

Property rights and grassland degradation: A study of the Xilingol Pasture, Inner Mongolia, China

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Received 27 May 2005; received in revised form 5 October 2006; accepted 17 October 2006

Available online 28 November 2006

Abstract

The semi-private property rights arrangement called the Household Production Responsibility System (HPRS) was started in the early 1980s in Xilingol pasture of Inner Mongolia (China), and stimulated the development of stockbreeding. The grassland has been degrading severely with increasing numbers of livestock. Based on a historical review of property rights regimes in Inner Mongolia and empirical surveys in Xilingol pasture during 2001–2003, this paper assesses the implementation of HPRS and its impacts on incomes of households as well as the environmental impact on the grassland. It was found that HPRS does not mitigate the “Tragedy of the Commons”, instead it has exacerbated the situation. It was also found that co-management of grassland and livestock among a few households presents a sustainable use of grassland to develop livestock breeding. We conclude with the recommendation that small-scale collective property rights systems should be encouraged in Xilingol pasture of Inner Mongolia.

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Keywords: Household Production Responsibility System; Property rights; Common pool resources; Small-scale co-management; Grassland degradation; Inner Mongolia

1. Introduction

Xilingol League, one of the largest primary grasslands in the world, is located in the central east of Inner Mongolia Autonomous Region in the north of China. It borders the Republic of Mongolia to the north with a shared border of 1095 km and covers an area of 200,000 km² with a total population of 906,000 in 1995 (the date of the last census). A majority of the inhabitants are of Mongolian ethnicity with 21 other ethnic minorities.

Since the early 1980s when the national rural reform was started, the private property rights arrangement called the Household Production Responsibility System (HPRS) has been implemented in Xilingol pasture of Inner Mongolia, and has stimulated the development of livestock breeding. HPRS was actually introduced in agricultural areas of China where it has been implemented since the end of the

1970s and proven to be successful in stimulating farmers’ incentives for increasing crop production efficiency. In the pasture areas, HPRS is also called the Double Contracts System which means that both the livestock and grassland are contracted to herder households by the government instead of only farmland in agricultural areas. Since the implementation of HPRS, the number of livestock increased quickly from 12.6 million in 1980 to 22.7 million in 1997 (Fig. 1). However, the grassland has been degrading severely. The available grassland per sheep unit decreased from 1.42 ha in 1980 to 1.05 ha in 1990 (Fig. 2). The degraded area accounts for 48.6% of the total Xilingol grassland (Qi, 2001), and the degraded grassland has exceeded 50% of the total area in half of the 12 sub-administrative areas under Xilingol League (Fig. 3).

Facing increasingly severe grassland degradation, both the central government and Xilingol local governments have been taking a series of counter measures to control this negative trend. Such measures include extending the HPRS contract expiration and adopting a policy of ‘Fencing Grassland, Forbidding Grazing and Moving

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Users' in badly degraded areas. However, recent field research shows that all these methods are not entirely effective (Bijoor et al., 2006). This paper attempts to explore the root causes of this inefficiency. In recent years, some western scholars (Sneath, 2000; Williams, 2002; Banks, 2001) as well as local Mongolian experts (Dalintai, 2004) have challenged the rationality of HPRS, and pointed out that it might be contributing to grassland degradation. This paper seeks to first understand whether HPRS led to the grassland degradation, and second to seek ways to mediate the grassland degradation given the current property right arrangements.

2. Methodology

Considering the route-dependent characteristics of institutional arrangements, firstly we collected secondary data and reviewed publications to present briefly the evolving history of property rights in Inner Mongolia. Our case study site was selected based on this secondary data to provide the most representative sample. The purpose of our field study was to understand the relationship between the existing property rights regimes under HPRS and the grassland degradation in Xilingol pasture. Taking Xilinhot as the case study area, one of the sub-administrative areas under Xilingol League, we gathered detailed information about HPRS through structured and open-ended interviews conducted with 13 government representatives from all the relevant departments of governments during 2001–2003 and structured interviews

with 19 herding families that were selected randomly in the summer of 2002.

The diversity of property right arrangements in Xilinhot led us to select it as our case study area. Before the HPRS was implemented, there existed a collective property system in *sum* (township in Mongolian Language) and state-owned farms; during the implementation of HPRS, the contracts (allotted for both livestock and grassland) were also variable (some *sum* only contract cutting grassland to households, but some contract all the grassland to households). Based on the data from the Annals of Xilingol League (Compilation Committee, 1996) and our pre-interviews in 2001, we knew that there were no significant differences among households in production, lifestyle and income in the same *sum* or sub-farm, so we selected randomly 1–2 households in each *sum* or sub-farm to interview aiming to cover all the permutations of HPRS implementation. In total, there were 19 households interviewed, which took 15 days of field time in the summer of 2002 due to the large distances between farms and poor traffic conditions. The interview questions were designed to obtain the following information: family size, the year in which grassland and livestock were contracted, the amount of grassland contracted, winter animal stock, summer animal stock, and earning and cost of stock-breeding. We analyzed the interview records of 19

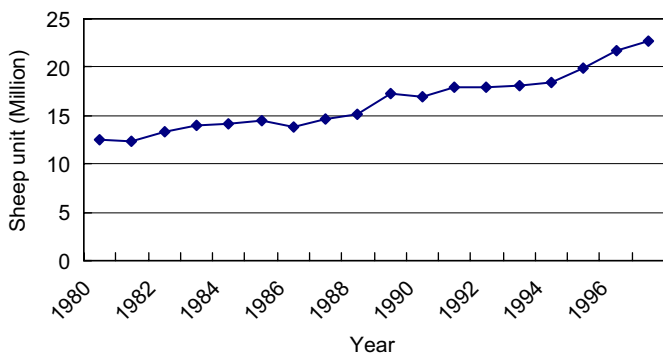


Fig. 1. Number of livestock increasing in Xilingol League (Units: sheep, 1 cattle/horse = 5 sheep). Source: Xilingol Statistic Bureau (1997).

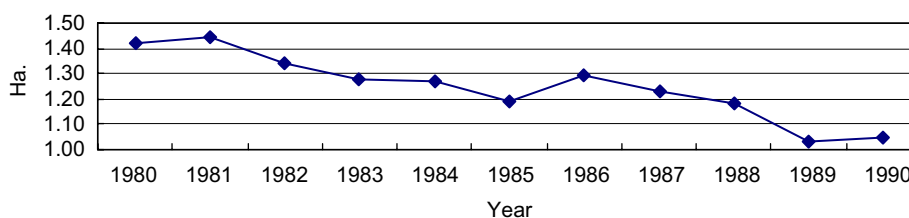


Fig. 2. Grassland area available for per sheep unit (Qi, 2001). Source: Qi (2001).

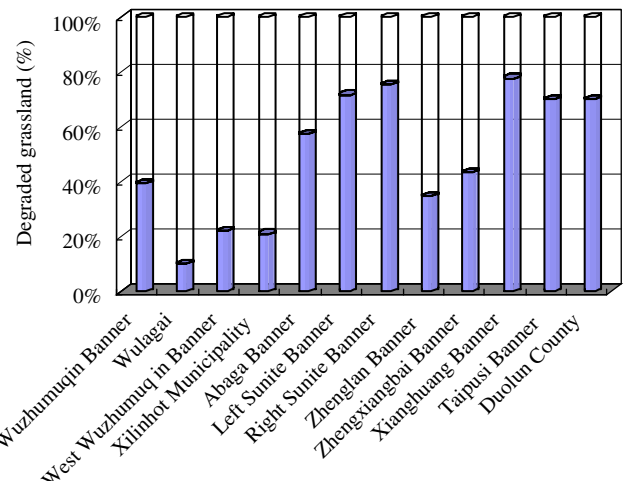


Fig. 3. Degraded grassland in the sub-administrative areas of Xilingol League. Source: Qi (2001).

households and discarded 3 samples with ambiguous information or without representatives.

The officials interviewed were from the stockbreeding bureau, grassland supervision bureau, agriculture and forest bureau, tourism bureau, desertification combating office and the office of fencing grassland and moving users at the League level, the similar sectors at the Xilinhot municipal level, and the *sum* level governments. The intent of the interviews with officials was to ascertain the motivation for HPRS policy, the details of the implementation plan, and a self-assessment of effectiveness from official sources. Informal discussion format interviews were conducted to garner candid responses.

3. Findings

3.1. The evolution of property rights in Xilingol

Historically Xilingol pasture experienced two types of property right regimes: a private property regime before 1955 and a collective/state property regime between 1955 and 1979.

Before 1206 when Genghis Khan united the whole Mongolia altiplano, the grassland in Inner Mongolia had been owned by the Khan of each tribe. The Khan allocated the grassland to his relatives and followers according to their contributions in wars fought on their land, and who then re-distributed the use rights to their sub-ordinates. At that time, the property rights of all the hunting grounds and rangelands were clear so that nobody could hunt or herd on the land of others without permission of the owners (Ayan and Wuen, 1999). In 1206 when Genghis Khan consolidated the Mongolian pasture, he re-allocated all the grassland resources thoroughly, and all the chieftains were required to herd their livestock on the set range of the allocated grassland. Every chieftain knew the boundary of the grassland he owned, and arranged the seasonal camps for the affiliated households (Vladimirtsov, 1980).

In 1271, the Mongols united the whole Chinese territory, and established a unified multi-ethnic country, called the Yuan Dynasty. During the Yuan Dynasty, apart from private ownerships, numerous state-owned rangelands were demarcated, often occupying the richest grassland to support the great financial need of the state. Since there were numerous kinds of livestock on the state rangeland, specialized work divisions appeared among the herders in the region, focusing particularly on sheep, goats and horses.

By the 15th century, the age of Mongol conquest was over, and the Han Chinese regained power as the Ming Dynasty. In Mongol pastures, the property regime was kept the same, i.e., all the grassland was owned by feudal nobles, and the general population (accounting for over 80% of the total population) only had use rights (Ayan and Wuen, 1999). Despite their lack of land ownership, the herder population often owned livestock. Regarding their

use of the grassland, Williams (2002, p. 69) recorded: “During the Ming (1368–1644)..., Mongol herders typically organized themselves into small suprafamilial units, which consisted usually of two to twenty households that shared labor and helped to dilute environmental risks such as drought, flood, or blizzard. A level above that, several of these units (usually four to twenty) coordinated their land use and access to resources informally in territorial groups sharing a common name, such as “people of one valley”.”

There is scant Chinese literature identifying the details of grassland use patterns in the Qing Dynasty (1644–1911). The following description was cited by Sneath (2000, p. 35): “The Qing emperor, through the banner prince, retained the formal rights to allocate land. In everyday life, however, the right to use pastureland was at the discretion of the banner prince, and his officials, who acted as custodians of both people and land. The territory of the hoshuu (banner) generally contained a number of different areas of pasture areas used in winter, spring, summer, and autumn. These seasonal pastures were divided between the various *sums* and *bags* (*gachaa*), and within these areas of land the individual households had customary use-rights to particular pastures. In effect this meant that each family owned no land as such but had a recognized area of pasture that is used in the different seasons, and of these the rights to the exclusive use of the winter pasture (*oboljoo*) tended to be the most strictly enforced.”

In 1911 when the feudal empire was replaced by the Chinese Republic, the government declared that all Mongol lands belonged to the federal Chinese authorities and that land titles were henceforth invalid unless ratified by local representatives of the government (Lattimore, 1934, p. 105; Jones, 1949, p. 61 cited by Williams, 2002, p. 28). For the general commons, herders still had use rights no matter who possessed the ownership. Vreeland (1957, p. 152) described that in 1930 “*Otor* (temporary camps, like winter camps or summer camps) were fairly permanent in their location, and a family generally had its customary sites which were recognized by other people. ... Each family had customary places where they cut hay, but it was also customary to mark the place where one expected to cut hay that year, Right to use such customary places was based on continuous use. There was more conflict over these haying sites than over the green pasturage sites.”

Thus historically the ownership of all grassland in Inner Mongolia belonged to a few feudal nobles or the state, and the common herder had no individual ownership of land, but had recognized use rights for certain grasslands to tend to his own livestock as well as the local nobles’ herds.

In 1945 when the Chinese communists took power in Inner Mongolia, most of the common herders had few livestock owing to the wars during the preceding few decades. The following data from East Abahanar Banner (the present Xilinhot) might be useful to understand the property regime at that time (You, 1999). In 1949 the Banner had 9 *sums* composed of 710 households with a population 3021. In each *sum*, there were 3 governors to

manage the pasture. The total number of livestock was around 139,000. Almost all of the livestock were owned privately by a small number of feudal nobles (no more than 20 households). For example, maharaja Balagong Surong possessed more than 10,000 livestock in 1949, which were divided into 15 livestock herds including 3 herds of horses, 1 herd of cows, 1 herd of camels and 10 herds of sheep. Horses, cows, camels, and some of the sheep (3 groups) were managed by his household workers directly, and the other 7 herds of sheep were leased to herder men (You, 1999).

Since most of the herders did not have their own livestock, they had two ways of earning a living: being employed as grazing workers/milking workers by the noblemen, or renting livestock herds to graze and breed. If they were employed as grazing/milking workers, they could get a salary for their living expenses. Usually one horse herd consisted of more than 200 horses, and for each herd the owner needed to employ 4 grazing workers. Their salary was paid on an annual basis. Each worker could get a 3-year-old young horse, a suit of leather clothes and a pair of felt boots for winter, and it was the owner's duty to supply the employee's meals. The grazing workers were expected to ensure that livestock mortality during 1 year was less than 2%, otherwise they had to compensate for the losses. For each herd of cows (more than 100 cows), the owner needed to employ 2 workers. One helped with grazing management and the other one did the milking. The milking worker could get a salary of 3 Yuan/month and some cloths, and the cow herder could only get one 4-year-old cow for 1 year's salary. For each herd of sheep (more than 500 sheep), the owner employed one herder. The owner paid a salary of 15 Yuan/month in addition to supplying the employee's meals.

Another way for the herders to make a living was to rent a herd of livestock from nobles through signing of a 3–5-year contract; this was called the Sureg contract system. Every year, 20–30% of the newborn livestock belonged to herders and 70–80% belonged to the land lord. Approximately, 80–85% of the adult female livestock were found to be fertile, and the annual survival rate of adult livestock was approximately 97–98%. The herders also had to give the land lords 1–2 kg of butter and 1.5–4 kg of cheese per cow, and a felt rug per 100 sheep every year.

Although socialism replaced feudalism in 1945, the noble private property regime was not changed until 1956 even though land reform was being carried out in agricultural areas during that time. This was because of Wulanhu, the first head of the Inner Mongolia Administration under the Chinese communists (Sneath, 2000, p. 16), who persuaded the central government to conduct a gradual land reform in Inner Mongolia (You, 1999, p. 186). This explains why there was little change in the percentage of district livestock owned by wealth groups between 1948 and 1957, which Sneath (2000, p. 51) tried to explain as the natural character of Inner Mongolia's pastoral system. Yet a new Sureg contract system was established between the private owners and herders, which increased the earning of herders

from the original 20–30% of the newborn livestock to 30–40%. The expected survival rate was found to be 94–95% instead of the original 97–98%. The new Sureg system brought more benefits to herders, and as a result of this system an increasing number of herders were able to own their own livestock.

In 1954, some small-scale mutual aid teams appeared under encouragement from the government. Initially, several households voluntarily moved and lived together, and shared all of their livestock. The herders of a mutual aid team took charge of all the livestock rotationally, and they were self-organized to cut the grass, weave felt rugs, and keep dairy products together. The gains were allocated equitably and amicably between the member households. During our interviews, some old herder men expressed a favorable opinion of the mutual aid teams.

By the end of 1956, the large-scale primary and advanced communes were encouraged to be established in Xilinghot by the governments following the Russian agriculture management style. Up till 1980, 5 communes had been established in Xilinghot. In one of the communes, for example, there were 503 households and 87,999 livestock. In order to establish this commune, the households sold their livestock to the commune at 20–30% of the market price; the other 70–80% of the livestock value was taken as stock for joining the commune. At the end of every year, the herders would get 3% of their livestock value as stock dividends. In the commune, all the herders ate in the common cafeteria, and the food was free for all the families of the commune. The free food meant that the salary was very modest. Herders were encouraged to leave their nomadic lifestyle and move into permanent settlements. Each commune had its own grassland, and the livestock herding was limited within the boundary of the commune. Neither our interviews nor secondary citations show any records of the rangeland's ecological situation at that time. This may be due to minimal rangeland degradation, or a lack of environmental awareness.

During this period, there were 4 state farms (Baiyinxile, Maodeng, Beilike, and Baiyin Kulak) established in Xilinghot. Most of the farm workers were Han Chinese, employed in the agricultural areas. The farms controlled livestock number and grazing regimes, and each sub-farm functioned separately within the guidelines of these terms. Most of the population lived in the villages, and only a small number of herders looked after the common livestock on the grassland in a more or less nomadic manner (depending on different sub-farms). Under this state farm system, productivity often was low due to an inefficient distribution system. As a result of the increased proportion of Han communities, the importance of traditional Mongolian culture also diminished in these areas (Thwaites, 1998).

3.2. Current property right regimes: HPRS

In 1980, China entered the economic reform period. In 1983, the HPRS (previously implemented in agricultural

areas) was also introduced to Xilingol pasture, which provided incentives for herders to increase production by providing them with direct interest in the level of production. In the grassland areas, this is called the “double contract HPRS”, referring to the two contracts that could be signed with herders: one contract for rights to livestock, and one for rights of access to grassland resources.

The implementation of the “double contract HPRS” was carried out at a local level, with each local government interpreting the policy and deciding how to implement it best within their own region. By 2002, in most parts of the Xilingol pasture, both the land and livestock had been privatized and allocated to the herders; while in some areas (subfarms 1, 2, 4 and 5 of Baiyinxile Farm, for example), only the livestock was allocated to the herders, but the grazing grassland was shared.

For the privatized grassland and livestock, the government issued a decree in 1989 to manage the grassland, which clearly defined the responsibilities, rights and interests of the herders who signed the Double Contract. According to the policy, grassland use fees are charged according to the number of livestock, and the quantity of livestock farming is determined by the level of grass production. In cases of excessive farming, herders will be ordered to raise the number of animals for sale and pay double administration fees. Each household that signed the contract is required to establish or restore at least 200 mu (1 ha = 15 mu) of pasture in 3–5 years. They should manage these pastures by means of fertilizer application, seeding, planting trees and irrigation. Starting from the third year, 100 kg hay per mu should be produced. In cases of failure to reach such a target, the household would be fined one yuan (US\$0.12) per mu.

Herders are allowed to inherit and sell their product. Grassland use licenses are issued for the contracted grassland. The contract of the grassland was based on the federal government’s Grassland Law and Regulation on the Management of Grasslands. A contract is signed with a household after the following tasks have been undertaken: grassland surveying, demarcation, classification, rating, determination of grass production and grazing capacity, and fixing of charges. The purpose is to ensure fairness and justice, and to maintain the ecological balance of the grasslands. If the contracted grassland is overgrazed by less than 5%, no violation fee is charged, and the herding household is allowed to rent other herders’ grassland. Yet if the overgrazing rate is between 6% and 11%, a violation fee will be charged of 30 Yuan per sheep. If a herder raises more livestock than the prescribed quota but fails to reach the goals for selling their animals in the autumn, they have to pay another 5 Yuan for each sheep as a violation fee (Compilation Committee for the Annals of Xilingol League, 1996).

In the areas where only livestock are allocated, i.e. the 4 subfarms in Baiyinxile Farm, the grassland is owned by the subfarms. Within the subfarm areas, there is no control

over who can graze where, and there are no formal agreements with herders over their livestock management or grazing rights. It is up to individual herders to decide where to graze their livestock and how many livestock to breed. Any controls over access to resources, such as bans on the digging of traditional medicinal herbs, are imposed by decree from the government. Herders are also allocated a specific designated area of grassland (cutting grassland) from which they can cut hay for winter feed. Nobody else can cut a herder’s allocated grassland, but the rest of the grassland is still common for grazing. The size of the allocation of cutting grassland is seen by the farm as an indirect form of control over livestock numbers. If livestock numbers are increased, there might be a lack of wintering hay even though the herders cut their entire allocation of cutting grasslands every year.

3.3. Perceptions of HPRS, household income and grassland degradation

As compared to the property rights history of Mongolia, we can see that the biggest change brought by the HPRS is that this system limits each individual household within a relatively small piece of grassland, which has resulted in many unexpected problems related to both grassland conservation and herder income.

All the interviewees in this study thought the grassland had been degrading since the early 1980s. During one of our surveys in the summer of 2001, one herder said “In 1984 the natural grasses were higher even than sheep in summer time, and I could not find my herd from far away; but now the herd is exposed in the bare sand land.” As shown in Fig. 4, the herder population living in the pastoral area has been kept quite stable since 1972 although the agriculture and urban population has increased in Xilingol League. Given no obvious changes in rainfall or natural ecological shifts during 1982–2000 (Han et al., 2002, p. 124), it is reasonable to assume that the property rights regime change might be one of the reasons for grassland degradation.

Because of continuous grassland degradation, the household income has begun to drop down since 1998. As shown

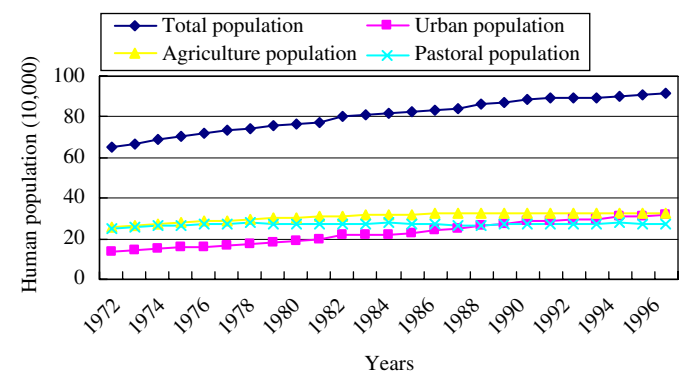


Fig. 4. Human population changes between 1972 and 1996. Source: Xilingol Statistic Bureau (1997).

in Table 1, for 10 of the 16 households we randomly selected during the interview process, income in June 2001–June 2002 (one husbandry year) was negative from livestock breeding. Even the 6 households that still made a profit complained that their income had been dropping, especially compared with the first 10 years after HPRS. The stockbreeding cost analysis (Table 2) provides some reasoning for why the herders might be losing money. As shown in Table 2, because of ecological degradation and excessive cutting, the grassland could not supply enough hay, the herders have to expend much money to buy hay from outside. For most of the households the hay expenditure accounted for more than 50% of the total cost, while in the husbandry year 2000, the expenditure for buying hay only accounted for 22% of total expenses (Zhang and Li, 2002, p. 150). Given the stable livestock and fodder market price (see the National Livestock and Fodder Market Price from web site of China Livestock Husbandry and Veterinary www.cav.net.cn), it could be concluded that grassland degradation was the major cause of income decline.

An important insight that we get from Table 1 is that there exists a common feature among those households that lost money from stockbreeding: the grassland contract was signed about 10 years later than the livestock contract except for household 8 of the Baiyinbaolige *sum* (Table 1).

In this case, although the *sum* contracted both livestock and grassland within 2–3 years, the household still lost money in the stockbreeding because this family immigrated from outside and rented grassland from a local herder family. Also, the rented grassland was not fenced due to expense concerns. Another exception is household #5, which is the only one still making profits from stockbreeding although there exists a time lag between the livestock contract and the grassland contract. This household got 4800 mu (1 ha = 15 mu) of grassland in 1997 through a grassland contract. In order to support the large stock herd of 925 sheep units, the herder rented additional grassland (5000 mu as summer grazing camp) from other households. This phenomenon is colloquially called ‘big household eating small households’ by local herders. Normally there exists one or two ‘Big Households’ in each *gacha*.

This phenomenon can be explained since the livestock are private, while grassland is common use; therefore, as predicted the “Tragedy of the Commons” happened in these areas. As a consequence of grassland over use, now all the resource users are losers. It seems the overuse problem is more related to the time-lag between the livestock contract and grassland contract than the privatization policy of HPRS itself. If that’s true, why has grassland overuse still been taking place even in those areas

Table 1
Property rights and stockbreeding profits per household (June 2001–June 2002) 1 Ha = 15 mu; 1 US\$ = 8.3 Yuan

Household	Family size (person)	Administrative area	Year of livestock contracted	Year of grassland contracted	Area of grassland contracted (mu)	Net savings (Yuan)
1	7	Yuejin sum	1985	1993	9000	–1672.5
2	3	Shengli sum	1981	1983	3000	6350.0
3	5	Maodeng farm	1983	1999	2660	–2552.0
4	4	Maodeng farm	1983	1999	2080	–10,689.0
5	5	Chaokewula sum	1983	1997	4800	18,712.5
6	4	Chaokewula sum	1983	1997	1800	–3142.5
7	5	Baiyinbaolige sum	1982	1983–1985	6000	62,887.5
8	6	Baiyinbailige sum	1982	1983–1985	6500	–750.0
9	3	Baiyinkulun farm	1984	1997	1400	–5850.0
10	3	Beilike farm	1984	1999	2700	–1640.0
11	3	Sub-farm #5 of Baiyinxile farm	1987	Only cutting grassland contracted, 1987	700	9900.0
12	3	Sub-farm #4 of Baiyinxile farm	1982	Only cutting grassland contracted, 1999	360	–21,660.0
13	5	Sub-farm #4 of Baiyinxile farm	1982	Only cutting grassland contracted, 1995	1000	16,475.0
14	3	Sub-farm #1 of Baiyinxile farm	1985	Only cutting grassland contracted, 1985–1993	600	2550.0
15	5	Sub-farm #2 of Baiyinxile farm	1985	Only cutting grassland contracted, 1999	650	–3974.0
16	4	Sub-farm #2 of Baiyinxile farm	1985	Only cutting grassland contracted, 1999	390	–4340.0

Table 2
Cost analysis of stockbreeding in 2002 husbandry year (June 2001–June 2002)

Household	Hay (percentage of total cost)	Fodder	Vaccination	Grassland use fee	Tax	Fencing	Grass planting	Grassland rent fee	Total cost
1	8820 (66)	2520	400	512.5	1020	0	0	0	13,272.5
2	4200 (67)	1200	100	250	500	0	0	0	6250.0
3	2000 (51)	720	204	764	264	0	0	0	3952.0
4	9000 (51)	2150	966	3871	1502	0	0	0	17,489.0
5	12000 (30)	15,000	925	2312.5	8100	0	0	2000	40,337.5
6	11,340(58)	3240	235	587.5	1140	3000	0	0	19,542.5
7	30,000 (67)	1250	1235	3087.5	7540	1600	0	0	44,712.5
8	24,680 (64)	6480	540	1350	2700	0	0	3000	38,750.0
9	3000 (22)	1350	600	8000	500	0	0	0	13,450.0
10	0	24,000	1800	4060	1780	0	0	2700	34,340.0
11	11,000 (33)	10,000	2400	6300	2200	1200	0	0	33,100.0
12	19,440 (60)	6240	1320	3320	1860	0	0	0	32,180.0
13	0	6000	2670	4895	2310	4600	100,000	0	120,475.0
14	0	4800	1860	3910	1880	0	15,000	0	27,450.0
15	3200 (45)	1260	516	946	1152	0	0	0	7074.0
16	20,000 (74)	2750	1080	1980	1080	0	0	0	26,890.0

Unit: Yuan (1 US\$ = 8.3 Yuan).

where livestock contracts and grassland use contracts were signed almost simultaneously as we learned from the survey?

Enforcement of private property rights to exclude other users requires fences around the grassland, but the survey showed that only 10% of the herders could afford the fencing expense, 20% could afford half-fencing, and the other 70% could not afford any fencing at all in Xilingol. Therefore only a few rich households could exclude the others from using the resources through fencing of grassland, for example, household #5. Therefore most of the area actually is open access grassland and that is the main cause of the degradation, even though the grassland is already privatized and allocated to individuals in the contracts. Although the government established a monitoring and punishment mechanism as described above to prevent overgrazing, it has not been enforceable, mainly due to the high project implementation cost.

In those subfarms where the grazing grassland is commonly owned, over-grazing happened because restrictions on cutting grasslands could not control effectively the livestock numbers as expected, since the herders still made a net profit even if they bought fodder from agricultural areas to compensate for the additional feed need due to over-breeding. Here the additional cost for over grazing is the expense for the winter fodder, which is actually a kind of penalty for those “defectors”. Taking the household #11 living in the sub-farm 5 of Baiyinxile Farm as an example (Table 2), in this household with 3 individuals, 700 mu (1 ha = 15 mu) of grassland is allocated for cutting winter feed, and no more than 135 sheep are allowed to breed according to the requirement of 45 sheep/person by Baiyinxile Farm Administration. Using the terminology of game theory, if the herder had selected the strategy of

“No Violation” and only bred 135 sheep, then he would have made a profit of 8575 Yuan in 2001. Yet the practical situation is that the interviewed herder had 250 sheep, which means he selected a “Violation” strategy. His profit was 9900 Yuan, which is more than the profit under the strategy of No Violation. Therefore, the herder still has economic incentives to select overuse of the grassland.

Therefore, the root problem might come from failure of stock rate control that was designed based on carrying capacity theory, no matter how the HPRS was implemented in different settings. Regarding the carrying capacity enforcement problem, recently there have been some questions raised in the literature about its practicability. In a study of grassland degradation in Africa, Bartels et al. (1993, p. 99) remarked: ‘*Though there are numerous attempts, we know of no case in which a government agency in Africa has successfully persuaded pastoral households, or a pastoral group to voluntarily reduce livestock numbers on rangeland to satisfy an estimated carrying capacity*’. Ho (2001) got the same conclusion based on a case study in the arid area Gansu Province of China ‘*Not only in Africa, but also in China, rangeland management on the basis of carrying capacities has proven to be unfeasible, or it involve very high enforcement costs*’. Based on the comparison of stocking rates and perceived pasture degradation in case-study sites in Inner Asia, Humphrey and Sneath (1999) also pointed out that ‘*It appears that stocking rates (sheep units/ha) alone are a poor guide to the levels of perceived pasture degradation*’ and proposed that ‘*in the open steppe case-study sites the amount of livestock mobility is a better guide to the amount of reported degradation of pastures than the stocking rate*’. Here again our study in Inner Mongolia demonstrated that it is unfeasible to use carrying capacity to control the over grazing in the grassland arid area.

Whether or not this is related to the nature of a non-equilibrium ecosystem in arid and semi-arid areas like in Africa is beyond the scope of this paper (for this debate, see Behnke et al., 1993; Ho, 2001; Illius and Connor, 1999; Sullivan and Rohde, 2002), but we can confirm in this study the failure of carrying capacity use in the management of grassland in Xilingol pasture, despite government intervention.

The primary theoretical basis for the HPRS system is carrying capacity control according to the quantity and quality of the grassland contracted to individual households. However, given the failure of carrying capacity implementation in Xilingol as presented above, it's reasonable for us to challenge the policy rationality of HPRS itself, designed for the grasslands in arid areas.

3.4. Small-scale collective management

Realizing the root problem of HPRS, we tried to ascertain if it was possible for the households to revert back to the previous common use regime for grassland. However, when we asked the households, all the interviewees replied that it is impossible for them go back to the earlier system. As one herder said: "human population has increased too quickly, so we could not rely anymore on our traditional nomadic production that needs huge grassland". However, realizing the pitfalls of HPRS, for example, failure to exclude other users, owing to the unaffordable cost of fencing, some neighbor households selected joint management of their grassland and livestock.

In the Bayintuga village of Abaga Banner, 4 households decided to co-manage their livestock and grassland in 1984. Through joint investment, they built 1667 m² of livestock pens, planted grass in 69,500 mu, dug 4 wells and bought 2 electricity generators. The small livestock (sheep) and big livestock (cattle, horses and camels) are now ranged separately according to the requirements of traditional stockbreeding, which is also impossible for the individual families owing to limitations of grassland and labor. They sat together to make the grassland use plan. In 1995 when the livestock population increased too fast and they thought their grassland could not support this increase any further, they decided to rent the extra livestock to other households that had extra grass through the *Sureg* contract. In order to gain more benefits without an increase in the number of livestock, they introduced new species to improve their sheep breeding. In 1996 the per capita income of these 4 households was 10,000 Yuan, compared to only 260 Yuan in 1984 before they decided to cooperate, and the average per capita income in 1995 was only 1933 Yuan in Xilingol (Qi, 2001).

4. Discussion and conclusion

Most environmental concerns can be seen as problems of incomplete, inconsistent, or unenforced property rights. Without a solution to the property rights problem, the

environmental problem will remain (Hanna et al., 1995). Historically, although the grassland was owned by a small number of nobles, for most general commons they shared their use rights within a relatively large area of grassland. Given these property settings, the Xilingol grassland was consistent with the definition of 'common pool resources' (CPRs) as Ostrom (1990) described. For CPRs, exclusion of users is difficult to achieve and joint use reduces the availability of benefits derived from the resources for others. Traditionally, privatization and government control have been regarded as solutions to the overuse tragedy of CPRs (Hardin, 1968; Olson, 1965), but recently there has been a shift toward the potential of community-based management, driven by empirical evidence that CPR users are capable of creating effective governance rules (Vira and Jeffery, 2001; Jeffery and Vira, 2001; Bromley, 1992; Ostrom, 1990). The HPRS that was designed and implemented in Xilingol pasture aimed to escape the tragedy of commons, but our surveys show that there exist many pitfalls, especially considering the special social economic and natural character of Xilingol pasture.

Privatized property needs clear boundaries for every parcel of private grassland. However, it is not so easy to demarcate fairly in pasture since the natural conditions, such as grass richness and water sources, vary greatly with the geographical location. For example, in any available grazing grassland, watering points (permanent ponds or rivers) are required, but they are not distributed evenly in the pasture. Secondly, private property needs to exclude other users by building fences around the grassland, but the survey showed that 70% of the households could not afford the fencing expense at all in XBR, which results in even more severe grassland overusing in most of the open areas. Thirdly, from the conservation perspective, fencing of private grassland will block the migration of wildlife and hence could have some adverse consequences without mitigating measures. Finally, from a stockbreeding perspective, some problems have come up with the privatization that include an unbalanced ratio of male and female livestock; a decrease in the number of big livestock owing to limited grassland owned by individual households; and a lack of laborers during the peak breeding season.

Privatization, without effective management and resource distribution, is clearly not always an effective way to prevent natural resource degradation. Karanth (1992) indicated that 'one consequence of privatization of CPRs in land was that there was a gradual depletion of village pasture'. For an open access or unregulated regime, the privatization program could be efficient only when (a) enforcement costs are nil; (b) property rights are well defined; (c) markets are competitive; and (d) markets are perfect (Baland and Platteau, 1996). Obviously, the first one is impossible in all the settings, and the next 3 preconditions are all largely absent in contemporary China.

The small-scale co-management of livestock and grassland in the Bayintuga village of Abaga Banner presented a new mechanism of sustainable stockbreeding. In

small-group settings, the individuals know one another well, can observe one another's behaviors, and are in continuous interaction with one another, so any pattern of collective behavior, including cooperation, can be sustained, which will make each individual better off than if they violated their social contract. When a group is small, it is less vulnerable to the problem of incentive dilution (Olson, 1965). Therefore, as the size of the group increases, the contractual terms of this exchange become more and more favorable to a "free rider" (since shares are diluted), and vice versa when the size of the group decreases (Baland and Platteau, 1996). This is why large groups are less able to act in their common interest than small ones. The advantage of small groups in this context is not only that they prevent incentives from being excessively diluted, but also that they allow for agreements to be reached among the people concerned at low negotiation costs, which include the costs of communication and bargaining as well as, possibly, those of creating and maintaining a formal organization.

Based on the Bayintuga village case and the above analysis, we propose here that the small-scale co-management of grassland management should be encouraged in Xilingol of Inner Mongolia. Yet, it must be stressed that there may be pitfalls in small groups as well. Precisely because the relationships among their members are highly personalized, the small groups are vulnerable to strong manifestations of envy and rivalry that may sometimes make cooperation very difficult under conditions of bad leadership.

The central government must also realize that Inner Mongolian pasture is not merely providing livestock products, but also ecosystem services. Therefore the past GDP growth-oriented development approach through increasing the number of livestock must be adjusted, and more attention should be paid to ecosystem and cultural conservation. While carrying capacity approaches ostensibly appear to serve this purpose, their implementation is often done through quotas which are not attenuated to cultural and economic behavior patterns of herders. Without adequate enforcement and concomitant conservation measures for the grassland regeneration itself, such measures lead to grassland degradation.

Furthermore, the central government should avoid a tendency to consider traditional Mongolian livestock husbandry as backward and uncultured, since managing pastures using the popular agricultural approach has been a failure during the past decades. Local governments should respect small-scale self-organization and self-management of herders, which is an endogenous institutional innovation from herders themselves. Particularly, more conducive policies should be made for these organized households which allow for amicable dispute resolution where needs may arise. As we face a growing decline in global grasslands and the impending threat of desertification in much of central Asia,

appropriate tailoring of property rights regimes to specific contexts is essential. While much progress has been made in understanding the dynamics of land degradation, there is still far greater need for concerted action on the part of governments.

Acknowledgements

We would like to acknowledge the help of our students, particularly Ganlin Huang and Neeta Bijoor in conducting fieldwork for this project. Financial supports for this research were provided by the National Nature Sciences Foundation of China (40271032) and a Henry Luce Foundation grant to the primary author that made the possibility of producing and improving the paper in the Watson Institute for International Studies at Brown University, USA.

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