Demonstration farms to improve grassland and household incomes in western China

Wang Jing [A], Zhao Mengli [A], David Kemp [B] and Gemma Turnbull [B]

[A] Inner Mongolia Agricultural University, Hohhot, Inner Mongolia Autonomous Region, China
[B] Charles Sturt University, E H Graham Centre for Agricultural Innovation, Orange, NSW 2800 Australia
Contact email: menglizhao@yahoo.com

Abstract. Western China is the less developed area of China, of which about 3.31×10^9 ha is grassland. The livelihoods 40 million people, the majority ethnic minorities, are supported by this grassland. To achieve balanced growth while reducing economic disparities is one of the major challenges that China faces to maintain both its current GDP growth rate and social stability. The development of demonstration farms is an efficient way to alleviate or ideally to solve this challenge. Recent studies conducted on the desert steppe in Inner Mongolia have shown, that under current conditions, stocking rates can be reduced to get both healthier grasslands and economic profits. Promotion of demonstration farms to herders is a problem, and work needs to be conducted to make them more accepted and popular in the future.

Keywords: Demonstration, stocking rate, profitability.

Introduction

China has been one of the world's fastest-growing economies based on per capita real incomes over the past three decades, largely due to the open-door policies (Demurger 2001). However, most economic growth has been concentrated in the coastal provinces and mega-cities. China's vast interior, especially in the west, is still less developed. China's northern and western grasslands support the livelihoods of 40 million people, many from ethnic minorities (Han *et al.* 2008). To achieve balanced growth and reduce the east-west disparities poses a major challenge that China now faces to maintain both its current GDP growth rate and social stability.

The grassland area of western China is about 3.31×10^9 ha, which is about 49% of the area of western China (Zhang and Yan 2006). It is well known that about 90% of this grassland is under different degrees of degradation. Overgrazing of grassland has often been identified as one of the major causes of degradation and desertification (Smil 1993) leading to hydrological disturbances and frequent, intense dust storms. The biodiversity, richness and production is reduced, there is a shift in the flora to less desirable species, ecosystem services are degraded, and severe environmental problems appear more often. Traditional herders have found it increasingly difficult to generate sufficient income to survive within the rapidly developing Chinese economy; they are among the poorest people in China.

The problems arising from the state of the Chinese grasslands, the desire to rehabilitate the grasslands, and to improve household incomes have all become urgent imperatives. Reducing livestock numbers sufficiently to enable grassland to rehabilitate but without reducing household income is the key to solving the problem. Reorganizing farms may enable amelioration of the grassland problem while enhancing income (Kemp *et al*. 2008).

Inner Mongolia located in western China has a large area of grassland. The grasslands in Siziwang Banner play a major role in providing people with the goods and services needed for survival (Han *et al.*, 2008). Farmers now face a more harsh and unproductive environment than in the past, with less land to sustain each household. This paper describes demonstration farms set up in the desert grasslands of Siziwang Banner in Inner Mongolia designed to improve household income with less livestock.

Experiment site

The desert grassland site is located in Siziwang Banner, approximately 150 km due north of Hohhot, the capital of Inner Mongolia. It lies in the northern piedmont of Yinshan Mountain on the Mongolian Plateau. It covers an area of 25,500 km^2, with a population of 209,000, most of them relying on agricultural activities for their livelihood. The region is classified as a fragile ecology and is an important ecosystem in northern China. The study area lies between 110.33° and 113.00°E, and 40.15° and 43.33°N. The altitude is 1,000-1,500 m. Winds are a common feature (especially in spring). Average monthly temperature varies from -15°C in January to 20°C in July; frost-free period is 70-120 days. Annual precipitation is 100-300 mm (summer dominated); the mean annual evaporation is 2340 mm. Vegetation is sparse (<20% cover), the dominant grasses are *Stipa* species; Annual net primary production (ANPP) from grasslands is typically < 1 t DM/ha.

Materials and methods

Fifteen farms were selected to investigate in the study village, all of which belong to Siziwang Banner. The survey result showed that the average farm of 520 ha of degraded grassland carried ~268 adult sheep and goats. Taking the lambs and kids in account meant the average stocking rate was about 0.8 adult ewe equivalent per ha. Livestock in

Siziwang Banner is managed for meat production since wool production and quality of the Chinese meat breeds are very poor.

The method used to establish and monitor the demonstration farm followed the model developed with cooperation from the Australian Centre for International Agricultural Research (ACIAR) project LPS/2001/094. We surveyed grassland species, monitored production and biodiversity of the desert steppe grassland and at the same time collected data on the cost and net revenue of livestock enterprises. The key management changes imposed in demonstration farms included reducing stocking rate and changing feeding strategy. Stocking rates need to be reduced and grazing confined to periods when animal production from grass can be optimized and to enable better opportunities for plants to regenerate and build reserves to survive the winter.

Results

Grassland biodiversity

This data discussed here were collected from 2004 to 2008. The relationship between plant species diversity and mean herbage mass is shown in Figure 1. Species diversity index under current conditions gets to the maximum value at an annual net primary productivity of 500 kg DM/ha or more. Species diversity did not change with the production growth. 500 kg DM/ha was approximately the average annual production which occurred irrespective of whether rainfall was at or above average and when the stocking rate was 1 DSE/ha or less.

Financial benefit

The data from farm surveys and the grazing experiments were used to construct a linear programming model to investigate the financial returns from different stocking rates, using current feed sources but with the goal of maintaining animal liveweights through the year (necessary for a production oriented system). Additionally, animals were kept in warm sheds through winter (Han *et al.* 2011). Warm sheds minimize weight loss when nutrition is poor and improve net household financial returns. Net returns were optimal at a stocking rate that was approximately half that of present practice, or about ~1 DSE/ha in the stocking rate experiment considered above. In the Siziwang district, 500 households have now reduced their stocking rates by 40%. When combined with better advice on animal nutrition and the creation of a better market system for lambs, household incomes have increased. Other changes in management (*e.g.* changes in time of lambing, early weaning, changes in enterprise) are possible that would further increase incomes.

Problems

Production decreases as the stocking rate increases once the optimum is exceeded. Proper grazing maintains grasslands in a healthy state, which leads to higher producing, more species rich and more stable systems. Herders typically reduce stocking rates after summer which makes an early summer gazing bans helps rehabilitate grasslands an acceptable strategy. Reducing stocking rate to a reasonable level relative to the optimum is the key point in

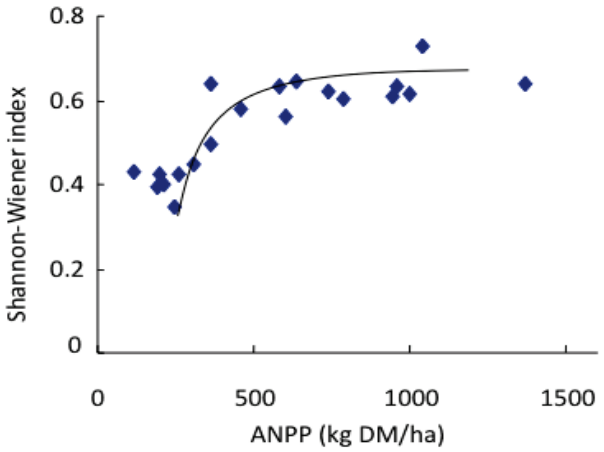

Figure 1. Annual net primary production (ANPP) and Shannon-Wiener diversity index for plant species under three stocking rates and for five summers on the desert steppe.

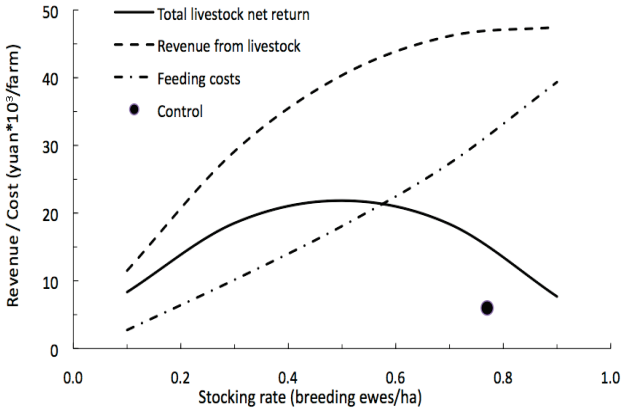

Figure 2. Livestock production revenue and feed costs for the current meat production system in Siziwang Banner, Inner Mongolia Autonomous Region.The 'Control' data point is an estimate of current net income from livestock on farms in same area, for which case animals graze outside all year, are not fed to maintenance requirements, and revenue and feed costs are less than apply in other calculations

grassland sustainable development. However, increasing farm income is the most important issue for the herders. As shown in Figure 2, there are two points either of the optimum that produce the total livestock net return but at quite different stocking rates. Since many herders have too many animals (well beyond the optimum) persuading them to down size their livestock thereby and providing opportunities for grassland rehabilitation leading to sustainable development can be effectively demonstrated which is now our main work. However, there are some cultural barriers to overcome because traditional livestock management practices are often based upon survival through the year rather than running the farm as a business and producing high quality goods for market. They hold an outdated, traditional concept that more livestock leads directly to more income. While this was the case in the past when there was a fixed price for livestock products irrespective of quality, now the price herders receive for livestock products reflects quality of those products determined by consumer demand. This means there is growing interest in improving profitability from every animal in their flocks and herds (Kemp 2008).

Land has traditionally been used in common by local groups, rather than being accessible to all. Herders traditionally did not own any land. Under such arrangements, the land had no saleable value to individual herders which meant that herders would seek out any available forage and aim to exploit it before others. In this system there is no incentive to preserve forage, as reserved forage would likely be used by others.

Solutions

In order to develop sustainable grassland in a market economy, many of the traditional ideas need to be re-assessed and new ideas and management practices demonstrated to help herders to realize the grassland rehabilitation and income stability are closely linked. Some approaches to assist change are discussed below:

(1) Offer training classes to herders to inform them that reducing livestock numbers does not mean less animal product and income; rather fewer, better fed animals will produce more meat, milk and wool per unit area of land. Improved feed conversion efficiency in the production of animal products will directly reduce the amount of methane emitted per kg of animal product over an animal's life.

(2) Help some herders to build their farms into demonstration units, and show-casing these to other herders. What herders care about most are benefits (*i.e.* higher profit, less work, improved environment), and this is the most direct method of showing how these new practices can affect their household income. Considerable research and herder experience has shown that as stocking rates increase, per head production (*e.g.* meat, milk, wool and growth of lambs, calves and kids produced) decreases with first quality, and then quantity being affected. Keeping the stocking rate at a safe utilisation level will maximize profit. When farms using these methods are more successful, then more farms will be drawn into wanting to be involved with this project.

(3) Working with local government to provide the herders some support, with policy and government financial assistance to build the farm. Farm productivity may or may not satisfy household needs—if a farm is too small and/or too degraded to satisfy the required household income, the solution is not to further increase the number of grazing animals, but to find other sources of income, which might include grazing compensation schemes or off farm income.

This approach helped to identify better strategies, including research and development and policy options, to improve smallholder incomes and overcome grassland degradation. National and local policies have been developed to combat these problems and the relative research had many components of livestock production and proposed better integrated livestock system concepts.

Demonstration farms have already begun to be promoted, but are still used on a relatively small scale. More grassland research is urgently needed in western China to achieve grassland rehabilitation through sustainable development while improving the incomes of herders.

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