

Degradation and protection of grassland on the Qinghai-Tibet plateau

YANG DINGGUO

Institute of Mountain Disasters and Environment, Chinese Academy of Science, Chengdu, PO Box 417, Sichuan 610015, China

Abstract The Qinghai-Tibet plateau, which has been called the roof of the world and the third pole, is a vast territory which includes a large area of grassland. It is one of the four main areas of animal husbandry in China. This paper, discusses the causes and development of grassland degradation in the region, and the countermeasures which have been proposed for protecting the grassland resource and preventing grassland degradation.

INTRODUCTION

Grassland degradation is an important component of eco-environmental degradation in the world today, and grassland protection represents an important aspect of eco-environment protection. The Qinghai-Tibet plateau, which has been called the roof of the world and the third pole covers a vast territory and includes a large area of grassland. It is one of the four main areas of animal husbandry in China. Study of the degradation and protection of grassland in the region is important for the protection of the eco-environment of the Qinghai-Tibet plateau and for the assessment of global environmental change. There is evidence that the degradation of the grassland has become increasingly serious with the developing animal husbandry during recent years, but further investigations are required. This paper analyses the causes and trends of grassland degradation, and reviews the measures that have been proposed for protecting the grassland resource and preventing grassland degradation in the Qinghai-Tibet plateau.

A BACKGROUND TO GRASSLAND DEGRADATION IN THE QINGHAI-TIBET PLATEAU

The Qinghai-Tibet plateau is located in the southwest of China, and includes the whole of the Tibet Autonomous Region, and most of Qinghai Province, west Sichuan Province and northwest Yunnan Province. The total area of land is approximately 2.269×10^6 km², which represents 23% of China. The area of grassland is approximately 1.33×10^8 ha, accounting for 58.8% of the Qinghai-Tibet plateau and 30% of the grassland in China respectively.

Grassland degradation has become an important, widespread and growing

problem in the Qinghai-Tibet plateau, involving both a large area and various types of degradation. The results of surveys undertaken in the grassland area of northwest Sichuan show that the area of degraded grassland accounts for between 30% and 50% of the total area of grassland in the region (Yang Dingguo, 1987). Based on these results, the total area of degraded grassland in the Qinghai-Tibet plateau is therefore estimated to be approximately 4.0×10^7 to 6.0×10^7 ha.

Grassland degradation occurs throughout the region in a wide range of physiographic and climatic zones. Degraded grassland therefore occurs in the plateau areas and in the alpine and subalpine zones. It is found in areas of both agriculture and animal husbandry as well as in areas of simple pastoral farming. However, serious degradation is particularly found on the plateau surfaces of the area of smooth terrain, in the winter-spring grasslands, on the banks of rivers and alongside traffic routes. It is most serious around watering sites and the camps where animals are gathered in the winter-spring.

Various types of degradation occur. The main types of degraded grassland in the Qinghai-Tibet plateau, based on underlying cause and outward characteristics, are the grasslands associated with hard soils, areas affected by rodents and insects, and areas influenced by encroaching sand and desertification. The degraded grasslands associated with hard soils, cover a large area and are widely distributed. The area involved is about 2.0×10^6 ha in the Ganzi Tibet Autonomous State accounting for 28% of the 7.15×10^6 ha of grassland in the State (Shi Yulin *et al.*, 1985) and 43% of the total degraded grassland in the State respectively. The degraded grassland caused by rodents and insects in northwest Sichuan accounts for more than 1.33×10^6 ha. This type of degradation extends over 32.5% of the usable grassland in Zhiqu County (Zheng Yuanchang, 1990). Grassland destroyed by sand encroachment occurs mainly in the areas with a dry climate and a plentiful supply of dust and sand. However, the destruction of grassland by sand encroachment in the region has been gradually becoming more serious. For example, the area of grassland in Qinghai Province affected by sand encroachment is 2.7×10^6 ha (Xiang Lipin & Zhong Shanchang, 1990).

The rapid increase in the extent of grassland degradation in the Qinghai-Tibet plateau should be noted. For example, the area of degraded grassland at the end of the 1970s was 3 to 4 times greater than at the beginning of the 1950s in the grasslands of northwest Sichuan (Yang Dingguo, 1987). Similarly, the area of grassland affected by sand encroachment caused by overgrazing in the Zoige region was about 3000 ha, whereas it only extended to 1100 ha at the beginning of the 1970s (Li Mingsen, 1986).

THE CHARACTERISTICS OF DEGRADED GRASSLAND

Grassland degradation reflects a destruction of the grassland eco-environment. The main characteristics may be summarized as follows:

- (a) Reduction in plant size and cover density. The results of typical surveys undertaken in the grasslands of northwest Sichuan show that the height of grasses is generally 50-60 cm in the natural grassland, and 70-80 cm and even over 80 or 100 cm in the good grassland. Cover density is generally from 60% to 80%. However, in the degraded grassland, the height of grasses is generally less than 30 cm, with heights of 10 to 20 cm common. Cover density is reduced to less than 50%. In the seriously degraded grassland, the height of grasses is only a few centimetres and seldom more than 10 cm, and cover density is often reduced to 20 to 30% together with a reduced yield. The yield of grasses is commonly reduced by 60 to 90%.
- (b) A deterioration in grass quality. The Qinghai-Tibet plateau, with its favourable natural conditions for grass growth, has some of the richest grass resources in China. There are more than 400 species of grass, and good grasses are represented by over 100 species.
- (c) Hard and impervious soils. Another obvious characteristics of degraded grassland in the region is that the soils become increasingly hard and impervious. Degraded grasslands, characterised by hard and impervious soils, are the most common type of degraded grassland in the region. The area of this type of degraded grassland in Ganzi Tibet Autonomous State is about 2.0×10^6 ha. This represents 27% of the grassland and 43% of the degraded grassland in the state respectively.
- (d) Desertification. Desertification is a serious result of grassland degradation. Deterioration of the grass cover leads to exposure of the soil surface and causes soil erosion. Desertification of grassland in the Qinghai-Tibet plateau is partly a response to natural conditions and partly the result of human activities.
- (e) Covering by sand. The covering of grassland by sand is the end-result of the degradation of the grassland eco-environment. It is associated with inappropriate human activity and occurs in regions with a dry climate and a plentiful supply of dust and sand. Sand-covered grassland in the Qinghai-Tibet plateau occurs mainly in the Zoige area, the Litang and Gonghe basins, the Beilu and Tuotuo River basins, as well as the longitudinal valley of the Yellow River between the Bayanhar and Anyemaqen mountains.

THE CAUSES OF GRASSLAND DEGRADATION

The causes of grassland degradation in the Qinghai-Tibet plateau include inappropriate human activities and natural disasters.

Inappropriate use of the grassland

The main causes are, firstly, overgrazing. Overgrazing is a fundamental cause

of the increasing degradation of grassland in the region. Uncontrolled increase in the number of animals causes the carrying capacity of the grassland to be exceeded. In this region, the development of animal husbandry was associated primarily with increased numbers of animals. For example, in the Ganzi Tibet Autonomous State, the number of animals at the end of the 1970s was double that at the beginning of the 1950s. In the Rongma area of Shiqu County, the carrying capacity of the grassland was exceeded by 25%.

Secondly, there is an imbalance between the winter-spring and summer-autumn grasslands, with the area of winter-spring grassland being too small. The proportion is generally less than 30% of the usable grassland in many places. This leads to overgrazing of the winter-spring grassland, especially around the watering points and the gathering areas for animals, where the number of animals may exceed the carrying capacity of the grassland by several times and even by as much as 10 times.

Thirdly, there is frequently uncontrolled and destructive grazing by animals. The former is particularly common in the boundary districts, due to uncertainties over grassland use. The latter occurs in favoured locations and due to a lack of knowledge amongst the herdsmen.

Poor management of the grassland

The utilization of grassland in the region is characterized by overuse and limited fertilizer input. There has also been only limited development of basic facilities, including irrigation, drinking water camps, feedgrass stores, and artificial grassland. Animal husbandry in the region still depends on the natural conditions.

Rodent and insect infestations

Such problems have affected large areas and have been an important factor in causing grassland degradation in the region. Rats gnaw the roots, stems, leaves and seeds of grasses, and insects eat the green leaves, tender stems and seedlings of grasses, thereby influencing the future reproduction and development of the grasses.

Reclaiming of wasteland and gathering of Chinese medicinal herbs

Although the Qinghai-Tibet plateau is a poor grain producing area, there has been a history of ill-planned reclamation of land for crops with an emphasis on grain production. The reclaimed land, with a low productivity due to natural conditions, was often abandoned after one to two years. Vegetation recolonization of the fallow areas is very slow leading to problems of

desertification and sand encroachment.

In addition, the Qinghai-Tibet plateau, with its unique natural conditions, is the habitat of many rare chinese medicine herbs, including *Cordyceps sinensis*, *Fritillaria thunbergii*, *Gastrodia elata*, *Astragalus membranaceus*, *Anemarrhen asphodeloides*, *Scutellaria baccalensis* and Licorice root. The peasants and herdsmen collect the chinese medicine herbs at suitable times of the year to make money. This leads to destruction of the roots of the grasses, burial of their seeds, and disturbance of the soil surface which in turn influences the reproduction, development and propagation of the grasses.

Forest clearance

Forest protects the grassland. Forest clearance leads to reduced precipitation, a drier climate, and soil erosion, which in turn harm the growth and development of the grasses.

SUGGESTIONS FOR THE PROTECTION OF GRASSLAND AND PREVENTION OF GRASSLAND DEGRADATION

On the basis of the above analysis, the following suggestions for protecting grassland and preventing grassland degradation in the region are advanced.

- (a) Improvement of the level of education and the eco-environmental awareness of the peasants and herdsmen.
- (b) Restricting the number of animals to the carrying capacity of the grassland in order to avoid overgrazing.
- (c) Sensible utilization of the grassland resource. This includes the development of regional plans and the establishment of rotation grazing. The former includes dividing the usable grassland into winter-spring and summer-autumn grasslands, as well as areas for hay production.
- (d) Increased economic input and improved grassland management. The management of grassland in the region is poor, with overuse and little input. The input should be increased to improve the management of the grassland. Here the term input includes many aspects such as funds, manpower, materials and science-techniques etc.
- (e) Improvement of the degraded grassland is an important task for management of the grasslands of the region, due to the large area of degradation. Measures for improvement include the development of grass cover through closure, soil aeration, reseeding, irrigation and fertilizer application, but the measures used should be adapted to the different characteristics and underlying causes of the degraded grassland.
- (f) Prevention and cure of rodent-insect infestations. Such infestations have had a major influence on the degradation of grassland in the region, and

their control is very important for protecting the grassland. Control measures include the use of pesticides and the protection of natural predators.

- (g) Strict scientific gathering of Chinese medicine herbs. The Qinghai-Tibet plateau, with its unique natural environment, is a region where the existing forests and animal husbandry should be preserved as the dominant occupation during the development of the economy, and reclamation of wasteland should be strictly prohibited. The rich resource of Chinese medicine herbs in the region is of great value to humanity, and since it is impossible to prohibit their gathering, scientific methods should be used.

To generalize, it is obvious that relatively little is known about the degradation and protection of grasslands in the Qinghai-Tibet plateau. In this paper, the problems have only been identified. Further work on the degradation and protection of grassland in Qinghai-Tibet plateau should be undertaken.

REFERENCES

- Li Mingsen (1986) Characteristics and utilization of the grassland soils in Zoige. *Studies of the Qinghai-Xizang (Tibet) plateau*. Special issue of the Henhduan Mountains scientific expedition, 489-502. Beijing Science and Technology Press.
- Shi Yulin *et al.* (1985) *Wasteland Resources for Agriculture in China*. Beijing Science and Technology Press.
- Xiang Lipin & Zhong Shanchang (1990) Sandification and prevention and cure of land degradation in Qinghai Province. *Agro-grass Resources and Regionalization Study* no.2, 43-47.
- Yang Dingguo (1987) A discussion of the degradation and protection of grassland in northwest Sichuan. *Mountain Research* 5(2), 115-121.
- Zheng Yuanchang (1990) Main problems of eco-environment in the northeast Qinghai-Tibet plateau. Expedition report.