Grassland Rehabilitation and Social Development in the Low Mountain Area of the Jinsha River Valley, China

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Grassland degradation has become a serious environmental problem in semiarid areas, where it is responsible for land degradation and declines in livestock production. China has about 4,000,000 km^2 of grassland (cao di, ie, any land that is not classified as "forest," "cultivated land," or "no vegetation"), accounting for 40% of its total area, mainly in the middle and western parts of the country, where the economy is relatively underdeveloped. One third of the grassland in China is degraded, and degradation continues at the dramatic rate of 6700 km^2 per year. This has hindered animal husbandry development and social development in pastoral areas. Grassland rehabilitation has now become an urgent task of local economic development in western China. The Jinsha River valley (Yunnan Province), a main source of sediment for the Yangtze River, is characteristic of fragile ecosystems in western China. In this area, the primary development problems involve conflicts between ecological rehabilitation (especially restoration of grassland) and grazing. Serious degradation of soil and vegetation on account of the fragility is the result of both natural fluctuation and human intervention. To maintain social and economic sustainability, countermeasures are needed as quickly as possible.

"Desertified land formed by water erosion in the dry hot valley of Yuanmou County in Yunnan Province makes up 40% of the total area of the county."
(Prof Zhu Zhenda, Institute of Geography, Institute of Mountain Disaster and Environment and Desert Research, China)

The environmental situation

The dry hot valley in Yuanmou County is located 200 km from Kunming, in the middle and lower reaches of the Longchuang River, a tributary of the Jinsha River, covering an area of 446.88 km^2. This low mountain area (1100–1350 m) is characterized by very fragile grasslands and an underdeveloped economy. Different topographical zones in the valley show considerable diversity in microclimate, population, nationality, and land productivity.

In the plains, where moisture is plentiful and human intervention is significant, the quality of the microenvironment has been increasingly improved. This has led to population increase and significant crop yields in what can be regarded as the relatively developed area of the valley. This low mountain area where grasslands are widely distributed is densely populated by the Yi, Lisu, Hui, and Miao minority ethnic groups (Figure 1). The main original grass species were *Heteropogon contortus, Aristida adscensionis, Bothriochloa ischaemum* (L.) Keng, *Cymbopogon distans* (Nees ex Steudel) Will. Watson, and *Chloris virgata* Swartz. Grasslands have been greatly reduced because of destruction for cultivation since the 1970s. Extensive human activity has caused serious grassland degradation and severe soil and water losses and led to species change as well as reduced grass yield and diversity.

Causes of grassland degradation

Natural fluctuations

The southwestern monsoon has a foehn effect on the Jinsha River valley. When monsoon winds blow across the Yunnan plateau, the downwind becomes increasingly dry and hot; rainfall in the valley is very limited, and evaporation is excessive. In the rainy season, accumulated rainfall affects the highly erodible red soil, mudstone, and shale, whereas warming intensifies grassland degradation. Biological invasion is another important factor in grassland degradation. In the dry hot valley, the exotic species *Eupatorium adenophorum* now occupies extensive areas between 300 and 1300 m. Local grass species can no longer grow in this area. Grassland deterioration has been rapid.

Human intervention

Overgrazing is the primary direct cause of grassland degradation. Traditional husbandry based on extensive grazing is the mainstay of the local economy (Table 1), but it inevitably brings about grassland destruction. Our survey of the area showed that most degradation comes from goat grazing (Figure 2). As the number of goats increases, grazed grassland becomes more fragile, coverage diminishes, and plant diversity declines. Husbandry development has now become dominant in the low mountain area in Yuanmou County. Almost all the goats, horses, donkeys, and oxen graze in the open air; hence grazing

YEAR	1980	1990	1995	1997	1998	2000	2001
Agricultural revenue (AR)	51.26	141.6	180.44	198.54	265.34	328.42	357.96
Husbandry revenue (HR)	5.28	16.30	45.56	47.50	52.75	66.23	79.84
AR:HR (%)	10.30	11.51	25.25	23.93	19.98	20.17	22.30

TABLE 1 Revenue from animal husbandry in Yuanmou County, as a percentage of agricultural revenue, in millions of yuan (RMB). (Source: Yuanmou Husbandry Administration. Revenue is based on prices in 1990.)

land has become highly degraded through trampling.

Destruction of grassland for cultivation has significant impacts. Extensive planting and cultivation take place on sparse slopes, where primitive production modes result in deeply eroded landforms. The search for simple sources of fuel in this rural region is another destructive factor.

Strategies for grassland rehabilitation

Grassland rehabilitation in the Yuanmou dry hot valley should involve natural restoration, prohibition of grazing, cre-ation of protected areas, closing the area to cultivation, sustainable utilization, and financial and scientific assistance.

Prohibition of grazing

Although its progress is relatively slow, natural restoration is the practicable, opti-mum strategy. An experiment in 2000 with prohibition of manual intervention in 2 villages in Laocheng Township showed that 1 year later local herb and shrub species returned on degraded slopes and 2 years later vegetative cover and wet bio-mass reached 95% and 928 g/m^2, increas-es of 400–600% and 170–430%, respective-ly. Meanwhile, species diversity increased

FIGURE 1 Yi minority village in the increasingly densely populated Jinsha River valley, Yunnan Province. (Photo by Feng Mingyi)

rapidly. Grazing has been prohibited in the low mountain area under a recent policy of promoting rehabilitation. Implementation has demonstrated that grass can be rehabilitated in this manner.

Introduction and popularization of fine grasses

To refine the quality of grassland, in recent years the local government has encouraged farmers to construct artificial grassland on cultivated land in the low mountain areas. Thus fine drought-resistant species such as *Medicago sativa, Rumex, Lolium perenne, Tephrosia candia, Vetiveria zizanioides*, and *Macroptilium atropurpureum* have been introduced and popularized. The yield of *M sativa* can reach 23–30 t/ha (dry biomass), whereas *V zizanioides* can reach 8–10 t/ha (dry biomass). This artificial grassland not only produces high yields but also prevents soil and water loss while providing plentiful fodder for farm

FIGURE 2 Goat grazing on a slope that shows signs of degradation. (Photo by Feng Mingyi)

animals. These introductory explorations have achieved success and been popularized in some locations in the dry hot valley.

Government subsidies to farmers

An underdeveloped economic structure and previous lack of financial support were key problems in restoration of grassland in Yuanmou. But since 1999, the implementation of a national project of converting farmland on slopes into forestland or grassland, combined with foreign financial investment, has encouraged both the local government and farmers engaged in animal husbandry. Farmers became active in protecting grassland environments as never before because this had the potential to guarantee their basic requirements in the long term.

Scientific and technical assistance

Although farmers in the low mountain area are poor, what they really lack is advanced scientific knowledge and production techniques. Their main concerns focus on earning cash through exporting labor or extensive grazing. But because of their lack of education and awareness, they lapse into poverty without scientific and technical assistance. Industrialized husbandry and campaigns to eliminate poverty in the low mountain area thus require scientific and technical assistance. The government should establish training workshops to promote advanced breeding techniques, and regional demonstrations of research activities should also be arranged in different localities. In addition, grassland protection, rehabilitation, and antipoverty campaigns should be features of legislation in both local and national policy-making.

Prohibiting cultivation and fostering ecological migration for rehabilitation

A campaign sponsored by the government since 1999 to prohibit cultivation in order to promote forest and grassland growth has been undertaken in western China. It has been warmly welcomed by local farmers and has had a positive effect. But it is impossible to rehabilitate forests in the dry hot area because of the lack of moisture in the dry season. Afforestation has

failed several times since the 1950s. Hence, grassland rehabilitation is the best and most practical form of ecological rehabilitation in the low mountain area in the dry hot valley (Figure 3). To rehabilitate the grassland swiftly, the local government should help farmers create protected areas for rehabilitation. Cultivation and open grazing should be strictly prohibited in the core protected areas. On the other hand, inhabitants of these areas can be relocated to the low plains in the dry hot valley.

Conclusion

Grassland rehabilitation should be integrated with local economic development and efforts to eliminate poverty. The practicable and optimum form of grassland rehabilitation is to prohibit grazing in favor of natural rehabilitation. Establishing areas for rehabilitation and ecological migration in core protected areas is an effective measure that can lead to sustainable development of husbandry and of society. To maintain sustainable grassland

FIGURE 3 Successful rehabilitation of grass and shrubs on a degraded slope. (Photo by Feng Mingyi)

utilization and husbandry development, the government should establish utilization rights on grassland and improve contracting systems for grassland and livestock, determine the grazing capacity according to the quality of grassland, revise livestock structure, change traditional husbandry patterns of quantity to a modern pattern of quality and benefit, and implement rotational grazing in non-core protected areas.

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