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## Rangeland Ecology &amp; Management

journal homepage: <http://www.elsevier.com/locate/rama>

## An Alternative Rangeland Management Strategy in an Agro-Pastoral Area in Western China<sup>☆</sup>

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### ARTICLE INFO

Available online xxxx

#### Keywords:

agro-pastoral region  
community participation  
family income  
livestock  
rangeland governance  
vegetation

### ABSTRACT

Governance plays a key role in rangeland management. In China, all rangeland, including pastoral land and agro-pastoral land, is owned by the State. Since 1980, use rights have been granted to households by the Chinese government extending the household contract responsibility system (HCRS). But in the agro-pastoral areas of northwestern (NW) China, the rangeland degradation is more severe than that in pastoral areas. The HCRS is difficult to implement because the limited and fragmented grazing land cannot be contracted to individual households. Thus the pastures in the agro-pastoral areas are grazed as communal pastoral land and the rate of rangeland degradation has accelerated as livestock numbers have grown. Several measures have been introduced in an attempt to reverse this degradation trend, but most failed. This paper reports a 5-year comparison of three rangeland management regimens, including the national "Protecting rangeland by restricting grazing" (PRRG) project under the individual HCRS (PRRG under IHCRS), the Allied Householders Contract Responsibility System (AHCRS) program funded by the World Bank/GEF, and the free grazing on common pasture as the control area (CA) at Mayinggou Village, Yongchang County, Gansu Province in NW China. The results showed significant differences ( $P < 0.05$ ) between AHCRS and the other two regimens (PRRG under IHCRS and CA) in terms of biomass of palatable forages, cover, and plant diversity index of vegetation but no significant difference ( $P > 0.05$ ) between PRRG under IHCRS and CA. Reducing the number of livestock in AHCRS also resulted in increased revenue from the livestock turn-off rate compared with that in PRRG under IHCRS and CA. Therefore, AHCRS is a better alternative management regimen for rangelands in agro-pastoral areas. AHCRS can solve the overgrazing problem, maintain or improve household income, and potentially ensure a long-term sustainable rangeland management regimen in agro-pastoral areas in NW China.

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### Introduction

Q4 China has the third largest area of rangelands in the world (Squires 2010). Rangeland can be categorized as either pastoral land, where cropping does not occur, or agro-pastoral lands, where cropland and grazing land are in close proximity (Cheng, 1999). The agro-pastoral land is the transition region of the traditional agricultural region and pastoral region (Hess, 1990; Xu, 1999). In China, the agro-pastoral

lands encompass the southeastern edge of Mongolia Plateau, south Loess Plateau, and part of Qinghai-Tibet Plateau (Chen et al., 2004; Shao et al., 2006). The transition zone covers 12 provinces and 140 counties with an area of 44 million hectare (Mha) and population of 35 million in 2003 (Sun and Shi, 2003). In this region, the rainfall is in the range of 250 to 500 mm, both plant cover and productivity are low, and the ecosystem is susceptible to degradation (Cheng, 2002; Pan et al., 2003). As a result, the farming system is sensitive to environmental change and human influence. The degraded and decertified area of rangeland in the agro-pastoral area represents about 50% of the total degraded rangeland area in northwestern China (Cheng, 1999). The rangeland area in agro-pastoral land in Inner Mongolia shrank by 0.41 Mha over a 10-year period (1990–2000) (Zhan et al., 2004). Although many areas were illegally converted to croplands for producing more grain crops, the problem of accelerated rangeland degradation in agro-

<sup>☆</sup> Research was funded by the Key Laboratory of Grassland Ecosystem, Ministry of Education (1102-02) and the Special Fund for Agro-Scientific Research in the Public Interest (201003061).

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pastoral land has been exacerbated by the imposition of new institutional arrangements relating to land tenure and use rights (Williams, 1996; DaLintai and Gaowa, 2010).

Governance is the key to promotion of sustainable use and management of natural resources and to achieve the goals of conservation of natural resources and environment, alleviation of poverty, and sustainable utilization of natural resources (Ostrom, 1990; Acheson, 2006). With the implementation of economic policy opening up and reform and cropland tenure reform in the better-watered agricultural areas, the household contract responsibility system (HCRS) (*jia ting cheng bao ze ren zhi*) was extended to the pastoral and agro-pastoral areas to solve the problem of unfettered common-use grazing (Feng, 1988; Cao and Wang, 1995; Yang 2008). HCRS is a policy designed to boost agricultural productivity and was first adopted in China in 1981. A key part of HCRS was to assign use rights to individual households from land that was formerly communally used (Brandt et al., 2002). HCRS has been the fundamental tool for rangeland management in China since the 1980s and raised productivity and increased animal husbandry output from the 1980s to 1990s (Wang et al., 2010). According to the Grassland<sup>1</sup> Law of the People's Republic of China (2002 Amendment), the use rights to rangeland belonging to the State could be contracted by individual householders (*dan hu cheng bao*) or cooperating householders (*lian hu cheng bao*) (Banks, 2003; Cao et al., 2011; Li et al. 2011). The individual HCRS (IHCRS) (*dan hu cheng bao ze ren zhi*) implies that a household has use rights to a specific area of pasture and can run privately owned livestock there. By contrast, under cooperating HCRS, each household has private ownership of livestock, but their pasture is shared and managed by the cooperating households. From 2001–2011, the contracted rangeland area by individual households and cooperating households in China increased to 273 Mha, which accounts for 83% of total rangeland available nationwide. The proportion of rangeland contracted to individual households is now about 80.5% of the total contracted rangeland area in China (China Grass Internet, 2013). The IHCRS has been the dominant management type in the rangeland region of China. However, the policy of IHCRS is difficult to apply in agro-pastoral areas because of the contradiction between population pressure and the relatively small areas of residual rangeland. In agro-pastoral regions in China, the average rangeland area was 0.23 ha per household, which is too small to be operated as functional rangeland by individual households (Xu et al., 2012). As a result, the rangeland in many parts of the agro-pastoral regions was used as communal grazing land and the overstocking rate was higher (42.07%) than that (23.37%) in the pastoral regions (Xu et al., 2012). IHCRS did not solve the dilemma of private livestock on state-owned land in the agro-pastoral regions. Severe overgrazing has become a major challenge because of the pressure to maintain or improve livelihoods that was believed by households to come more quickly from bigger herds (Richard et al., 2006).

In order to find a better management approach for rangeland in the agro-pastoral region, a potentially viable alternative was trialed in Mayinggou Village, Yongchang County, Gansu Province in NW China in 2007 when the World Bank/GEF supported a rangeland conservation project there. Each community of the village has use rights to its own winter pasture (closer to the village) and summer pasture (often far from the village). However, the pasture was allocated by the village committee to households, more or less at random. Each allocation has a use right certificate, but there was no clear boundary between these individually assigned pastures, so trespass grazing was a problem. Entry and exit dates were either not well defined or ignored, and the pastures received no rest. Therefore, the key issue of rangeland degradation in the agro-pastoral village was the failure of the existing rangeland management regimen. There was an opportunity to devise a new rangeland management arrangement. A participatory rural appraisal was conducted (Hua and Zhang, 2012), revealing that most households

considered the uncontrolled grazing on communal rangeland was the biggest contributor to rangeland degradation in this village. After several discussions between the project officers and farmers, an alternative Allied Households Contract Responsibility System (CRS) (*lian hu ze ren cheng bao zhi*) was implemented in the village in accordance with the households' approval (World Bank, 2004).

Since 2000, the Protecting Rangeland by Restricting Grazing (PRRG) (*tui mu huan cao*) project funded by the Ministry of Agriculture (MOA) has been conducted in China (Huang and Wang, 2004; Li, 2011). The PRRG project was predicated on the prior registration of IHCRS for all households in the project area and on demarcation of individual pasture allocations (Liu, 2010). For the funding support from the central government, the local government of Yongchang County extended the IHCRS to other communities of Mayinggou Village and the pasture belonging to the participating households from the village was divided into each household's portion on the basis of the number of people in the household.

In this study, the rangeland recovery and changes in stocking pressure within the three management regimens were used to assess the impact on rangeland recovery and family income of reassigning grazing use rights to groups of cooperating households in the agro-pastoral rangeland in NW China. There was opportunity to compare outcomes under three contrasting management regimens: 1) the nationally sponsored PRRG under IHCRS, 2) communally grazed rangeland without institutional management, and 3) a new regimen, Allied Households Contract Responsibility System (AHCRS), developed in western Gansu.

## Study Site and Methods

### Study Site

Mayinggou Village is located in the middle section of Qi Lian Mountain in the Hexi Corridor of western Gansu Province (Fig. 1). The village has 518 households (HH) with 2 155 people of Han nationality. Each household has up to six people. The available areas of rangeland and cropland are 8 677 ha and 260 ha, respectively. This accounts for 30.6% and 2.9% of the total land area, respectively. The other land type is primarily sparse woodland with low shrub and plantation forestry for woodlots and shelter belts. The altitude is 2 178 to 2 515 m. The climate is temperate with a semi-alpine zone at higher altitude. Annual rainfall ranges from 170 mm to 320 mm and temperature from 1.5°C to 7.0°C (Yang, 2010). The rainfall is mainly distributed in July, August, and September. The rangeland types include alpine meadow, temperate grassland, semi-arid rangeland, and arid rangeland. The livestock number in 2007 was 3 240 Sheep Unit.<sup>2</sup> According to the record of the village committee, sheep are the dominant livestock in the village (Yang, 2010). The main crops are barley, beans, and wheat. The dominant plants on the rangeland are *Leymus secalinum*, *Agropyron cristatum*, *Poa pratensis*, *Stipa sareptarta* var. *krylovii*, *Deyeuxia scabrescens*, *Stipa purpurea*, *Stipa breviflora*, and *Artemisia frigida*.

Various rangeland regimens existed in past decades in the village. Before the 1980s, all rangeland and livestock was State owned, but the village had the right to use the pastoral lands and manage the livestock enterprise. From 1980–2007, the State-owned livestock was redistributed to individual householders, and the rangeland was owned by the village as common pasture. Since 2007, with the extension of HCRS in pastoral land, partial rangeland in four communities has been redistributed to individual householders. In 2007, the World Bank/GEF funded a rangeland conservation project to solve the rangeland degradation based on a reformed rangeland regimen in two demonstration communities of this village.

<sup>2</sup> Sheep Unit: a 50 kg sheep with a half-year lamb at foot eating 1.8 kg per day dry forage with 14% of moisture.

<sup>1</sup> Grassland in China involves rangeland and sown grassland.

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