, erosion showed a downward trend. According to the newest dada published by Water Ministry of China recently[4], the area of erosion in Hunan has decreased from 47,100 to 40,393 km^2, dropped by 14 percent, Apparently due to key conservation projects carried out in small watersheds. In 90's, whole Hunan had had 198 small watersheds controlled in 35 countries by 1997. The controlled erosion areas were 3,100 km^2, and its effect was well[2]. For example, The World Bank financed 9.47 million Dollar work on 22 small watersheds having a total area of 12,860 ha in the Yongzhou, beginning in 1994 and ending in 2001. About 1,990 ha were terraced. Other practices that were introduced included grass planting and crops such as fruits and tea and intercropping, plus afforestation and building small engineering structures. As the result that has been get acceptance recently, forest coverage increased from 28 to 49 percent, erosion area decreased by 1,485 ha, erosion module decreased by 180 t/(km^2 • a), per capita annual net income of rural households increased from 647 to 1,791 yuan[1]. Although progress has been made, the intensity of erosion in large scale has not dropped obviously. Take Yongzhou for example also, the forest coverage rate increases from 45.4 in 80's to 57.8 in 90's, by 27 percent [6], but, according to data offered by the Hydrometric Bureau[7], the average annual sediment and sediment module in Xiao-Xiang watershed decreases from 1,630,000 t and 76.4 t/(km^2 • a) to 1,610,000 t and 75.4 t/(km^2 • a), only decreased by 1.2 percent and 1.3 percent, respectively (Fig. 5). Causes are various. Firstly, not all of the forestry restoration activities have been successful because of unreasonable forest structure. On one hand, it is mainly one kind of conifer in large scale of afforestation, which will not reduce erosion significantly because of little thickness of the litter layer. On the other hand, the percentage of oil plants in economy forest is high to induce severe

erosion there because of cultivating every year. The percentage of conifer forestry kind is high at 82.55 percent by the cumulation of forest in Yongzhou. The percentage of oil plants in economy forest by the area of forest is high at 82.08 percent[6]. Secondly, there still remain large amount of hills of desolated slope unsuitable for forestry and sloping land cultivated, where erosion are most severe. According to statistics in whole Hunan, though a part of cultivated land was planted to trees in recent years, there still remain 266,667 ha of scarps cultivated. Thirdly, average annual precipitation in 90's have had a increment because of coming into a period of rich rains in climate, increasing from 1,371 mm in 80's to 1,495 mm in 90's, by 9 percent[7](Fig.5), which leads to an increased intensity of erosion in 90s.Finally, it is also most important, the increment of man-made erosion by a big extent in partial areas has counteracted the decrement of natural erosion by a little degree in large area.

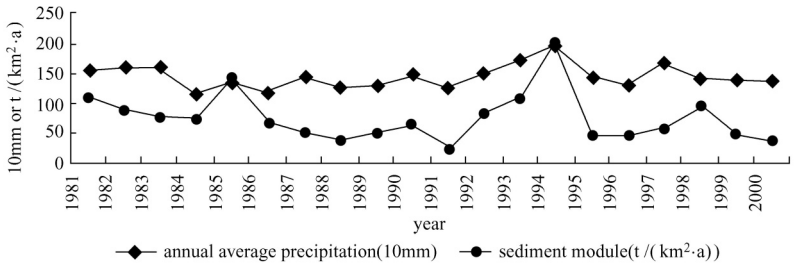

Fig. 5 The change of rainfall and sediment in Xiao-Xiang watershed for 20 years

3 Erosion control

The most important problem which mountainous and hilly areas in southern China such as Hunan face is human induced erosion. Controlling it depends upon a coordinated approach that involves social, economic, administrative, and technological factors.

With the above, it is imperious to intensify the administrative status in charge of the existing soil and water conservation unit. At present, national and local government has established different kinds of related policy, rules and laws, by which a specific soil and water conservation unit operates within the Water Administrative Department, but this administrative arrangement has not been entirely effective because of poor administrative authority and economic control power. A soil and water conservation committee composed of leaders of each department in the province was established recently. Its effectiveness has been limited because it is not a formal administrative organization. We are urged government to establish better commitment mechanism to raise the status in charge of the soil and water conservation unit, and to become a powerful administrative organization like the land resources department. Meanwhile, strict enforcement of existing regulations and careful supervision of field activities should be done.

Subsequently, it is necessary to call for more investments and assistances for environment and development of backward mountainous hilly regions. The main reasons for the occurrence of man-made erosion in the region are the social poverty and weak economic basis. Main problem in soil and water loss controlling is insufficient investment. While most of key projects financed have achieved better effectiveness, and establishing a more effective regional eco-economic social safeguard system touches to benefits of international, national and neighboring regions. So, the investments and assistances should be increased and stabilized through all kinds of ways. Meanwhile, local government should develop economy and eliminate poverty by giving play to the resource priority of the region.

In addition, various ways should been taken, including broad social propaganda, special technological education and effective checking mechanism to administrative official, to raise the awareness of whole society on soil and water conservation and environmental protection. At present, Soil and water conservation is not emphasized by the leader who pursuit of short-term political achievement, due to the period of enter office is short but that of soil and water conservation taking effect is long. The administrative effectiveness are delayed by management staff because of lack of professional competence.

The technological effect of key projects on conservation is declined because the people have a bad educational background and faint awareness of environmental protection. Therefore, the importance of soil and water conservation should be broadly propagandized from top to bottom by local radio station, TV station and papers. The environmental education net should be established. The professional competence of management staff should be intensified through specialized train and professional supplement. The system of administrative responsibility of leaders in the period of enter office, to soil and water conservation, should be established. The goal is to made conservation to be a voluntarily action in the end and to require good effectiveness.

Moreover, scientific and technological research should be reinforced to optimize ecological and technological measures. The natural erosion in the region must still be slowed down due to humid climate and rapid plant growing and previous achievement and social development. We should play full role to the natural priority, continue to enlarge afforestation and raise its ecological effectiveness through closing the mountain and cultivating forestry, remedial planting for sparse and incomplete forestry, multi-gradient construction of grass, shrub and arbor, adjusting present forestry structure, under scientific guidance. To the desolated mountains where occur severe erosion at present and it is difficult for afforestation, we should strengthen scientific and technologic research to make engineering measures and optimize technology to lift the quality of control program. To sloping land cultivated, we should enlarge the intensity of return of cultivation, alter slope to terrace and afforestation on slope in the light of local conditions and increase the effect of slope control technology.

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