

# CLIMATE VARIABILITY, CHANGE OF LAND USE AND VULNERABILITY IN PASTORAL SOCIETY: A CASE FROM INNER MONGOLIA\*

*Xiaoyi Wang and Qian Zhang*

## Abstract

Climate variability is a primary characteristic of arid and semi-arid areas where drought occurs frequently. As a disaster, drought is the result of both low precipitation and social factors. If the institutions governing grassland use fail to deal with drought, grassland degradation and herder poverty will result. Based on a case study conducted in Hexigten Banner of eastern Inner Mongolia, we found that drought impacts caused by climate variability were aggravated by resource use conflicts. A series of social and economic changes in pastoral societies, including grassland segmentation, sedentarization, increased buying-in of fodder, decrease in cooperation amongst herders, and industrial development, have made herders more vulnerable to drought. Less fodder production, increased costs, and heavy debt within a disrupted community make a herder's life unsustainable. The paper points out that changes driven by policy makers may aggravate herders' vulnerability and that an alternative approach of adaptation should be developed.

**Keywords:** drought, sedentarization, grassland privatization, vulnerability, Inner Mongolia

## Introduction

When we arrived at Gonger Village in Hexigten Banner in 2010, we joined in the Nadam Fair, a traditional Mongolian sporting and cultural event. Suri, the chief of the village, said that herders were not as enthusiastic about the traditional competitions as usual because there had been no rain for a long time. The livestock rearing would be a failure this year if there was no rain in the near future. Without rain, there would be no forage for cutting, and no way to pass the winter. In the village, all of our conversations concentrated on rain and drought. In the first evening we stayed in the village. When a snake passed the door of Suri's house he was very happy because there is a local saying that a snake on the road is a sign of rain. When the morning was very cold he was upset because he believed that the colder the weather, the drier the summer.

Since 2000, Inner Mongolia has experienced a period of frequent disasters, especially drought. Even though most of Inner Mongolia is semi-arid, arid or extremely arid, and 'nine droughts in ten years' is the primary characteristic of the climate, the frequency of drought in the past ten years has been much higher

than before (Gong and Wang 1994; Weather Society of Inner Mongolia 1985). According to data from the Water Conservancy Bureau of Chifeng City, where Hexigten Banner is located, the water supplies of nine reservoirs decreased by 73.7 per cent in 2010 compared with the multiyear average level. Moreover, several important rivers of Chifeng City had zero flow (Xinhuanet 2010). An important background to all of these natural disasters is the impact of climate change on global precipitation and temperature, whereby drylands are the most severely affected (Anderson et al. 2010). As the Fourth Assessment Report of the IPCC concluded, globally, the area influenced by drought has possibly expanded, with mid-latitude drylands affected by climate change especially with regard to water resources (IPCC 2007).

In addition to the impacts of climate change there have been two dramatic changes in socio-economic institutions in pastoral areas in Inner Mongolia in the last thirty years. One is the implementation of the Livestock and Grassland Double-Contract Responsibility System (LGDCRS) started in the 1980s. The other is a series of ecological protection projects that include fencing grassland, decreasing livestock numbers, implementing grazing bans, and protecting forests, which started in 2000.

Since the 1980s, the LGDCRS has been implemented in Inner Mongolia with the aim of promoting grassland protection and livestock husbandry development. By contracting grassland usufruct to individual households, it was expected to promote the transition from transhumance to settled living and grazing. The construction of productive infrastructures and planting of fodder and forage became the main themes for developing grassland livestock breeding (Li and Zhang 2009: 63). Meanwhile, the planned economy was replaced by the market economy, with herders' production and consumption transferred to this system. On the one hand, a smallholder economy was gradually formed, and wandering traders became the main channel for herders to sell their livestock products. The cost of fodder and forage increased continuously, and a grassland usufruct circulation market started to develop. On the other hand, the health care, education and veterinary services, which had been provided by the collective in the past, have been decreasing, and herders now have to bear most of the cost of these services (Dalintai and Zheng 2010). Under the impact of marketization, the social structure and organization of pastoral areas of Inner Mongolia has changed to a large degree, with the gap between rich and poor expanding (Humphrey and Sneath 1999). A series of problems gradually appeared in pastoral areas, such as shrinking grazing land, inadequate grassland management, and a decline in herders' cooperation (Wang 2009).

The year 2000 marked the beginning of herders' difficulties in combating drought and was the turning point in government concern about grassland deterioration because of frequent large-scale sandstorms. From 2000 to 2009, 6.5 trillion yuan<sup>1</sup> was invested in Inner Mongolia, including 1.8 trillion yuan for the Beijing–Tianjin Sandstorm Sources Control Project and 4.7 trillion yuan in the

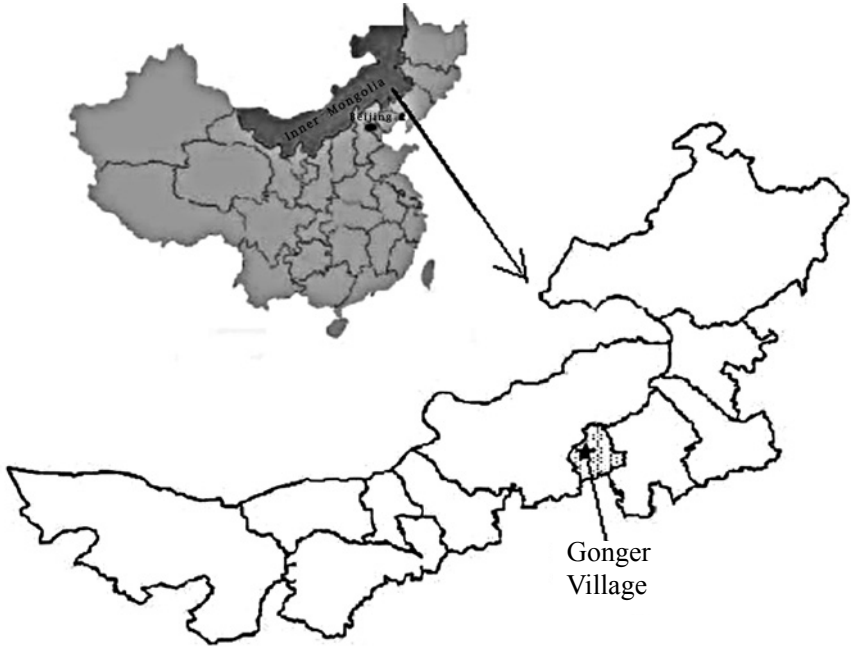
Project for Converting Pastures to Grasslands (*People's Daily* Online 2009). Based on the conclusion that overgrazing is the main reason for grassland degradation and sandstorms, these two projects primarily relied on grazing bans, including seasonal (spring) and whole-year bans for several years. During this period, herders had to buy fodder and forage to feed their animals, which increased costs of livestock production to a large degree and made livestock too weak to survive drought (Wang and Zhang 2010).

Vulnerability is an important analytical perspective from which to evaluate the impacts of climate change. Vulnerability is the extent to which a natural and social system is susceptible to sustaining damage. Vulnerability to climate change is a function not only of biophysical outcomes related to variations and changes in temperature, precipitation, topography and soil, but also of socio-political and institutional factors that can vary significantly at a relatively fine scale (Adger 2006). There are two kinds of analytical framework in studying vulnerability to climate change: the risk–disaster model (Füssel and Klein 2006) and the endowment–livelihood method (Adger 2006). The former is also called impact analysis, which explores multiple results caused by a climatic disaster. The latter is a more integrated method because it analyses the consequences of climatic disaster (such as poverty) from multiple perspectives, including natural conditions, disaster event, social and economic institutions, and so on. Therefore, it reflects the character of vulnerability analysis. It traces different causes from one result, among which is climate change (Ribot 2010). In this analytical framework, climate change is only one of the reasons; social and institutional causes also play roles.

With the changes in both climate variability and social institutions, herders have become increasingly vulnerable to natural disasters. Based on a case study in Gonger Village, this paper analyses herders' vulnerability from two aspects: one is the disturbance resulting from damaging events on individual and group livelihoods; the other is their adaptation and the effects of coping with these changes. This paper explores the complex process of drought impacts and explains how the capacity of herders to deal with drought has weakened, especially from a social perspective. Herder strategies to decrease their vulnerability will be discussed at the end.

## Study Area and Research Methods

Gonger Village is a pastoral village located in western Hexigten Banner of Chifeng City, Inner Mongolia (Figure 1). When fieldwork was conducted in 2010 and 2011 there were about eighty households in five sub-villages. The total area of grassland was about 15,000 ha and consisted of three parts: 10 per cent was summer pasture along rivers, 30 per cent was winter pasture on sandy land and the remainder was spring and autumn pasture where most herders built their



**Figure 1.** Location of Inner Mongolia Autonomous Region and Gonger Village.

houses. Of ten thousand livestock, about 30 per cent were cattle and 70 per cent were sheep – there were less than a hundred camels. Local government had prohibited goat raising from 2004 in the belief that goats seriously damaged the grassland by digging out grass roots. As a result there were no goats in Gonger Village.

The analysis of this paper is based on two groups of data: one is meteorological data (1959–2009), the other is data collected from case study fieldwork in April, July and August 2010 and in May 2011. By using statistical methods, the characteristics of climate variability of temperature and precipitation during 1959–2009 were analysed. We interviewed twenty-six households in 2010 and thirty-one in 2011, among which there were eighteen revisited households. In total, thirty-nine herder households were interviewed based on a semi-structured questionnaire. It covered household contracted grassland area and use mode, its changes, infrastructures, livestock numbers, and the benefits and costs of livestock breeding in 2009 and 2010. Open-ended questions included herders' perception of climate variability, losses caused by natural disasters, strategies to cope with disasters, grassland use, water resource use, and implementation of government projects.

## Climate Variability in Hexigten Banner and its Impacts

The climatic conditions of the Mongolian plateau have fluctuated over time, and drought and snow are frequent natural disasters for herders. Climate variability has significant impacts on pastoral community livelihoods and changes their relationship with outsiders. Fagan (2008) concluded in *The Great Warming* that nomadic people were sensitive to climate change. Mongolian herders remained in their grasslands whilst weather was good and invaded other areas during drought. It was warming and drought on the Mongolian plateau that led to the Mongol invasion of Europe. In Hexigten Banner, heavy snow and drought have been common throughout history (Table 1). For instance, between 1959 and 1990, there were ten snow disasters and five winter droughts (Hexigten Banner Annals 1993). Droughts in spring and summer occurred almost every year. Before the 1980s, herders relied on long-distance mobile herding to overcome the difficulties brought by these natural disasters (Hexigten Banner Annals 1993).

**Table 1.** Disaster occurrences in Hexigten Banner

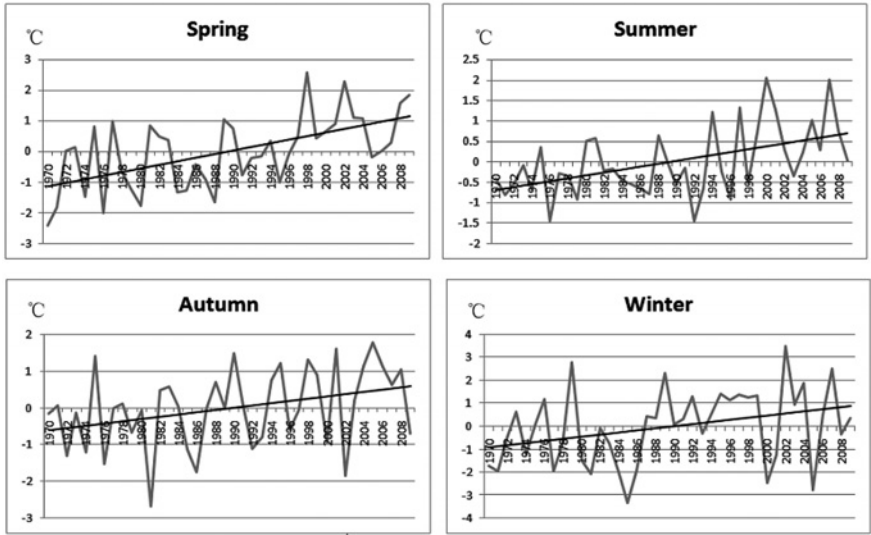
Disaster		Time period	Frequency	Probability of occurrence (%)
Drought	Spring	1961–1990	12	40
	Summer		16	53.3
	Autumn		7	23.3
Snowstorm		1959–1990	10	31.3
Winter drought		1959–1990	5	15.6

Data source: Hexigten Banner Annals 1993

### *Characteristics of Climate Variability and Herders' Perception*

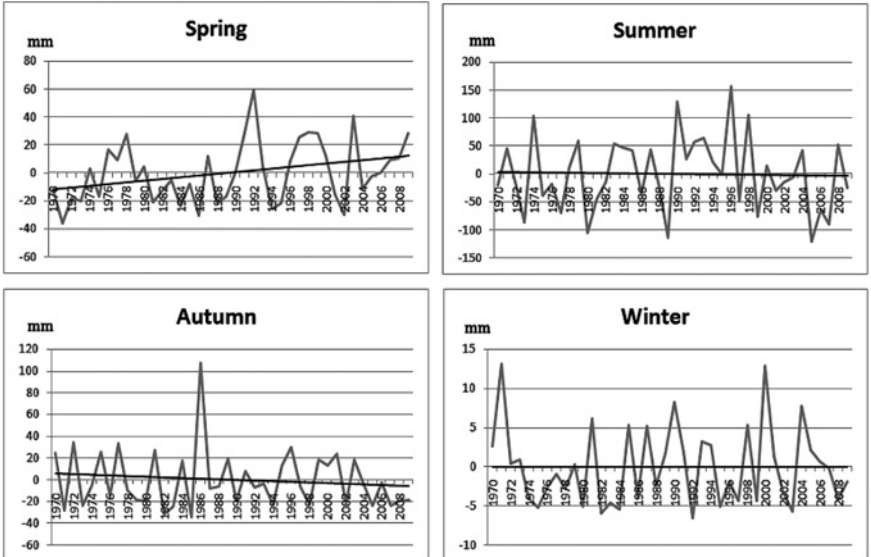
Since the 1980s, droughts have increased on the Mongolian Plateau (Liu 2005). Data from Hexigten Banner also confirmed a warmer, drier trend. In order to evaluate deviation of temperature and precipitation from average value, we use anomaly instead of real value to show the trend of change of climatic conditions. Figure 2 and Figure 3 show the seasonal changes in temperature and precipitation respectively in Hexigten Banner over the last fifty-one years.

Looking at Figure 2, temperatures have tended to rise in all four seasons during this period. As time passes, the trend of temperature increase is obvious, especially in spring ( $r^2 = 0.33$ ). After the year 2000, spring, summer and autumn temperatures have remained higher than the 51-year average level for several years, while winter temperature had a wider fluctuation range. Figure 3 shows that precipitation has increased in spring and winter, but decreased in summer. Over time, the trend of precipitation decrease is not obvious in summer, autumn or winter (the maximum  $r^2$  is autumn, which is 0.02). However, after the year



**Figure 2.** Seasonal temperature anomaly in Hexigten Banner (1959–2009)

Data source: Meteorological Station of Xexigten Banner (1959–2009)



**Figure 3.** Seasonal precipitation anomaly in Hexigten Banner (1959–2009)

Data source: Meteorological Station of Xexigten Banner (1959–2009)

2000, there are several continuous years' precipitations lower than the average level of fifty-one years, especially in summer (2005–2007) and autumn (2007–2009).

Due to the warmer and drier trend, drought has been a problem in Gonger Village for more than ten years, with five years of severe drought. When we went to the village in 2010, the grassland was yellow in summer when it should have been green. In our interviews, herders emphasized the warmer, drier trend in summer. Summer had much higher temperatures, especially in July and August, and there was little rain until the end of August. An old herder mentioned that he did not remember any drought between the 1970s and the 1990s. If there was drought, it would not last very long. But our interview with herders in July 2010 indicated that since 2000, drought has become more serious, especially in the last five years. Suri mentioned that the year of 2010 was more difficult, as there was no rain at all from spring to summer.

In winter, the number of cold days decreased, and the amount of snow declined, but the wind was stronger. However, herders have a different perception of climate variability for spring and autumn from the results shown in figures 2 and 3. Instead of getting warmer in spring, herders said that spring had been delayed for about half a month during the last five years. In the past the weather became warm after the middle of March and grass turned green in April. The livestock would have adequate fresh grass in April. Now the wind is strong in spring and there is little rain, so fresh grass is limited before May. In autumn it becomes cold earlier than before. Herders need to wear cotton-padded clothes even in the period of cutting grass at the end of August. Moreover, autumn rain tends to fall after mowing, which does not contribute to grass growth.

The differences between herders' perception and the meteorological data analysis exactly prove climate variability in pastoral areas. The data of figures 2 and 3 were collected at the nearest weather station in Jingpeng Township, which is over 60 km from Gonger Village. But these two places have totally different geographical conditions. Jingpeng Township is surrounded by hills but Gonger Village is located on the open steppe where strong winds may lead to a temperature decrease in spring and autumn. Moreover, the spatial distribution of precipitation is variable from village to village, and even from household to household. According to some old herders, this kind of phenomenon has been happening more frequently. Precipitation may differ even between neighbours. As herders mentioned in interviews, only a narrow belt of grassland now receives rain, which did not happen before. Herders' sensitivity to cold in spring may be caused by their settlement and abandonment of sandy land as winter pasture. Before the 1990s most herders moved to sandy land in winter where it was warmer and the grass turned green earlier. Now they stay in their houses on their spring and autumn pasture year-round. In the early spring it is also colder there than on the sandy land.

*Impacts on Grassland and Water Resources*

The droughts decreased grassland productivity significantly. Interviewed herders estimated that grass yield would be reduced to about 25 per cent of normal. For instance, according to herders, grassland harvesting could produce 100–150 kg of grass in the 1990s but only 20–25 kg in 2010 on the same area of land. Many plots for grass cutting have been changed into grazing land because all the grass in the mowing pasture was too short to harvest. Forage for feeding animals in winter has been necessary since the late 1980s as herders stopped moving to their traditional winter pasture after the implementation of the LGDCRS. If herders could not harvest forage they needed to purchase it, which was costly, especially in drought years. Suri emphasized: ‘There was only forty-five days for grass growing this year. If there is no rain within half a month, there will be no forage to harvest. Who knows how we will pass the coming winter?’

Due to an ongoing increase in temperature and decrease in rainfall, the surface water in Gonger Village has sharply decreased. In the past, there were at least three ponds in the village, but now they have all disappeared. Two rivers, the Gonger and the Shali, have much less water and even experienced zero flow. Dali Lake is one of the four largest lakes in Inner Mongolia and is located 20 km from the village. It has become smaller and smaller, and the water level has decreased by three to four metres per year. The declining water level in Dali Lake is reflected in the declining underground water-table. As herder Zha Laceng explained, when underground water was sufficient a little rain could help the grassland to recover, but when the grassland underground water dried up it needed more rain to recover.

Besides less rainfall, herders emphasized that an upstream iron mine and water overuse by Datang Company for coal gasification are the most important reasons for the decrease in groundwater and surface water. The rivers have been dammed, with most of the water transferred to meet the demands of mining. Together with less precipitation, less water from the river and the decline in the groundwater level have caused poor pasture conditions.

Briefly, we conclude that precipitation in Gonger Village has decreased in the past fifty-one years, especially in summer. This has caused frequent droughts and more uncertainty in the Inner Mongolian grasslands. Compared with the frequent snow disasters but few droughts in the past, this poses a new challenge for herder livelihoods. Drought has not been caused only by warming and less rainfall; the changing use of rangeland and competition for water resources, both among herders and between animal husbandry and the mining industry, have also contributed to the drought.



## Changes in Grassland Use after the 1980s and its Impacts

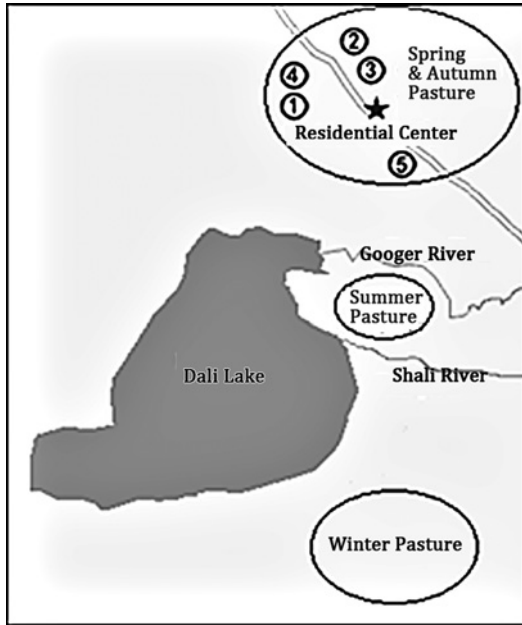
Since the 1980s, there have been two dramatic changes in socio-economic institutions in pastoral areas in Inner Mongolia. One is the implementation of the LGDCRS starting from the 1980s; the other is a series of grassland protection projects starting from 2000, mainly focusing on a grazing ban on both grassland and forest in sandy land. They brought extensive changes to grassland use and hence to herders' capacity to cope with drought, which led to three results: shrinking grasslands, decreasing migration and grassland overuse.

### *Implementation of the LGDCRS and Ecological Protection Projects*

Before the LGDCRS, grassland was used as common pasture for rotational grazing, with all livestock moving between different pastures in different seasons. There are three types of grassland in Gonger Village; sandy land, steppe, and *carex* (sedge) grassland between the two rivers. Figure 4 shows the location of these three types of grassland. Sandy land is used as winter pasture because it is warmer than steppe and the grass turns green early. It accounts for about 30 per cent (or 5,500 ha) of the total grassland of Gonger Village. *Carex* grassland is an area with higher productivity, and these summer pastures form about 10 per cent of Gonger's total grassland. The remaining 60 per cent or so is spring and autumn pasture. These three areas of grassland are quite distant from each other, and it is 50 km between the spring and summer pastures and between the summer and winter pastures.

From the 1960s, local government encouraged herders to settle down to improve their living standard. The village collective selected some parts of the spring and autumn encampment as residence centres for herders to build their houses. The five sub-villages were arranged into different parts, which formed a square. The Second Group and Third Group are in the north-east, the First and Fourth Groups are together in the south-west, and Xin (new) Group is in the south-east. Before the LGDCRS was implemented in the 1980s, herders and livestock moved four times each year to use these different grassland types in different seasons. Since the late 1970s, cutting grass for winter was promoted to cope with snowstorms, and herders selected some flat areas with high grass productivity for mowing grassland. Of the total 18,667 ha of grassland in Gonger Village, 2,667 ha is cutting grassland, which is located on spring and autumn pasture.

The LGDCRS was implemented in Gonger Village in 1983. Livestock were distributed according to the number of labourers in the same year but grassland was not divided until 1997 due to the complexity of grassland division and differences in herder livestock management practices. Herders wanted to have grasslands close to their houses, but each type of grassland was necessary for their livestock. As a result, the grassland was fragmented into very small pieces, ranging from 100  $mu^2$  to 500  $mu$ . Most herder households now have three pieces



**Figure 4.** *The location of seasonal pastures in Gonger Village, and of five sub-villages (Xin Group)*

of grassland, including all three types of grassland. It was assumed that herders would continue with traditional mobile grazing, but in reality, most herders have not been returning to the summer or winter pastures because they have not had enough labour to do the herding after the large livestock herds were divided into small herds for individual households. Some have transferred their winter pasture to other households but some have just abandoned it.

After 1997, herders began fencing their grassland. Different types of grassland had different fencing methods and even for one type of grassland different sub-villages had different processes. The summer pasture between two rivers is not fenced at all because fences would create too much trouble for grazing and watering livestock. This pasture is still used in common, and every household has a contract for an amount of summer pasture but nobody knows the exact location of their allotment. For winter pasture, every household has a piece of sandy land, but only a few households have fenced it because it is too far from their houses. Nearly every household has fenced its spring and autumn pasture, and different sub-villages have experienced different results from fencing their spring and autumn pasture. The First, Second and Third groups now have fences on each individual household's grassland. The Fourth Group fenced its herders' grassland as a single unit. In Xin Group, every three or four households cooperated to fence

their grassland together. Herders explained that the reason for these different fencing methods was grassland quality and the promotion of fencing projects. For example, Xin Group and the Fourth Group had support from local government to fence large areas because the groups thought the grassland would be degraded if it was fenced into very small pieces. But the First Group had high quality grassland and so they chose to invest in fences to protect their grassland from use by other herders.

To enable the degraded grassland to recover, government initiated two grassland protection projects in 2003: Beijing–Tianjin Sandstorm Sources Control Project, and Natural Forestry Protection Project. The main measure implemented by these projects is a seasonal grazing ban in spring. Herders had to buy large amounts of fodder and forage to feed livestock in sheds from 1 March to 1 June. After these projects finished, with support of some herders in Gonger Village, the Forestry Authority of Hexigten Banner initiated another forest protection project, which enclosed part of the winter pasture of Gonger Village to allow vegetation to recover. Grazing was totally forbidden in this area, and herders who lived inside were required to move out. As supporting measures, both the county government and the Forestry Authority of Hexigten Banner provided 9,000 yuan for every household. Householders paid 8,000 yuan to build a house.

### *Impacts on Grassland Use and Livestock Breeding*

The implementation of the LGDCRS and ecological protection projects has had three main impacts on grassland use and livestock breeding: decreasing strategic mobility, shrinking grassland, and overusing spring and autumn pasture. After livestock were distributed to individual households in the 1980s, the number of herders going to winter pasture gradually decreased. Until 1992 about two-thirds of households still moved to the sandy land in winter. However, after the grassland was divided in 1997, this proportion decreased sharply. There were two reasons for this decrease. One was the labour shortage, as under the LGDCRS every household managed their livestock production independently. Without cooperation between herders it is difficult for individual households to move livestock to the remote winter pasture. The second reason was that neighbouring villages occupied and used the winter pasture in summer.<sup>3</sup> They left little grass for the livestock of Gonger Village to use in winter. In 2009, herders decided to convert their winter pasture to forest conservation land monitored by the forestry authority to control its misuse.

When most summer pasture and winter pasture was abandoned, the total pasture used for grazing shrank. Among the thirty-one interviewed households in 2011, we collected information about winter pasture use from twenty-six of them. According to these data, only two households still used their winter pasture, five households rented it out to their relatives or other herders, fifteen households stopped using or renting due to the forestry authority project, and three households

had abandoned their winter pasture several years ago. The average grassland areas of these households are: 486 *mu* cutting pasture, 1,457 *mu* grazing pasture and 833 *mu* sandy land, so the average total area is 2,776 *mu*. However, the average pasture area used by each interviewed household is 1,422 *mu*, accounting for only 51.2 per cent of their contracted grassland area.

From the late 1980s, more herders settled in the spring and autumn pasture. They built houses for themselves and barns for livestock. The cutting pasture was also the spring and autumn pasture. Many herders grazed their animals on spring and autumn pasture throughout the year, leading to overuse. Herders observed that after five years of serious drought the grassland had become much worse than before, with yields reduced by half or more compared to a decade earlier. Moreover, livestock cannot get enough nutrients within one type of grassland yet they cannot go to other pastures any more. In the interviews many herders reflected that cattle had deficiency diseases and they ate everything, such as cloth, plastics and bricks.

In summary, the implementation of the LGDCRS brought tremendous changes in grassland use in Gonger Village, and ecological protection projects imposed further limitations on livestock grazing. Most herders abandoned seasonal movement and stopped using the winter pasture. Nearly all the spring and autumn pasture was fenced and overused. All these changes have led to herders' vulnerability to drought.

## **Herders' Vulnerability to Drought**

As stated above, drought caused reduction of water in rivers and ponds, while grassland productivity decreased sharply. Confronted with water and fodder shortage, herders took various measures.

### *Measures to Solve Water Shortage*

Digging wells is a common measure to solve the problem of water shortage. According to our interviews in 2011, most households now depend on well water. However, due to the uneven distribution of groundwater not every household can have a well. For the First and Fourth groups, most households have their own wells. But for the Second and Third groups, they only have one pumped well. The Xin Group has four common wells. Because of the drought and water resource use by the mining industry, groundwater levels have fallen rapidly. Before the year 2000 there were several wells of less than ten metres, but in the late 2000s, villagers needed to dig over 30 metres to reach water. In 2010 the local water conservancy bureau supported Gonger Village to dig a pumped well 150 metres deep, at a cost of 100,000 yuan.

Even though villagers can provide livestock with enough water with the support of local government, there are still three problems leading to an increase

in the cost of livestock breeding. First, compared with water in the lake and rivers, which is exposed to the sun, the well water is too cold for fattening livestock. Second, the fall in water in the two rivers caused the under-utilization of summer pasture. Now herders have to move back from the summer pasture to the wells in the spring pasture before summer has ended. Early use of autumn pasture forces herders to buy more fodder and forage in winter. Lastly, with substantial water extraction by the mining industry, herders are forced to dig ever deeper wells, with high costs both of digging and pumping water.

### *Measures to Solve Fodder Shortage*

The traditional adaptation to drought is to move to other pastures and is called ‘*Otor*’ in Mongolian. When herders encountered drought, they could move animals to unaffected or less affected pastures. It is local custom in pastoral society to allow herders to use other people’s pastures. In the 1960s and 1970s before the LGDCRS was implemented, herders could move long distances to avoid disaster, with coordination by the government.<sup>4</sup> This was a reciprocal system in nomadic society that strengthened herder capacity to combat drought. After grassland was leased to individual households, the *Otor* was halted because herders were unwilling to accept others grazing livestock on their land without payment.<sup>5</sup> When migration stopped after the LGDCRS there were four choices for individual herders who experienced difficulties during drought: the first was to sell livestock, the second to rent pasture, the third to plant forage and the fourth to buy fodder.

Many households reduced their livestock population because of drought. The sheep population of the whole village decreased from 10,647 in 2005 to 7,375 in 2010. The total livestock population reduced from 23,347 SSU (Standard Sheep Unit) in 2005 to 19,850 SSU in 2009, but it then recovered to 22,965 SSU in 2010. Herders need to maintain their livestock above a certain number to maintain their livelihoods. If the herd falls below a certain size, the herder would slide into poverty that is difficult to reverse. Based on our calculations, about one hundred sheep are needed per person to maintain this level. The relationship of herders and livestock is similar to that between enterprises and machines, or farmers and land. They did not want to reduce their livestock but drought forced them to sell some of their animals to survive.

When grassland was leased to individual households, some herders rented pasture to supplement their fodder shortage, which is more difficult in drought years. Normally the herders rented cutting pasture, not grazing pasture. To rent a piece of grassland for harvesting forage was cheaper than buying fodder. For instance, Si Qin, the chief of a sub-village, rented pasture to harvest forage for many years. In 2006, 5,000 yuan was enough to rent a piece of pasture, and in 2009 he spent 7,000 yuan. But he could not find pasture to rent and had to buy forage directly in 2010. Normally, herders rent pasture for short periods – usually one year. When serious drought occurred, herders would not rent it again

afterwards because there was probably no grass for cutting. If the pasture was still good, the price would have increased dramatically. Siri Guleng complained about the increased cost of renting pasture. In 2009 he paid 16,000 yuan for a 69 *mu* pasture, or around 230 yuan per *mu*, but in 2010 he paid 30,000 yuan for 100 *mu*, or 300 yuan per *mu* and it was not as good as the pasture in 2009. In 2010 most herders stopped renting cutting pasture because they could not find good pasture.

Herders also wished for other ways to obtain cheap fodder to maintain the balance in their livestock production. Cultivating grassland for forage, mainly corn, was a common strategy in Inner Mongolia. In 2009, Gonger Village planted a forage field. Most herders hoped this forage could reduce their livestock production overheads. The cost for cultivating the land and digging wells was funded by the government. More than 1 million yuan was invested in land development and well digging, but a further 200,000 yuan was needed to install irrigation equipment. It was estimated that the fodder grown in the field would be cheaper at one-quarter or one-third of the cost of forage on the market. With cheap fodder, livestock production would be profitable. But herders had two doubts: first, if the government investment was included in the calculation, planting forage might not be profitable. The second was the impact of irrigation on the underground water, lowering the water-table, so that the irrigation might not be sustainable. As they did not find anyone to provide the 200,000 yuan to install the irrigation equipment, the field was not planted in 2010. They still needed to buy a large amount of forage.

If herders did not want to sell all of their animals they needed to buy fodder during drought. Herders recalled that ten years ago, only a few households bought a very limited amount of forage. When drought was not serious, animals could be grazed in winter and spring and so the forage they prepared was mostly for the pregnant animals and new-born animals. They could harvest fodder from the mowing pasture. When droughts were more serious herders needed more forage, but with almost no harvest from cutting pasture it was necessary to buy forage. As droughts continued and more herders bought forage, the price of forage kept increasing. For instance, in the late autumn of 2009, forage was sold for about 0.5 yuan per kg but in late winter, when less forage was left, the price increased three or four times. The increasing cost of forage made it difficult for herders to maintain a profit from their livestock production.

Suri, the village chief, mentioned: 'Before 2005, there was no need to buy forage. The forage harvested from mowing pasture was enough for them. But after that, they needed to buy more and more forage.' For his household about 40,000 yuan was spent on forage in 2009, but income was only about 60,000 yuan. To cover all his costs, especially of forage, he had to borrow 50,000 yuan.

Zha Lazeng, the former village chief, bought forage for four years. In 2009 he sold livestock for about 40,000 yuan but spent 20,000 on forage. Drought made the livestock production a loss. A few years ago incomes might have been lower than the present, but costs were also relatively low so he was never in debt. Now,

after he had paid the forage and other costs, he could not make a living by just relying on income from livestock. He borrowed 10,000 yuan in 2009.

These two households were relatively well off within the village. For the other households, the impact of drought on their livelihoods was even worse. Another woman named Si Qin married into the village in 2004. Since her marriage, her family borrowed money every year. As the weather became drier, their life became much worse. In 2005, her family rented a piece of rangeland for 800 yuan and harvested 10,000 kg of forage. As the weather became drier it was difficult to rent pasture which they could harvest for forage. They started to buy-in forage at very high prices, especially in a dry year. In 2007, she had spent a few thousand yuan for forage, but in 2009 it rose to about 30,000. To afford the cost of forage Si Qin borrowed a large amount of money. By 2010, the loans totalled 70,000 yuan.

Based on the above analysis we can see that herders became more and more vulnerable in coping with drought. First of all, they lost their most important advantage in livestock production, the use of natural grassland, which was free of charge. All the herders paid high costs to buy fodder. According to their calculations, if a sheep was fed solely with purchased fodder, then at least 3 kg were needed each day, which cost about 3–5 yuan. If the period of feeding lasted for six months, then the forage alone would cost 500–700 yuan, whereas the best price for one lamb was 400–600 yuan.<sup>6</sup> As a result, herders' livestock decreased but their loans increased. In 2010, about twenty households, or 25 per cent of all households in Gonger Village, had no livestock. It was evident that feeding animals with forage purchased from the market was unsustainable.

All the households we visited had at least some loans. Credit providers included the Rural Credit Cooperative (RCC), store owners and moneylenders. The RCC was the only formal finance institution in this pastoral area. Interest rates were relatively low, but loans were not easy to access, especially for poor households. Normally store owners sold commodities to herders in advance and collected payment when herders sold their animals. When they sold commodities in advance the prices were high. If herders could not pay back on time they would have to pay interest. According to the Gonger Village shopkeeper, about 10 per cent of herders bought on credit ten years ago, but the proportion increased to 50 per cent by 2010 of whom 20–30 per cent were unable to pay back within the year. Due to drought, moneylenders in the pastoral area increased in number, charging very high interest rates. As more herders relied on credit to buy fodder and their daily necessities, the interest on the loans also increased. In the interviews with local herders the highest interest rate was 36 per cent annually. After five years of continuous drought all the herders relied heavily on informal finance, which affected their livelihoods. Normally they would not have ready cash so they bought most goods on credit. This led to a vicious cycle. Each autumn, when they sold their animals, they needed to pay what they owed to the fodder sellers and store owners. The better-off households did not have much

cash after they paid their debts. For others, the income was not even enough to pay off the debt, so they took out new credit to repay the old one. After May, no households in the village had cash in hand.

### *Cooperation and Mobility as Adaptation to Drought*

To adapt to serious drought, some herders restored herding mobility. They understood the importance of mobility from their herding experiences. With rotational herding, the summer and winter pastures would be used which could protect the spring and autumn pasture. Balanced use would not only protect the grassland but also reduce demand for costly fodder. But the difficulty with using winter and summer pastures was social: how to reduce the labour needed and how to prevent the use of winter pasture by herders from other villages.

Suri overcame these difficulties through cooperation. In contrast to other herders, Suri did not stop grazing the winter pasture. Every winter, he coordinated with his brother-in-law. He said that in most cases, animals had to be fed fodder for three to six months from January, or from November in the case of severe drought. But Suri fed his animals after they came back from the winter pasture, which was usually in March. Two or three months less of feeding means a large amount of forage saved. How could he continue to use the winter pasture when others had stopped? Suri explained it was because he cooperated with his brother-in-law. The two households had worked together to enclose their winter pasture. In winter the two households would take turns to send their labour to care for the livestock grazing there.

In the face of continuing drought Suri collaborated with seven other households to form a group to graze cattle on the summer pastures. The village enclosed a piece of summer pasture in 2009. From 2010 the village heads decided to give the pasture to the sub-village to use. Single households could not use it because the labour in any one household was insufficient. However, eight households were able to use the pasture collectively. All of their cattle grazed there. Each week the eight households sent three herders from different households to stay in the summer pasture to care for the animals.

Pastoral mobility could enhance the herders' capacity to deal with drought by rationalizing their use of rangeland resources. From Suri's case, we can see the opportunity for mobile herding. There are three preconditions for herders to increase their cooperation and mobility. The first is common use of grassland. Xin Group did not divide its grassland among individual households and the herders used grassland in common. This has provided a basis for herding cooperation and a large area of grassland to facilitate mobility. Second is local regulation or institutions. There should be regulations that address grassland use and division of labour. Some procedures to resolve conflicts are also necessary. These regulations should be worked out from the bottom up and not by official regulations. Finally, reciprocity between herders plays an important role in herders' cooperation, not only within one herder group, but also between the



different groups. The latter is the most important as it affects herders' flexibility in coping with natural disasters. However, after nearly thirty years of the LGDCRS being in force, most herder communities have lost these relationships and this has made it difficult to establish cooperation among herders.

## **Discussion and Conclusion**

In line with the global trend, Gonger Village is confronting rising temperatures but little rain and increasing fluctuation in climate. However, as in Mearns and Norton's (2010) findings, the main reason why these factors became a threat to herders and made their livelihood unsustainable was unreasonable policies. Moreover, zero flow of rivers and decrease of groundwater caused by mining industry development have made Gonger grassland vulnerable to drought. Since the LGDCRS was implemented, the system of grassland use has changed to a large degree, especially in the shrinking use of summer grassland and sandy land for winter, leading to the decrease of available grassland area in practice. The concentration of livestock on a smaller area caused grassland overuse, which further exacerbated the effect of drought. Herders had to rent grassland or buy fodder and forage to feed livestock. However, the price of fodder and forage soared during the drought, which increased the cost of livestock breeding and reduced herders' income. Most herders fell into debt, and some poor households could not even sustain their livelihood. All these factors show that drought in pastoral areas is not only a natural phenomenon but also a kind of social problem. To cope with the consequences of drought, herders took two different sets of measures. Some herders dug wells to solve the problem of water shortage. In order to alleviate fodder shortage, herders had four countermeasures: reducing livestock numbers, renting grassland, planting forage and buying fodder. Even though these measures did alleviate drought impacts in the short term and government had invested large sums to support them, especially on planting forage, all of these measures led to a rise in the cost of livestock breeding, shrinking herds and high market risk. In serious drought, herders had to reduce livestock, which is the last resort in adapting to drought. However, due to the low disposable income and high cost of livestock breeding, recovery of livestock numbers after drought became more and more difficult. As a result, herders fell into debt and then poverty.

Compared with the dominant strategy of forage plantation, which is very costly, some herders in Gonger Village have developed cooperation and mobility to cope with drought, based on the institutions of common grassland use and reciprocal relationship with their relatives. Through cooperation, they used winter and summer grassland efficiently once again, which helped them to increase their adaptation to drought.

The climatic characteristics of dryland Inner Mongolia, including low precipitation, high variability and unpredictability, have been the most important factors for herders to grapple with in livestock breeding. For generations, herders' choice of strategy to cope with this uncertainty has been mobility, following grass and water resources (Scoones 1994; Humphrey and Sneath 1999). On the one hand herders need stable use rights for key resources which play an important role in livestock breeding. On the other hand they need flexible access rights for grassland resources, and social relationships which are adapted to the ecological, climatic, political and economic uncertainties (Fernández-Giménez 2002). All of these need herders to cooperate to move their livestock to track available resources in a large area of grassland, and thus solve the problem of labour shortage. Besides the institutions of cooperation at the local community level, it needs both local government and central government to build a management system to support this kind of cooperation and reduce the conflicts over grassland use between and within local communities. Therefore, instead of 'clarifying' land usufruct for herders and fencing grassland, government should pay more attention to the grassland management institutions of local communities to protect grassland.

## Notes:

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- 1. 1 USD = 6.5 yuan (May 2011).
- 2. A Chinese unit for area, 1 ha = 15 *mu*.
- 3. Before the LGDCRS, few herders stayed in the sandy land, except during winter. However, to implement the LGDCRS, different villages used different methods. Some villages, like Gonger, focused on their traditional use of grassland and every household received three types of grassland. However, some other villages divided grassland completely and distributed only one large piece to each individual household. As a result, some households only received sandy land and so they stayed there throughout the year. This made it possible to trespass on the winter pasture of other villages when there is no herder living there in summer.
- 4. Shuren Liu, personal interview, July 2010.
- 5. Grazing animals from other villages has not been allowed since the 1980s. It was considered that animals would aggravate the pressure on grassland and then cause damage to other villagers. Only the powerful herders could graze their animals in another village, including during natural disasters.

6. The interview was conducted by Xiaoyan Yu in July 2010. In the pastoral area, herders normally sold year-old lambs and kept adult sheep for reproduction. The major income from livestock production was selling lambs.

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**Xiaoyi Wang** is a senior research fellow and Professor at the Center for Rural Environmental and Social Study (CRESS), Institute of Sociology, Chinese Academy of Social Sciences. He graduated from Nankai University and majored in Sociology. He has published a series of books and articles on rural sociology, in particular on rural poverty, rural environment and community development.

Email: xywang@cass.org.cn

**Qian Zhang** is an associate research fellow at the CRESS, Institute of Sociology, Chinese Academy of Social Sciences. She earned her Ph.D. from Peking University with a study on grassland tenure and its impacts on the ecosystem in Inner Mongolia. She has published on the ecological, social and economic reasons for grassland degradation.

Email: zhangqian@cass.org.cn