

The Means of Returning Farmland to Forest on Slope Farmland and Agriculture Sustainable Development in Guizhou

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Abstract: The slope farmland extended is accelerator of leading to soil erosion increased and rocky desertification's area enlarged. That is the basic reason of poverty and important obstruction of economic development in Guizhou mountainous district. Now returning farmland to forest program is the key's project of controlling soil and water loss and ecological rehabilitation on sloping upland. Means of returning farmland to forest classified active means and inactive means. Through analyzed that the policies, measures and styles on returning farmland to forest in past and now, active means is classified direct means (for example carrying out the project of returning farmland to forest on slope farmland in large exploiting in west of China) and indirect means (for example: thought engineering which farms from slope into terraces, emigration, adjust industry structure and harness of small watershed etc. promote returning farmland to forest. In order to ensure the project of returning farmland to forest implemented smoothly. From the development of sustainable agriculture angle, the idea was pointed out in the course of returning farmland to forest, that people must combine the direct means and indirect means, to practise returning one mu farmland to forest, simultaneously, other one mu land is carried out that terracing of the land on gentle slopes. By this means, to ensure stop cultivating and keep in step with afforestation, and making new forestland sustainable management; to realize ecological rehabilitation, improving the agricultural production condition and grain safe in the region; It must depend on S&T progress that improve the quality of returning farmland to forest. In accordance with sustainable, the strategic measures which promote returning farmland to forest and agriculture sustainable development in Guizhou province are proposed.

Keywords: returning farmland to forest, active means, sustainable means, strategic measures

Foreword

Guizhou is a mountainous and agricultural province, with the hills accounting for 97%, larger distributed karst, higher mountains and steeper slopes, as well as no level ground to support it. From 1949 to 1988, with the population increase and the economic development, the area of soil erosion was increased to 7.67×10^4 km² in 1988 from 2.5×10^4 km² in 1952, accounting for 43.5% of the provincial land area, which leads to the land rocky desertification. Now, the area of rocky desertification is 13,888 km², accounting for 7.9% of the total area of the province. The increased soil erosion and the enlarged rocky desertification have become the main restricting factors for the sustainable development in Guizhou. It is shown by the research results that the main reason that leads to the increase of soil erosion in Guizhou is the nonirrigated slope farmland (especially the steep slope farmland) extended. So, the implementation of returning farmland to forest in Guizhou is the essential measure to control soil erosion and improving the ecological environment, is the radical policy to help the poverty-stricken peasants to cast off poverty and become prosperous, and is the key means to adjust of rural economic structure, promote the local economy and increase the peasant's income. Setting up scientific and reasonable means for returning farmland to forest is the guarantee for implementing this project successfully.

1 General information

1.1 Natural conditions

Guizhou province, called “Qian” or “Gui” for short, is located in Southwestern China, between $103^{\circ} 31'—109^{\circ} 30'$ E and $24^{\circ} 30'—29^{\circ} 13'$ N. Its land area is $176,000\text{km}^2$.

Guizhou province is situated at the upper reaches of the Yangtze River and the Pearl River. Within the boundary of this province, the physical features are higher in the west and lower in the east, sloping northward, eastward and southward. The average elevation is about 1,100m, with the highest point at 2,900.6m, the lowest point at 147.8m and the elevation difference being 300m—500m. Mountain lands account for 61.7%, hilly lands for 30.8% and inter-mountain flatlands for 7.5% of the province.

Guizhou is a typical karst mountainous area, with the developed karst landforms, complete karst patterns and categories, and clear regional differentiation. The karst area in province is $109,000\text{km}^2$, accounting for 61.9% of the total area of the province, forming a special karst eco-system.

Soil types in Guizhou province are varied. The zonal soils are yellowish red soil (13.0% of the total area), yellow soil and yellow-brown earth (52.5% combined). The non-zonal soils are limestone soil, purple soil and mountain shrubby-meadow soil (28.9%, 5.2% and 0.4% respectively).

Guizhou has a humid sub-tropical monsoon climate, with no extreme coldness of winter or intense heat of summer. The mean annual temperature is about 15°C . That of the coldest month (January) being $3^{\circ}\text{C}—6^{\circ}\text{C}$; that of the hottest month (July) $22^{\circ}\text{C}—25^{\circ}\text{C}$. The annual precipitation is $1,100\text{mm}—1,300\text{mm}$. The annual amount of sunshine is 1,300 hours. The frost-free period is about 170 days. The relative humidity is usually over 70%. The various physical features result in climatic diversity with marked vertical differences. The climate in Guizhou is characterized by a saying: “Different phenology on high-or low-lands, and different weather within the area not more than 10 kilometers around”.

1.2 Population & ethnic groups

The whole province has jurisdiction over nine (9) prefectures, autonomous prefectures (cities); 87 counties, city districts and special zones. The year-end permanent resident population in 2000 was 37.8 million. There are 49 ethnic groups in the province, accounting for a minority population of 37.85%. Key minority groups are Miao, Buyi, Dong, Tujia, Yi, Gelao, Shui, Yao.

1.3 Present forest resources

By the year 2000, the area of forests in the whole province was up to $5,428,700\text{hm}^2$, with 200 million m^3 of the growing stock of standing timber and a forest coverage of 30.83%. Though forests in Guizhou have undergone a rapid expansion in recent 10 years, the problems still remain: the total volume of forest reserves is inadequate, with uneven distribution, low quality, irrational bases, fragile ecosystems etc. The overall management level for forests is to be improved. It is still an arduous task to control water and soil loss and rocky desertification.

2 Present soil and water loss & the slope farmland

2.1 Present soil and water loss^[1]

According to the $1:50 \times 10^4$ satellite imagery interpretation, the total land area of Guizhou province is $176,128\text{km}^2$, soil erosion area is $766,824\text{km}^2$, accounting for 43.54% of the total area. They are distributed over a province were showed in Table 1.

2.2 Present rocky desertification^[2]

On the base of observed the different period's aerial imagery, satellite photo, combine fact-finding conditions. Now the rocky desertification's area is expanding at a speed of 508.16km^2 a year in province,

its area has been up to 1.39×10^6 km² (7.9% of the total area), relative concentration in Qianxinan, Liupanshui, Anshun city and Bijie prefecture (Table 1).

Table 1 The major ecologic indicators by state (city, prefecture) in Guizhou

State(City, Prefecture)	Total Land Area (km ²)	Culti-vated Land (%)	Dry Sloping Land (%)	>25° Dry Sloping Land(%)	Forest Coverage (%)	Soil Erosion (%)	Rocky Desertification Rate (%)
Guiyang	2,405.98	35.9	25.06	7.14	31.74	37.2	6.19
Bijie	26,846.00	38.5	35.26	6.79	25.97	62.7	7.97
Liupanshui	9,914.00	37.8	33.56	11.75	16.39	55.7	25.98
Zunyi	30,753.00	29.5	18.59	4.22	33.10	50.2	3.25
Anshun	14,891.00	35.4	23.54	9.95	20.50	35.7	15.23
Qiannan	26,197.00	20.4	11.83	2.72	35.62	29.9	10.61
Qiandongnan	30,302.00	13.4	4.76	3.50	47.17	31.2	0.39
Qianxinan	16,796.00	29.5	22.76	7.07	26.44	33.4	8.02
Tongren	18,023.00	29.6	16.69	5.51	33.09	54.1	7.83
Total	176,128.00	27.8	19.32	4.91	30.83	43.54	7.90

2.3 Present the slope farmland ^[3]

According to the data of land survey from land and sources bureau of Guizhou province. There is 4.9×10^6 hm² of farmland in Guizhou, reclamation percentage is 27.84%. The area of dry farmland is 3.4×10^6 hm², cover 70.05% of the farmland's area. There is 80.9% of dry farmland with a slope steeper than 6, in these lands, the slope between 6° and 15°, 15° and 25°, 25° and 35°, more than 35°, accounting for 30.36%, 30.65%, 14.04% and 5.85% respectively of the total farmland area. The condition of agricultural production is very bad.

2.4 The dry sloping farmland is accelerator of leading to soil erosion increased and rocky desertification's area enlarged

The dry farmland's reclamation rate is 19.47% in Guizhou province, taking nine state (city, prefecture) as sample, the relative coefficient between dry farmland's reclamation rate and soil erosion is 0.654,1, and the coefficient between dry farmland's reclamation rate and forest coverage is -0.425,1. they show that the dry sloping farmland extended, the area of soil erosion increased; forestry area become more, the soil erosion's area become smaller. With relativity, that slope farmland's area influence to soil erosion is more than forest coverage. So return farmland to forests is basic measure to control soil and water loss, to construct ecological environment. According to research^[4], in the serious range of soil and water loss, for example, Wujiang river, North-pan and South-pan river valley, the dry sloping farmland with a slope steeper than 8 of 23.55% and 27.7% of the total area of valley respectively, on these sloping farmland, the soil erosion amount of 71.9% and 85.34% respectively. In Wujiang river valley, the soil erosion amount of slope farmland with more than 25° of 29.68% of total amount, and in North-pan and South-pan river valley, it account for 46.55%. According to research combined the sand drift modulus of suspended load and nature, societal factor in 19 valley of Guizhou mountain area^[5], in influential factor to soil and water loss, the most marked is reclaimed rate of dry lands, the seconds is forest coverage, the third is population density. The remote sensing application, location observe and quantitative analysis said that the dry sloping farmland extended is chief root of soil and water loss in Guizhou mountain area.

There is 86.46×10^4 hm² of dry farmland with more than 25° of 4.9% of total lands in Guizhou province, but its soil erosion amount of 40% of total amount, taking nine state (city, prefecture) as sample

still, the relative coefficient between the area of dry farmland with slope steeper than 25 and forest coverage is $-0.886,5$, and between the area of dry farmland with slope steeper than 25 and the area of rocky desertification (%) is $0.804,7$, it said: dry farmland on steep slope is more, the forestry area become small, rocky desertification become more serious.

Above research illustration, dry sloping farmland extended lead to soil erosion increased, return farmland with a steep slope to forest will decrease the amount of soil erosion, control rocky desertification's area enlarged effectively. For this reason, harnessing soil and water loss must take return farmland to forest as precursor, take forest ecological construction as importance, adopt the technological line to combine the harness and carrying out the slope farmland in Guizhou province. Nowadays, making reasonable scientific implement plans have become key of haessing soil and water in province.

3 Means of returning farmland to forest

According to the power source of the returning farmland, the roles of ecological environment project and other measures on returning farmland to forest, and the effect of the policy and measures, the means of returning farmland to forest can be classified to inactive means, and active means.

3.1 Inactive means

Basically, mountainous was in the closed and self-developmental stage and the agricultural production was mainly for self-sufficiency for a long time in Guizhou, because of the backward communication and information as well as the deeper effect of traditional minority culture, which made the peasants have a lower educational level and know little external development. Up to now, many peasants are still engaged in self-sufficient agricultural production and the commodity economy is not developed. Under the conditions of shortage of fund, technology and helpful policy, the peasants can only destruct forest for land reclamation to extend the farmland area in order to solve the grain shortage that was resulted from the population increase. Thus, the area of slope farmland was enlarged gradually. When the population is increased, they extend the farmland area; when the extended farmland is degenerate to not suitable for cultivation, they make new land reclamation again, which is called the inactive returning farmland.

When the slope farmland in Guizhou is cultivated to the inactive returning farmland, the deserted farmland in karst area forms the landscape of rocky desertification, while that in non-karst area, such as arenaceous rock soil and basalt soil, could be cultivated again after several years of slack rotation until the land is resumed. The extensive slash-and-burn cultivation is carried on as before from generation to generation, which not only makes the soil in this area seriously eroded but also increases the geological disasters, such as mud-rock flow, landslide, and so on. Inactive returning farmland coexists with the extension of slope farmland, which results in the worse of ecological environment and the loss of productive conditions even living conditions.

3.2 Active means

According to the effect degree of the policies and measures on the returning farmland to forest, it can be classified to indirect means and direct means.

3.2.1 Indirect means

It can promote the project of returning farmland to forest through the measures of controlling soil erosion, improving the conditions of agricultural production, increasing grain yield, adjusting the rural industrial structure, controlling the population and improving the population quality. Since 1980s, the indirect means, which has been implemented in the mountainous area of Guizhou, includes the follows:

(1) Promote the returning farmland through terrace. Returning steep slope farmland can be promoted through terracing the farmland with the slope below 25° , completing irrigation works to build the basic farmland with high and stable yields, at the same time, leading the peasants to develop diversified economy, thus to realize the yield increase.

(2) Promote the returning farmland through adjustment. Returning steep slope farmland can be promoted through adjusting the rural industrial structure, actively developing forestry, fruits, traditional Chinese medicine and livestock farming, and giving full play to the superiority of the mountainous area.

(3) Promote the returning farmland through emigration. As for those remote and rocky mountainous areas, the returning steep slope farmland can be promoted through ecological emigration, combining with the construction of small towns.

(4) Promote the returning farmland through the harness of small watershed. Taking small watershed as the unit, the returning steep slope farmland can be promoted through comprehensively harnessing hill, river, land, forest and road to improve the functions of ecological and economical systems of the small watershed.

(5) Promote the returning farmland through forestry ecological program. In those serious regions, the returning steep slope farmland can be promoted through the implementation of forestry ecological program, such as the construction of Yangtze River and Pearl River protection forest systems, natural forest protection and the control of rocky desertification, so as to cultivate forest resources, develop forest sideline products and increase peasant's income.

The implementation of above measures in Guizhou mountainous area has played an important part in the aspects of improving the agricultural productive conditions, increasing the grain yield, adjusting the rural industrial structure, raising the peasant's income and improving the regional quality of ecological environment. Many successful patterns have been explored in the province. However, because of more population and less land, undeveloped economy in Guizhou mountainous area, there are more surplus rural labors and the peasants mainly rely on slope farmland to produce grain and other economic crops so as to solve the shortage of grain or become the main source of economic benefit, which makes the returning slope farmland to forest difficult to be carried out in most of the regions.

3.2.2 Direct means

It means the policies and measures drawn up by the governments in view of the returning slope farmland to forest. According to the unit area of the slope farmland, the governments provide free seedling, grain subsidy and living allowance for the peasants and directly carry out afforestation on planning. At present, returning farmland to forest is one of the indicative projects in the Western Development made by Chinese government, so the required materials, grain and funds is resolved by the central government. It reflects that our national power is raising and the governments pay attention to the ecological environment, and it is an important action in the implementation of sustainable development. In a sense, the present implementation of returning farmland to forest belongs to a political measure. On the basis of summing up the pilot experience of 200,000 mu in the year of 2000, the speed of returning farmland to forest in Guizhou will be 1,000,000 mu annually from 2001, with the kind proportion being 80% of ecological forest and 20% of economic forest. The project of returning farmland to forest is directed against the soil erosion on slope farmland. Within a certain time (for example, 8 years for remote mountainous area), the government provides grain subsidy and cash allowance, which can compensate the peasants for their income from the slope farmland basically. Therefore, the peasants, especially those from remote mountainous area, have a higher enthusiasm. From a long-term point of view, returning farmland to forest demands us to realize the land conversion, afforestation, stability and no repeat. For this purpose, we must consider the followings:

(1) The peasants have a strong dependence on the policy of returning farmland and have a poor capacity of self-development. Although the project of returning farmland to forest is implemented under the major premise of the strengthening of our national power and the surplus grain on region, stage and structure, yet our economic foundation is weaker. Those regions where there are much slope farmland are the backward areas in Guizhou in economic development, also are the most backward areas in China. In those regions there were nearly one million people having the income less RMB 400 yuan in the year of 2000, the relation between peasant and land is tense, and the spontaneous returning farmland is difficult to be realized. Many peasants want to get the financial subsidy from the state for a long time, which undoubtedly adds to the burden of central government finance.

(2) The surplus labor force will be more. Returning farmland to forest, especially to ecological forest, will decrease the demand and increase the quantity for rural labor force.

(3) Grain security problem. Because of the backward conditions of agricultural production and the weak ability to resist the natural disasters in Guizhou mountainous areas, the implementation of returning farmland to forest will bring pressure to bear on grain self-support.

(4) The adjustment of rural industrial structure will meet with a bigger pressure. At present, our country is in the transferring period from planned economy to market economy. The economy has entered the buyer's market stage, the market development is not perfect and the degree of organizing peasant is lower. In addition, the agricultural products of China will be influenced by acceding to WTO. During the period of implementation of returning farmland to forest, Guizhou's agriculture faces serious challenge.

(5) Poor population quality and weak capacity of self-development.

4 Sustainable means and guarantee measures for returning farmland to forest

Returning farmland to forest should be changed into a spontaneous action from the political measure. In this way, the peasants will no longer rely on slope farmland to get their grain rations, grain is self-supported basically, ecological environment is improved obviously, economic development is speeded up, the rate of citification rises, the rural surplus labor can be transferred to other fields effectively, and non-repeat of returning farmland can be guaranteed. In order to realize the above, we hold that the technical line for comprehensive treatment of soil erosion in Guizhou mountainous area must take the project of returning slope farmland to forest as the breakthrough point, combining the direct means with indirect means organically, to practise returning one mu farmland to forest, simultaneously, to transform one mu farmland with the slope below 25° into terrace. Through ameliorating the soil and adding water conservancy facilities, we will improve the agricultural productive conditions to make the grain yield or economic benefit exceed that of the sum of the original farmland and the slope farmland. Thus, Guizhou's agriculture can be led to a resource-saving and high-efficient road, the ecological rehabilitation can be realized, and the foundation of sustainable development of Guizhou's agriculture can be laid. In order to make the project of returning farmland to forest step a sustainable way, we must make great efforts to the followings:

- (1) Control the population quantity and improve the population quality.
- (2) Rely on S&T progress and improve the quality of returning farmland to forest.
- (3) Take returning farmland to forest as the key point, strengthen the cooperation among different departments and increase the integral benefit of comprehensive control of soil erosion.
- (4) Make our agriculture step the road of resource-saving, high-efficient and sustainable development.
- (5) Adjust the rural industrial structure and strengthen the peasant's capacity of self-development.
- (6) Actively explore the agricultural industrialization and develop the special industries.
- (7) Speed up the small town construction, develop the ecological tourism and create the conditions for the peasants in the regions of returning farmland to convert non-peasants.

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