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RESEARCH ARTICLE

Poverty under drought: an agro-pastoral village in North China

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How did the drought, which lasted for a few years in Inner Mongolia, impact on the livelihood of local citizens? Did the policies and practices to cope with the drought work well if assessed from a long-term perspective? This article aims to answer these questions informed by a case study in Horqin Sandy Land in Inner Mongolia. The research indicates that continuous drought, perceived to be a result of climate changes, has significantly increased costs of crop farming and livestock breeding. However, government countermeasures did not reduce the impact of the drought but increased costs further. As a result, villagers became more and more exposed to serious risks, and many were not able to avoid falling into poverty.

Keywords: drought; poverty; vulnerability; agro-pastoral community; Inner Mongolia

Introduction

Reducing or alleviating poverty in pastoral areas in North China remains a major governance challenge because of limited natural resources, backward livestock production and frequent natural disasters. In 2005, the poverty rates in Inner Mongolia, Gansu, Qinghai and some provinces in Western China was 5%, which was twice of the average level of rural areas of the whole country (China Development Research Foundation (CDRF) 2007, p. 41). Taking Xilingol Prefecture of Inner Mongolia as an example, the poverty population increased from 150,000 in 2000 to 180,000 in 2001, and it doubled in Sunite Right Banner, which is one part of Xilingol Prefecture (Tuya 2004). In the 24 pastoral counties of Inner Mongolia, the average livestock number held per person had decreased from 108 in 1998 to 33 in 2004 (Dalintai 2006). Besides three well-recognized reasons for rural poverty, that is, low farming income, and high expenses for health care as well as for education (CDRF 2007, p. 41), drought has become a more and more important factor causing poverty in pastoral communities in North China during the recent 10 years. Under the impact of global climate change, the climate in different regions in Inner Mongolia has different features, but there is a common trend of warm and dryer climate (Lan 2007). Although rural poverty reduced dramatically in the whole of China due to economic development and public policies, drought decreased the amounts of available natural resources significantly in ecological vulnerable area, where local people totally depend on these natural resources to make a living.

Normally, herders would suffer transitory poverty after drought (Little *et al.* 2008). They would lose many livestock and fall into poverty, but could get out of poverty after

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their herds recover themselves, which would take 3 or 4 years without continuous drought. However, the inappropriate impact of government policies on natural resource degradation has made herders falling into chronic poverty. Livestock number limitation and increasing feeding costs have made more and more herders falling into chronic poverty. Since the end of the twentieth century, grassland degradation has attracted concerns of both the central government and the public by several serious and large-scale sandstorms. Herders were blamed for destroying grassland because they had too many livestock, which overgrazed natural vegetation (Zhu and Liu 1981, p. 29, Li 1997, SEPA 2001, Chen 2005). Therefore, a series of policies on eco-conservation were applied to protect rangeland. Among these policies, the grazing ban policies were more affective in pastoral societies. The main method of grazing ban has been to decrease livestock population and stop grazing on natural grassland seasonally or even the whole year. Unfortunately, the policy did not recover degraded grassland as expected, but aggravated rural poverty.

This article is divided in four sections. In the first section, the case study site is introduced. In the second section, the process of villagers' falling into poverty by drought and land degradation is being described. The changes in farming and livestock husbandry caused by drought made villagers poorer than before. The third section focuses on why the institutional arrangement to cope with the grassland degradation did not improve environment, but rather *increased* the vulnerability of local livelihood. The last section discusses the transition of villagers' livelihood and increasing vulnerability of the community. Finally, some general conclusions are being presented. Unless the government recognizes the impacts of drought on local livelihood and facilitates villagers to cope with these impacts, it is impossible to achieve success of poverty alleviation and grassland restoration.

Introduction of the case study site

Baiyin Haga, located on the edge of Horqin Sandy Land, is a typical agro-pastoral community. There are about 260 persons living in more than 70 households. In the 1980s, more than 20 households moved to the northern pastoral area at the call of the local government. Therefore, compared with population in the 1980s, the population of this village decreased. Hence, if we are only concerned with the size of available farmland and grassland, the resources held per person increased. However, due to the drought and consequent land degradation, farmland area and grassland production decreased significantly, which made it difficult for villagers to make a living.

Even though most of local people are Mongolian, they have conducted crop farming for a very long time. In the collective era¹, Baiyin Haha, people were mainly depending on crop farming and had very limited livestock. According to Nadamuer, an old villager, there were about 500 sheep, 300 cattle and 100 horses at that time. Besides the 1500 mu² cropland in their village, 5 mu per person, local government assigned 2000 mu high-quality farmland to Baiyin Haga, which was 100 km far away. The income from this land had constituted a main part of the villagers' income. In general, the crop farming and livestock breeding in the collective era were underdeveloped because of the backward mode of production and unreasonable institutions of the commune, but the villagers were, despite this, able to be self-sufficient in food production.

The rapid improvement of community livelihood since the early 1980s ended around 1998. In this period, the increase of villagers' income stemmed from two sources: one was a continuous extension of farmland and the other was development of the livestock population.

Large amounts of grassland were reclaimed in the 1980s and 1990s, which brought villagers increasing income. In the early 1980s, the Household Responsibility System (HRS) was introduced to pastoral areas in Inner Mongolia. The main purpose of this reform was to break the extreme equalitarianism of distribution and stimulate economic development. After this reform, each villager was allocated 5 mu of farmland. This policy reform stimulated local enthusiasm because all productive surpluses were retained by villagers themselves. Therefore, every household cultivated part of their grassland and, hence, extended their farmland and increased their income as long as they had enough labour and were willing to work hard. Because the local government could collect taxes on crop farming, they did not take any measures to stop grassland reclamation and only increased the area for tax collection from 5 mu per villager to 20 mu in 1993.

Some villagers recalled their farmland area at that time. The couple of *Zhou Qi* was famous in the village due to their capability of exceptionally hard work, and they had about 50–60 mu farmland to plant *mung* bean and some other land to plant corn. *Mao Naohai* had almost 200 mu farmland at that time, which could produce 20,000 kg corn and some other crops. All this land was rain-fed farmland. Villagers had deposits made possible by income from crop selling. The farmer *Yinshan* recalled that he had over US \$2000 in savings before his marriage. However, in 1997, the local government issued an injunction to limit farmland area to 8 mu per person. All the surplus farmland should be converted into grassland. This objective was achieved after year 2000. Yet, continuous drought after year 2000 made it impossible for the villagers to extend farmland area because most farmland is rain-fed. Moreover, local government has strengthened land management and monitoring, and the reclamation of grassland is totally forbidden.

Livestock breeding grew rapidly after the implementation of the HRS, especially after the development of the grassland cultivation initiative. According to Jingui, a villager of Baiyin Haga, there was only about 1000 livestock around 1990 in the village, which equals to about 2500 sheep units.³ It increased to 5000 sheep units in 2004. There was a trend that sheep population was growing but cattle population decreasing because the reproductive rate of sheep is much higher than that of cattle, which means more profit from sheep. The rapid development of crop farming had supported livestock increase from two aspects. The cash income from crop selling brought enough funds for villagers to enlarge their herds. Meanwhile, the straw and surplus crops provided plenty of forage for livestock. Even though the balance of vegetation production and livestock population was put forward after the implementation of the HRS, the supervision and management lagged behind seriously. Local government had no incentive to limit livestock population because they collected tax based on livestock number.

However, with the impact of frequent droughts and grassland degradation, the increase in villagers' income ceased. Both area and productivity of farmland decreased and livestock herds shrank due to high productive cost. When we did field work on which this article is based in December 2007, villagers had suffered several dry years after 2004. The drought exerted a series of impacts on crop farming and livestock breeding. However, both central and local government paid much attention on grassland degradation rather than poverty increase in local community. It was even worse that the countermeasures to grassland degradation increased villagers' productive costs further, which in effect aggravated their poverty.

The policy of *carrying capacity management* (CCM) and the project of grazing ban had been implemented for over 5 years. Carrying capacity of grassland is the maximum number of livestock that an area's grassland can sustain indefinitely without significantly depleting or degrading grassland. In order to protect grassland from overgrazing, the CCM

was put forward after the HRS was implemented at the beginning of the 1980s, but it had not been carried out until grassland degradation became a problem after year 2000. In Inner Mongolia, it is expressed as the amounts of grassland area in 'mu' that can feed one sheep unit based on the calculation of vegetation productivity of grassland. The local grassland monitoring bureau is responsible for counting livestock number of each household in every spring to see whether there is overgrazing. Different from the CCM, which focuses on the control of livestock population, the purpose of the grazing ban project was to protect grassland through forbidding livestock grazing on grassland in spring, which is supposed as the time that grass begin to sprout. Villagers had to feed their livestock in pen but they could get some compensation from the central government. In conducting our local research we were soon convinced that it was urgent to review the impact of these projects to provide a more robust basis for policy making in the future.

During 2 weeks of fieldwork in December 2008, about 25 households of Baiyin Haga accepted to be interviewed, which accounted for one-third of the whole village. These 25 households covered rich and poor people. Meanwhile, we put much emphasis on making interviews with village leaders and their predecessors, who could provide more historical information on the village. The interviews were conducted by using open questionnaires. It focused on several aspects of villagers' livelihood, including change of crop farming practice and livestock population, productive income and cost of crop farming and livestock breeding, poverty incidence and the control measures, and impact of drought and the effects of the projects to conserve grassland.

How droughts affect the livelihood?

Under the impact of global climate change, the climate has become increasingly warmer in China's arid areas over the last 50 years, especially in winter time (Wang *et al.* 2008, Gao *et al.* 2010). The climate of eastern parts of arid areas in Inner Mongolia has changed greatly, and temperatures have shown continuous increase (Li *et al.* 2008). From 1961 to 2007, the average annual temperature in China's dryland increased 1.8, and the linear change rate was 0.39 every 10 years (Zhang *et al.* 2010).

According to the local weather bureau of Wulanhaote, covering the weather forecasts of Baiyin Haga, the average annual temperature from 1999 to 2008 increased by 0.68 (Wang 2010), which was much higher than the average level of the whole dry land in China. Meanwhile, the average annual precipitation of Wulanhaote in the same 10 years decreased from 440 to 310 mm (Wang 2010). In interviews, villagers confirmed the trend of warmer and drier climate. According to old villagers, the rainfall was abundant and the vegetation grew well before the 1980s. However, there were no data to verify the exact amount of rainfall in Baiyin Haga before 1980. Yet, the fact is that villagers used to cultivate land in the higher slopes of the valley because the lower lands were always flooded before the 1980s. They have now changed to planting crops in the lower areas. The lands on the ridge had been abandoned due to water shortage.

The impact of drought on villagers' livelihood was not a simple 'linear' mechanism, but rather complex. Based on the information collected from interviews, Figure 1 shows the impact of drought on crop farming and livestock breeding, and how these result in poverty through interaction of the various factors. Drought did not only decrease in the farmland area, but also changed the traditional crop farming practices, which brought negative ecological effects and land degradation. For the livestock breeding, drought decreased vegetation production and the livestock reproductive rate. Villagers needed to sell more livestock and buy more forage to sustain their herds. As Figure 1 demonstrates, the impact

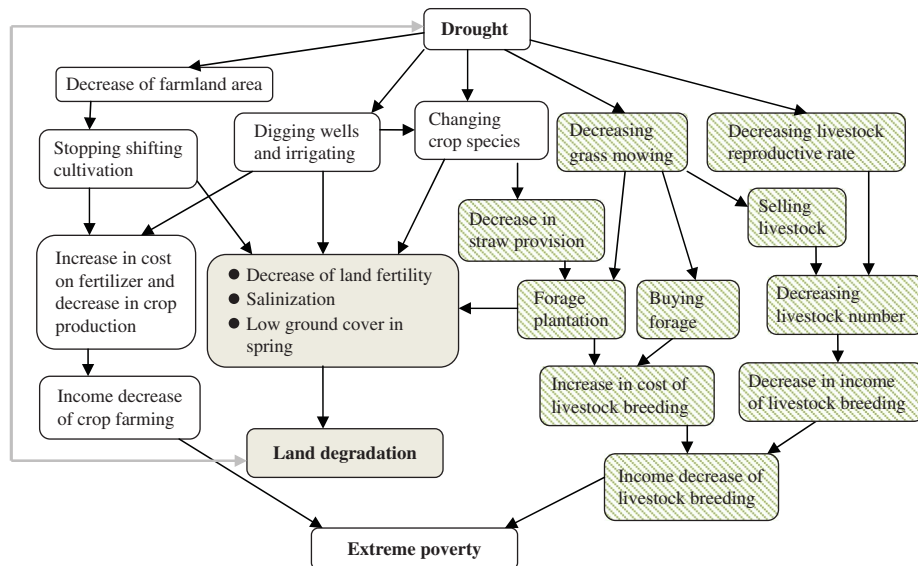


Figure 1. Impacts of drought on crop farming and livestock breeding in Baiyin Haga.

Note: The left part is the impact mechanism on crop farming, and the right part with shade line is the impact mechanism on livestock breeding. Grey boxes show ecological results of the change of traditional crop farming practices.

of drought was an accumulative process, in which drought and land degradation were mutually strengthened. As a result, it caused increased poverty among the villagers.

From the perspective of crop farming, the first impact of drought was a decrease in available farmland area, which made shifting cultivation impossible. Villagers had to abandon more and more ridge land and move to lower land for cultivation, but in some areas, it was impossible to cultivate lower land without irrigation. Moreover, local government had forbidden villagers to enlarge the area of their cultivated land, and the area of crop farmland shrank greatly. Therefore, villagers stopped the traditional shifting of cultivation. In Baiyin Haga, shifting cultivation had two purposes. One was a shift between reclaimed and abandoned cultivation. Because there was no additional fertilizer added in the soil, villagers always abandoned part of their farmland and reclaimed part of the grassland. After several years of recovery, the abandoned land would be cultivated again. However, drought made it difficult to recover the abandoned lands, which prevented this kind of shift of cultivation. The other purpose of shifting cultivation was to alternate between grain crops and oil crops. When there was plenty of farmland, villagers preferred to follow this alternation because it could promote the recovery of land fertility and reduce soil erosion. However, the decrease of farmland area made it impossible to continue these alternations in modes of cultivation. Villagers had to plant the same crops year after year and depended on fertilizer to maintain land productivity.

The second impact of drought was the digging of wells and irrigation. It did not only increase productive costs greatly, but also caused land salinization. In Baiyin Haga, villagers began to dig wells to irrigate farmland around the end of the 1990s. In the beginning, the wells were shallow and equipped with handy pumps. In the early 2000s, an Australian sponsored aid project introduced large and deep wells in the village, which were more

effective.⁴ Villagers relied more and more on the large wells for their farming. However, for some farmland with long and narrow shape, the pumped water could not reach the end of the land. Even with eight deep wells in the village, they could not meet water requirements of cultivation. Therefore, many villagers began digging wells on their own farmland. For example, Zhou Qi did not only dig a well on his farm but also dug one well on forage planting land.

The development of irrigation changed the mode of production in Baiyin Haga from low-invest and low-output to high-invest and high-output agriculture. In the past, villagers did not irrigate land and they used little fertilizer. The land productivity was mainly depending on labour investment. Therefore, the risk of production in terms of losing capital on failed investments on fertilizers and other equipment was very low. After irrigation developed, villagers had to invest a lot in seeds, fertilizer, irrigation and all kinds of agricultural machinery. The land productivity had depended on capital investment but not labour. According to villager Wuritu, it was very difficult to make money from crop farming for villagers without enough funds even though there was a lot of agricultural compensation. Many villagers had to borrow money to rent agricultural machinery and buy seeds and fertilizer. After paying the rent fee and interest, there was almost no net income left. Moreover, irrigation of groundwater caused land salinization, which led to decrease of land productivity.

The third impact of drought on crop farming was changing crop species, which was caused by two factors. One was irrigation development. As the temperature of pumped groundwater was too low, the crop could not grow until the land surface got warmed after exposure to sunshine. The other factor was sandstorms brought by drought. According to villager Shuangxi Bayer, it was more and more difficult to plant early spring crops, such as corn, because they would always be destroyed by sandstorms. Now corn was one of the important forage for livestock in Baiyin Haga. Meanwhile, villager maintained stubble of corn in land in winter, which was favorable to protect soil from blowing away. However, villagers tended to change corn to late spring crops, such as *mung* bean, due to more and more serious droughts and sandstorms. This change of crop species caused increasing land degradation and decreasing forage for livestock.

From the perspective of livestock breeding, the first impact of drought was decreasing amount of grass mowing. In agro-pastoral areas, grassland area per capita is small. In Baiyin Haga, the grassland was 20,000 mu, among which there were 2000 mu for grass mowing. When the HRP reform was implemented at the beginning of the 1980s, all the grazing land was divided between households. However, villagers could not mow grass anymore because of drought. Moreover, large amount of grazing land had been reclaimed at that time, which pushed animals out to mowing grassland. Therefore, the original mowing grassland became common grazing area. Until the last part of mowing grassland was cultivated for forage plantation under the AusAID project, all mowing grassland vanished. To meet the forage requirement of increasing livestock, villagers had three ways of adaptation: (a) forage plantation, (b) buying forage and (c) selling livestock.

As noted above, the decrease of crop farmland caused shortage of storage for livestock. When the grassland management project of AusAID was introduced in Baiyin Haga, part of the mowing grassland was reclaimed for forage planting. Every household was distributed 10–20 mu forage planting land. However, due to lack of fund investment and drought, most of forage planting land could not provide the expected level of forage.

Villagers had bought grass to make livestock survive in winter for over 10 years because they could not mow grass themselves. The cost on buying forage, however, was increasing year by year. On the one hand, the price of grass increased rapidly. In 2006, the price of

grass of one agricultural vehicle was about US \$60, but it increased to US \$74 in 2007. On the other hand, the purchased volume of forage was increasing due to lower production of natural grassland and decreasing straw in farmland. Moreover, the grazing ban policy compelled villagers to buy more grass because they had to feed livestock until June, which will be discussed in the next section.

The year 2007 was a very dry year. Zhou Qi bought four vehicles of grass and five vehicles of straw in 2006, but in 2007 he brought twice of that amount. Jie Daogao spent about US \$200 on forage in 2006. In 2007, he had spent about US \$400, but the forage was still in shortage. Li Shan had sold out over 50 sheep and only retained cattle, but he spent the same amount of money to buy forage as the year before.

To reduce the required amount of grass buying and have cash to buy grass, every household had reduced their livestock number as much as possible. According to statistical data of June 2007, livestock population of Baiyin Haga had decreased greatly. Sheep decreased from 1281 in 2006 to 598 in 2007 and goat from 1006 to 875, yet cattle had a small increase, from 484 in 2006 to 523 in 2007.

The second impact of drought on livestock breeding was decreasing livestock reproductive rate. There were more and more ewes having no lamb. According to villager Mao Naohai, before 1998, 10 ewes could produce at least 7 lambs, but now only 1 or 2 lambs were produced. In 2007, only 1 of his 30 ewes gave birth to lamb, the others were barren or aborted. Even for some households with good labour and plenty of investment, such as Nadamuer, 30 ewes only produced 7 lambs and the others were aborted. Baoshan was a herdsman feeding cattle. He complained that cattle had no estrus due to grass shortage. In 2007, only 30% of cattle gave birth to a calf.

Villagers attributed decrease of livestock reproductive rate to drought and change in farming practice. First, livestock could not get good supply of nutrients due to serious reduction of the palatable grass. Large amount of straw were used to feed livestock, which was much less nutrient than natural grassland vegetation. All these led to prevalent malnutrition of livestock. Second, livestock had to walk longer to find enough grass now, increasing the use of energy to find enough grass. If grass had grown well, livestock could have enough food without going too far. Third, some villagers doubted that the use of herbicide in farming land had impacts on reproductive rate because livestock ate too much straw.

In conclusion, drought had brought great impacts on crop farming and livestock breeding in Baiyin Haga. Villagers had to invest more funds to sustain crop farming. The development of intensive agricultural practices, including irrigation and application of agricultural machinery, had caused some ecological problems. For livestock breeding, increase in cost and decrease of reproductive rate of livestock reduced the villagers' livestock. In pastoral areas, not to have a livestock was an important indicator of poverty. Due to these changes, 10% of total households in Baiyin Haga had no livestock in 2007. Many households depended on loan to sustain their livelihood. Table 1 shows the decrease of livestock numbers of some villagers. All households had large reductions in their herds. Livestock structure had also changed, which aggravated villagers' poverty. There was a trend of cattle increase and sheep decrease, but sheep were more profitable for villagers.

Government's countermeasures to land degradation and drought

After the year 2000, when there were several serious large-scale sandstorms in the spring, governments of both central and local levels had paid much attention to grassland degradation. Different from the explanation of villagers, who thought grassland degradation was

Table 1. The changing of livestock in the households interviewed.

Name of HH	Maximum livestock number		The year of maximum livestock	Livestock number in end of 2007	
	Cattle	Sheep		Cattle	Sheep
Wu Shuanzhu		70	Around 2002		6
Bai Jingui		>200	1998	More than 30	0
Hao laote	30 (Cattle plus Horse)	>200	Around 2002	30 (Horse)	0
Lishan	6–7	120	Around 2000	Around 20	0
Baoshan	8	20	Not known	8	0
Mao Naohai	14–15	0	Not known	6	30
Yinshan	Not known	Not known	Not known	Not known	9
Nadamuer	20	50	Around 2000	18	50
Jin Gaotao	10	260	2002	6	50
Bao Bagen	15–16		Around 2002		60
Bilige	15	50	2000–2002	10	
Bao Jinhu	60	280	2000–2001	30	60
Zhou Qi	30	200	Around 2005	30	40

Note: The number of pig and horse was not included.

mainly caused by continuous droughts, government attributed grassland degradation to overgrazing. Therefore, governmental countermeasures to land degradation and drought covered two aspects. From an ecological dimension, the *carrying capacity management* (CCM) and grazing ban were implemented to limit livestock population and control its grazing time on natural grassland. From a productive dimension, to reduce impact on villagers' income due to livestock decrease, livestock breed improvement was promoted by government to increase profit per livestock. However, due to different reasons, none of these countermeasures achieved their objective of grassland restoration, but aggravated the problem of land degradation and escalated poverty.

In Baiyin Haga, the CCM was implemented with support of the AusAID project, which helped villagers understand the importance of limiting livestock population based on vegetation productivity. However, the implementation was not strictly monitored. There were two shortcomings in the implementation of the CCM, which made it impossible to carry out the management policy. On the one hand, the carrying capacity management standard issued by local government was not the true carrying capacity of vegetation. Vegetation productivity in arid and semi-arid areas varied from year to year based on the change of seasonal combination of precipitation and heat (Liu *et al.* 1998). However, the carrying capacity calculated by local grassland monitoring and management station was almost static and only adjusted every 3 years. On the other hand, the CCM was inconsistent with villagers' strategy to combat drought. In arid and semi-arid areas, herders followed opportunistic strategies in livestock breeding, that is, they were trying to maximize their livestock population in case of good year with plenty of rain to gain profit as much as possible (Oba *et al.* 2000). They would not sell livestock unless they had no alternative because livestock was not only the income source but also the basis for reproduction. After the CCM was implemented, villagers had to limit their livestock population under carrying capacity, which made them lose opportunities to take advantage of good years by keeping more livestock. In fact, as shown in Table 1, villagers automatically followed the CCM in years of serious and long-term drought, for example, in 2007, because they would suffer serious loss if livestock died in winter.

The original objective of grazing ban was to protect vegetation from livestock's eating and trampling in spring time. However, after several years of implementation, villagers frequently broke the demands of this policy, which made them fined by local government frequently. Therefore, for the local government, the implementation of grazing ban had become a new source of income. Grazing ban compelled villagers to feed livestock for at least 3 months (March–June), which meant sharply increased costs. Even though the central government in Beijing provided compensation for grazing ban, it could only meet livestock requirement for about 20 days. Therefore, besides buying more forage, villagers had to graze their livestock with violation of the grazing ban. This kind of covert grazing brought four results. First, it disturbed livestock habit of grazing. To avoid sanctions by ecological monitoring staffs of local government bureau, some villagers grazed their livestock at night. And sometimes villagers drove sheep to run back quickly to escape from fine, which often caused abortion of ewe. Second, to avoid fine, villagers grazed their livestock around village centers, which made grassland unequally used. Grassland around village centers was degraded quickly due to overuse. Third, fine became part of production costs of the villagers, but there was no standard on the amount of the fine. Normally, the staffs took away the livestock and waited for villagers to pay the fine. Some villagers complained that the staffs always took the sheep with best quality. For the local government, it seemed that the objective of grazing ban had become able to issue the fine. The local government issued an informal policy, which promised that they should not fine villagers if villagers paid US \$1.5 per sheep each year. But it did not guarantee that the higher level government, for example, at the county level, would not issue fine. Because the central government in Beijing cancelled all agricultural tax in 2000, the local government lost an important income source. Grazing ban provided a good opportunity for them to have at least some income. Therefore, after several years of implementation, the grazing ban policy had lost its original objective, which was to protect grassland. Grazing was still going on with higher costs, and local government had some profit on it.

From a production perspective, to reduce the impact on villagers' income due to livestock decrease, livestock breed improvement was promoted by government to increase profits per livestock. In Baiyin Haga, cashmere goat and yellow cattle were recommended breeds. Compared with local breed, cashmere goat could produce 0.75 kg cashmere, which was two times higher than local breed. And the improved breed cattle could also be sold at a higher price, normally about US \$150 higher. However, all these improved breeds needed grassland with productive vegetation. Goats needed to be grazed on grassland, and under the grazing ban project, the cashmere goat could not produce the expected amount of cashmere. Moreover, the price of these improved breeds was much higher than local breed, which made it difficult for villagers to buy buck and bull to improve breed. Under the impact of droughts and grazing ban, villagers had to decrease their livestock but did not have capability to improve the breed.

Increasing vulnerability to villagers' livelihood

With seriously decreasing livestock and increasing costs, villagers had to think about other ways to sustain their livelihood and struggle against poverty. In Baiyin Haga, there were four kinds of transitions, including intensive livestock breeding, breed improvement, livestock broking and migrant off-farm working. For most of the villagers, the last one was their only choice because the former three ways needed special funds and social capital.

The villager Jin Gui was a successful example of transition in Baiyin Haga. He gave up feeding sheep and focused all resources on feeding cattle. There was an advantage to

feed cattle because the grazing ban policy was only implemented for sheep but not cattle, which meant that cattle could graze freely throughout the whole year. He planted forage to feed his cattle and pig. It seemed that intensive livestock breeding was a success. However, based on our interview, Jin Gui's income was mainly coming from ploughing for other villagers in spring by using his tractor, which he had bought after selling out his sheep. In 2007, he earned about US \$7400 by ploughing, which was much more than that earned from livestock breeding. He had nine calves in 2007 and had US \$3700 gross income, including US \$1470 from pig raising. The basis for his successful transition includes two aspects. One was a piece of irrigated land for forage plantation. The other was because he was leader of this village. He had extensive social networks and interaction, which helped him get contracts for ploughing.

Bao Jinhu, another villager, was responsible for livestock breed improvement in Baiyin Haga. He improved breed for all his livestock, which brought him high income. Livestock breed improvement had been promoted by government for many years, and there was no bull in Baiyin Haga for a long time. All villagers had to buy frozen semen for mating. Therefore, there was another business for Bao Jinhu to buy frozen semen from Tongliao and resell it to villagers. However, he said that it would be very difficult to continue breed improvement because of drought. Most of the yellow cattle did not have estrus because they were innutritious.

Seeing no future for livestock breeding and crop farming, villager Bagenar became a livestock broker in 2007. He had only 18 mu farmland, among which there were 9 mu farmlands with very low fertility. He sold out his livestock to buy a vehicle. He collected cattle locally and transported them to Tongliao City for selling. From March to December 2007, he had transported and sold over 300 cattle. He could earn US \$7.4 per cattle. He had never done this business before, but now he invested all his funds in it.

Compared with Bagenar, Bilige had more flexibility in his business. He still had his own herds and only resold sheep occasionally. Some dealers asked him to collect some sheep because he was familiar with villagers and could collect sheep with good quality. These dealers paid him commission (US \$0.7 per sheep in 2007). Normally, some villagers sold sheep to Bilige at a lower price because they urgently needed cash. Bilige could resell to the dealers when they returned. The profit in the latter case was, however, not very high, and he decided to turn to other income sources in order to support the schooling of his two children.

Most villagers in Baiyin Haga who did not have funds to invest in other businesses had to go to other places to find jobs. It was their last choice because they did not have any skills but could only do simple manual work. Therefore, income from these jobs was very low. Siqin had depended on short-term jobs for a long time. After his wife fell sick, he had sold out his livestock. Moreover, he had to support two children to go to school. Therefore, Siqin sustained the family by doing short-term jobs. Villagers often called on Siqin if they needed assistance. Sometime, he went to outside ranches to make some money, as salary for short-term jobs had increased greatly from US \$3.8 to \$6.1 per day over the past few years. However, it was still very difficult for him to sustain his livelihood because the job opportunities were unstable.

In fact, villagers regarded migrant work as a last resort due to three reasons. First, even though the salary looked higher than the income from livestock breeding, the living costs also increased greatly, and reduced the real income. For example, there was a distillery near Baiyin Haga recruiting workers, and the salary was US \$132 per month (in 2007). But the cost of lunch and transport to work would account for one-third of the salary. Second, as migrant work would decrease labour in crop farming and livestock

breeding, only household with more labourers could benefit from migrant works. A successful example is Shuangxi Bayer who had two sons. He found a work in a construction site and could earn US \$176 per month. Moreover, his younger son worked in the distillery for two months. After five months of working, he had paid off all debts accumulated in the previous years. Third, it was difficult for migrant workers to accumulate assets to recover livestock breeding. For example, Jinbao took his family to move to another place. After several years, he had earned some money and came back. However, his house fell down. If he rebuilt the house, he would have no money to buy livestock. Therefore, he had to leave again. As a whole, drought had drive more and more villagers to go outside the village, but migrant work was still the last resort for villagers and the income for it was very low.

From the cases stated above, drought had compelled villagers to sell their livestock and find other income sources. However, due to the shortage of funds and social capital, it was difficult for villagers to achieve a real transformation in their lives. The increasing cost of health care and education made villagers vulnerable to poverty. Therefore, a series of factors, such as high cost on health care and education, the selling off of livestock and decreasing income from livestock breeding, and the borrowing of money to pay for all kinds of expenditures, ultimately led people to situations of serious poverty.

Based on the above cases, we see the problems villagers face when they struggle to sustain their livelihood under present institutions of health care and education. In fact, these institutions have not reduced the burdens of villagers but brought more vulnerability. As livestock deceased greatly, villagers' capacity to cope with risks had become weaker and weaker. On the other end of the spectre of the social fabric, the rich villagers in Baiyin Haga had special resources, such as additional grassland and project support on forage plantation, which made them capable of coping with drought.

Conclusion and discussion

Our studies of Baiyin Haga found that drought had threatened villagers' livelihood in agropastoral areas. For crop farming, it did not only decrease the farmland production, but also changed traditional rain-fed agriculture into high-investment intensive farming, which brought a series of changes leading to land degradation. For livestock breeding, drought reduced vegetation productivity. The villagers had to buy forage and sell their livestock to sustain their herds. As a result, villagers' livestock decreased sharply. All these impacts of droughts made villagers poorer and poorer.

Government of both central and local levels had paid much attention on land degradation. They tried to restore degraded grassland by carrying capacity management and grazing ban policy. Meanwhile, they promoted livestock breed improvement in order to reduce villagers' loss caused by livestock decrease and grazing ban. However, the grazing ban project totally focuses on grassland and excludes villagers' livelihood depending on it, which trapped villagers in a vicious circle: increased productive and living costs require larger scale of production to compensate them, which means more livestock, and this results in grassland degradation and serious risk of livestock loss in drought. Both central government and local government did not give full reflection on the impacts of drought on land degradation and villagers' livelihood. Therefore, the government's countermeasures did not achieve the objective of grassland restoration, but caused further cost increase and unreasonable land use.

Under the impacts of drought and failures of government ecological policies, villagers were facing increasing productive costs, which compelled them to find other income

sources to sustain their livelihood. Some villagers had found alternatives, such as farm-land ploughing, reselling livestock products and livestock breed improvement. However, all these transitions needed large amount of funds or specialized social capital, which were unavailable to most villagers. Therefore, they had to find short-term jobs to compensate increasing cost of living, especially on health care and education. Villagers became more and more vulnerable to risks, which were coming from diseases, natural disasters or market variation. They had little choice but to fall into poverty.

Dry lands cover about 41% of the Earth's land surface and are home of 2500 million people. Global climate change has brought increasingly more serious drought in these places, leading to further impoverishment. Therefore, it is urgent to learn how to survive under conditions of drought, especially how to reduce productive costs and risks caused by drought. More importantly, the establishment of better modes of production, which involve grassland ecosystem and herders depending on it as a whole system, and securing sustainable resource utilization in dryland areas should become a priority objective for policy makers in the years ahead.

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Notes

1. Collective era in Inner Mongolia lasted from the middle of the 1950s to the beginning of the 1980s.
2. 'mu' is a Chinese area unit, equal to 1/15 ha.
3. Balance vegetation production and livestock population, different kinds of livestock are equated as sheep unit based on their grass consumption. One cattle equals to 5 sheep units and 1 horse equals to 7 sheep units.
4. Aid is abbreviated as AusAID in the following text.

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