Effects of land tenure on pastoral management:
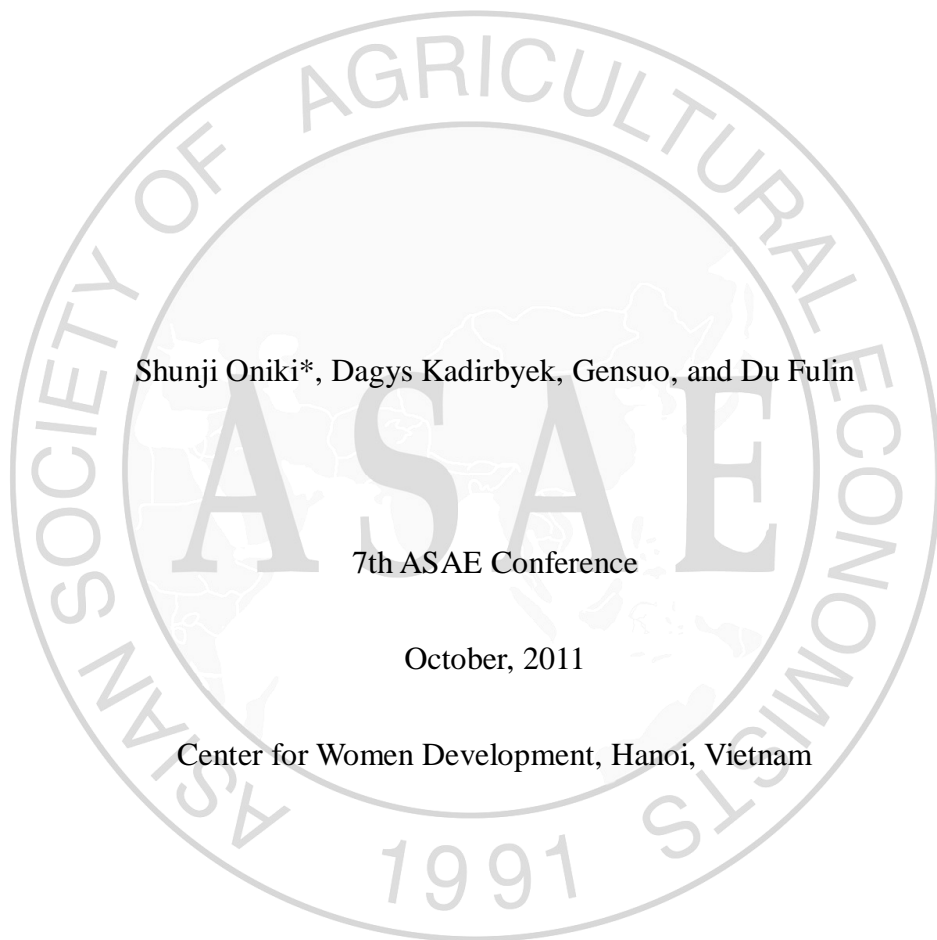
A comparative analysis of Mongolia and Inner Mongolia,

China

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Abstract

The number of animals rapidly increased after the transition to a market economy in Mongolia, where all grassland remains open-access. Some policy makers argue that the country should introduce a land tenure system in highly populated areas in order to prevent overgrazing and improve productivity of livestock production. However, this paper explores whether land tenure system lead to intensification of the livestock production. It compares the herders' livestock managements of Inner Mongolia in China with those of Mongolia. Most part of Inner Mongolia distributed grassland to all herders under the Grassland Contract Responsibility System. In order to compare regional situations of pastoral management, we conducted household surveys for 4 years in Inner Mongolia and 3 years in Mongolia and constructed a panel data set. The results show that both of the land tenure system and the population pressure influence the amount of supplemental feed and the productivity of animal. However, the amount of supplemental feed per animal is greater and the productivity of animals is higher in individual land. It shows that pastoral production become more intensive under population pressure and a land tenure system promotes the intensification.

Key words: Animal husbandry, Mongolia, Inner Mongolia, Land tenure, Productivity

Theme: Asian Agriculture in Development

1. Introduction

Mongolia made the transition from the state-planned economy to the market economy in the early1990s. However all grassland remains open-access so that all herders have a right to move and graze animals in any pasture in the country. Since many herders move to peri-urban areas for better access to markets and other social services after the transition, the number of animals rapidly increased in the areas. In order to prevent overgrazing, some policy makers and international donors argue that Mongolia should introduce a private land tenure system in the peri-urban areas.

Hardin (1968) argues that overgrazing is likely to occur in open-access land with high population pressure. It implies that provision of ownership of pasture to individual herders or groups of herders is necessary to avoid the problem of overgrazing. However, the overgrazing problem also occurs in Inner Mongolia, where most grassland has been already distributed to individual herders.

Boserup (1965) argues that population pressure on private agricultural land induces more intensive production. In fact the effects of population pressure on agricultural production are a controversial issue (Pender, 2001). It is not clear, however, whether such intensification may occur even for an open-access land. Especially for pastoral household's behavior only a few economic studies have ever conducted (*e.g.*, Oniki and Gensuo, 2006; Oniki, *et al.*, 2007) but little has been done on the above issue.

On the other hand, a part of argument made by Hardin has been cited many scholars. Although effects of land property right for common resources on sustainability on resource management have been examined by many studies (*e.g.*, Ostrom, 1990 and Bromley, 1992), surprisingly the Hardin's original argument that both land property right and population pressure influences the grassland management has been rarely tested.

This study attempts to examine whether intensification occurs in open-access

grassland and if so, how much it is different from privately-used grassland. Especially, the study explores whether population pressure and land tenure leads to increase in the amount of supplemental feed and to increase in productivity of livestock. For the purpose, we compares the herders' livestock managements in Inner Mongolia, where grassland was distributed to individual herders' households, and Mongolia, where all grassland remains open for any herders. Areas with different population pressure are selected in both countries. Herders' household surveys are conducted in these region and the survey data are used for comparative analyses.

2. Data

The survey areas of this study are Xilingol League located at the central part of Inner Mongolia, China and Tov Province (*Aimag*) located at the central part of Mongolia. The study areas in Xilingol League of Inner Mongolia are Xilinhot, Abaga and the northern part of Lan. Abaga is located at the west of Xilinhot and Lan is located at the south of Xilinhot. In Mongolia, the study areas are Bornuur and Tseel of Tov Province. Bornuur is situated around the main road connecting three major cities in Mongolia: Ulaanbaatar, Erdenet, and Darkhan-Uul. Tseel is located at the same latitude as Bornuur but access from Ulaanbaatar is not as good as Bornuur because of lack of paved road or graveled road.

The random sampling survey is carried out in 5 townships in Xilinhot, 2 townships in Abaga, and 2 townships in Lan[1]. These townships are all in flat steppe area. This study applies the two-stage random sampling method using the table of random number: First, villages are selected and then households are selected from each village.

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[1] Township is the sub-administrative units under *Banner*, *Xian* or *City* (*Xian*-level), which is called *Sum*, *Xiang* or *Zhen*.

Data in Inner Mongolia are collected for four years (2006-2009) and data in Mongolia data are collected for three years (2007-2009). The number of cross-section observations in Inner Mongolia is 291 in each year, so that the total number of observations for 4 years is 1164. In terms of Mongolia, the number of observation is 202 each year and 606 for 3 years. Regarding pooled data for Mongolia and Inner Mongolia, the common period for the survey is 3 years and the total number of observations is 1479.

The annual precipitation of all study cites are between 250 and 350mm (Atlas of Inner Mongolia, 2006, Atlas of Natural Geography, 1998). The average annual precipitation at the center of Xilinhot for 2003-2008 is 237mm and that at the center of Abaga is 235mm[2]. The annual precipitation in Bornuur during a period from 2003 to 2006 is 231 mm and that in Tseel is 238 mm. Thus, the climate conditions in these survey cites are not significantly different each other.

3. Changes in Population and the Animals

The population of the Xilingol League has rapidly increased until the mid-1980s. The average annual growth rate of the agricultural population from 1962 until 1990 in Xilingol League is 2.1%[3] (Statistical Yearbook of Xilinguolemeng). As the population increased, the number of animals also increased. The annual growth rate of the number of animals for the same period is 1.7%[4]. Although it sharply dropped in 1979 due to

[2] The survey areas in Lan do not have any meteorological station. Annual precipitation should be a little more than the center of Xilinhot because it borders with the south part of Xilinhot. The southern part of Xilingol League has in general more precipitation.

[3] From 1968 until 1974 the population of Inner Mongolia rose temporarily due to in-migration during the Cultural Revolution.

[4] The total number of animals is converted to a sheep unit (SU) value using the following conversion factors: 1 goat=0.9 SU, 1 camel =5 SU, 1 cattle or 1 horse or another large animal=6 SU.

severe snow damage, it began to grow after it. The annual growth rate of animals was 3.8% during the 1990s (1990-1999). During severe snow disaster for 1999-2001, the annual growth rate declined to -8.6 % and after it the number of animals was even declining due to consequent drought and government control on the number of animals, especially goat and sheep.

With respect to Tov Province in Mongolia, the population of herders and the number of animals did not change so much during the socialist regime. The annual growth rate of herders' population was -1.1% and the annual growth rate of the number of animals was 0.7 % during 1975-1990 (Mongolian Statistical Yearbook). It began to increase sharply after the reform of the beginning of 1990s. An increase in unemployment in the urban sector generated new herders around urban areas during the transition and many herders moved from remote areas to peri-urban areas in want of markets, employment, educational opportunity and other social services after the collapse of socialist regime. The growth rate of herders' population became 10.0 % annually during the 1990s (1990-99) and the growth rate of the number of animals accelerated to 2.6 % during the same period (Mongolian Statistical Yearbook). Mongolia also experienced severe winter disaster during 1999-2002. The annual rate of animals for 1999-2001 was -9.1 %. But after the disaster, it started to grow faster again. The annual growth rate was 10.2% for a period from 2002 to 2009.

Privatization of animals was completed around 1983 in Xilingol, Inner Mongolia[5]. The contract system of grassland for 30 years started in most villages around 1997[6]. In terms of Mongolia, all grassland areas are public and exclusive possession of grassland

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[5] Although it is called 'animal contract system' in China, herders have got actual ownership of animals.

[6] Bainxil in Xilinhot, which is used to be a national farm, is an exceptional case. It introduced the grassland contract system in 1999.

is banned under Constitution of Mongolia.

4. Pastoral Production

In order to reduce the animal density while maintaining the household incomes, herders must use more supplementary feed. In other words, the supplementary feed is substituted for natural grass. In a case of privately-used grassland, the herders would protect their own grassland by increasing the amount of feed; However, in a case of open-access land where many herders may not dare to increase the amount of supplemental feed in order to reduce consumption of natural grass. Thus, we may make the following hypotheses: As the population density increase, the amount of supplemental feed increases only in privately-used grassland.

In order to explore whether the grassland tenure system and population density may affect the amount of purchased feed, we compare the amount of the feed among the study areas. Results of the survey show that the amount of supplementary feed per animal (in sheep unit) is greater in Bornuur than in Tseel in Mongolia (Table 2). It may be because available grassland area per herder is smaller in Bornuur than in Tseel. Similarly in Inner Mongolia, the amount of feed per animal is greater in Xilinhot than in Abaga. The grassland area per herder is smaller in Xilinhot than in Abaga. On the other hand, the amount of purchased feed per animal in Lan is smaller than Xilinhot and Abaga, although the average grassland area in Lan is smaller. Many herders in Lan have some field to grow feed crop, such as corn, in their land and produce feed by themselves, so that they can reduce the amount of purchased feed.

Table 2 The area of grassland per herder and the amount of purchased feed per animal (sheep unit): Regional average of the survey data

		Area per capita (ha/person)	Feed supply per animal (kg/sheep uit)
Mongolia	Bornuur	82	63 (138)
	Tseel	209	13 (41)
Inner Mongolia	Abaga	335 (226)	69 (63)
	Xilinhot	169 (176)	107 (100)
	Lan	65 (72)	70 (50)

Note: Standard deviations are in paretheses.

According to the results of the household survey in Mongolia, the number of animals per person (herder) is smaller in Bornuur where population density is higher than Tseel where population density is lower. Thus, the gross income per person is higher in Bornuur. However, the total cost per person is higher in Bornuur than Tseel, so that the ratio of the total cost to the gross income is higher in Bornuur.

Similarly if we compare with Xilinhot and Abaga in Inner Mongolia, the number of animals per person is smaller in Xilinhot where population density is higher than Abaga. The gross income per person is lower in Xilinhot than Abaga, while the total cost is higher. Therefore, the ratio of the total cost to the gross income is higher in Xilinhot. In terms of Lan in Inner Mongolia, where the population density is the highest, the total cost per person is higher than Abaga but lower than Xilinhot. This is because many herders in Lan have some farmland for feed crop so that the cost of feed is lower.

Table 3 The total costs and the gross incomes per herder in each region.

		Gross income	Total cost	Cost/Gross income	Animal per person
		(USD)	(USD)	(%)	(Sheep unit)
Mongolia	Bornuur	1,899	471	25	139
	Tseel	2,166	381	18	165
	Total	1,982	443	22	250
Inner Mongolia	Abaga	7,647	407	27	250
	Xilinhot	5,437	1,727	32	199
	Lan	2,793	800	29	118
	Total	4,072	1,188	29	178

5. Estimation

The model for determinant factors of the amount of purchased feed per animal is estimated by panel data of the studied regions. We will test the hypothesis that the amount of the feed per animal is increased as the available grassland for a herder declines. The dependent variable is the amount of purchased coarse feed per animal. The independent variables are listed in Table 4. The number of animal is expressed in sheep unit. Area per capita is the area of grassland per herder (in hectare): In Mongolia it is the average grassland available for a full-time herder in the soum. As for Inner Mongolia, it is the area of grassland (in hectare) per household divided by the number of herders in the household. The proportions of animals are computed in sheep unit. Prices of feed and livestock products are used to control regional difference in the prices. They are important because difference in the prices may affect the number of animals or the incomes. The prices are expressed in US dollars. The variable for the number of animals in household is the number in the previous year of the estimation, which avoids endogeneity of the variable. The Breusch and Pagan Langrangian multiplier tests for random effects in all models are not rejected at a 10% level, thus supporting the random effect model.

The results of estimation reveal a negative relationship between the amount of the feed per animal and the area per capita both in Mongolia and Inner Mongolia when prices of feed and products are controlled, showing that more supplementary feed is

used for an animal as available grassland is smaller (Table 4).

The dummy variable of Mongolia is significantly less than zero, which means that the amount of feed per animal is smaller in Mongolia than Inner Mongolia. It implies that the herders in Mongolia use less supplementary feed than the herders in Inner Mongolia. The coefficient of the number of animals is negative in Inner Mongolia, which implies that the production become less intensive when the number of animals is large.

Table 4 Determinants of the amount of feed per animal: Coefficient estimates of the random effect model

	All regions		Mongolia		Inner Mongolia	
Area per capita	-0.045	(0.016) ***	-0.176	(0.099) *	-0.025	(0.013) *
Proportion of cattle	-12.189	(14.000)	18.340	(18.278)	28.311	(35.029)
Proportion of sheep	27.129	(15.660) *	-37.261	(27.299)	88.419	(34.753) **
Proportion of goat	-11.725	(17.800)	-31.074	(25.581)	95.232	(38.762) **
Feed price	-323.8	(145.1)	-1439.5	(537.5) ***	80.7	(129.5)
Price of livestock products	-0.864	(0.357)	4.504	(3.144)	-0.958	(0.299) ***
No of animals in household	-0.021	(0.007) ***	0.000	(0.013)	-0.027	(0.007) ***
Mongolia dummy	-59.040	(8.746) ***	n/a		n/a	
constant	163.46	(22.028) ***	8.81	(100.143)	78.81	(37.748) **
no. of observation	1960		940		1065	
r-squared	0.064		0.064		0.055	
Note: ***Significant at 1%, **significant at 5%, *significant at 10%. Standard errors are in parentheses.						

Next, we will explore determinant factors of productivity of animal. We will test the hypothesis that the productivity of animal is increased as the available grassland for a herder declines. For the purpose, we estimate a random effect model of the gross incomes per animal in terms of grassland area per herder, Mongolian dummy, labor, capital and prices of feed and products (Table 5). The incomes include values of animals consumed in herders' own household, as well as sales values. Labor is the number of working-age herders. Capital is the amount of investment on capital goods in US dollars.

Results of the estimation reveal that the income per animal is larger as the grassland area per capita is smaller. It implies that if grassland area is smaller, more input is used

per animal, because the number of animal cannot be increased in a limited land. In addition, milk production is more active in areas with small area per capita and a good access to urban markets.

In the model of all regions, Mongolia dummy is significantly negative when assuming other factors are the same. The results imply that the productivity of grassland is lower due to lack of individual grassland.

Table 5 Determinants of the gross incomes per animal: Coefficient estimates of the random effect model

	All regions		Mongolia		Inner Mongoiia	
Area per capita	-0.005	(0.003) *	-0.026	(0.013) **	-0.004	(0.002)
Mongolia dummy	-4.905	(1.683) ***	n/a		n/a	
Labor	-1.133	(0.449) **	-0.712	(0.794)	-1.433	(0.432) ***
Capital	0.000	(0.000) ***	0.001	(0.000) **	0.000	(0.000) ***
Feed price	-41.740	(26.6)	298.583	(90.132) ***	-70.048	(23.347) ***
Price of livestock products	0.466	(0.074) ***	3.856	(0.760) ***	0.470	(0.059) ***
constant	12.112	(4.106) ***	-116.364	(27.333) ***	14.761	(3.276) ***
no. of observation	1787		928		859	
r-squared	0.15		0.05		0.13	

Note: ***Significant at 1%, **significant at 5%, *significant at 10%. Standard errors are in parentheses.

6. Conclusions

The analysis of this study shows that population pressure of herders affect the amount of purchased feed and productivity of animal. The smaller is grassland available for a herder, the more amount of feed per animal is used and the higher is the gross income. It suggests that pastoral production, which is extensive by nature, can be more intensive as the population pressure is higher. While the intensification of pastoral production is possible regardless of presence of a land tenure system, the production is more intensive in the privately-used grassland than in open-access grassland. If the land is allocated to each herder, the amount of feed is greater and the productivity of animal is higher.

This situation has the following policy implications. First if the land use right is more secure, the productivity of livestock is higher, so that herders utilize the limited grassland more efficiently. Since the herders in a populated area suffer from a decrease in the incomes, intensification helps to offset the income decline. We have revealed that population pressure affects management of animal-raising in open-access land. Government should monitor if herders in highly populated areas have proper degree of intensification.

Secondly, this study shows that a land tenure system may induce more intensive production for livestock farming in over-populated areas in open-access grassland. Without the tenure system, productivity of livestock cannot be improved even if population of herders, which results in either low incomes per herder or overgrazing on the pasture. Improvement of the productivity is an important issue for sustainable development in peri-urban areas.

However, we also should note that the problem of overuse of grassland could not be fully solved by introduction of the land tenure system. We have shown that even if grassland is individualized, grazing pressure can be higher for grassland with high population pressure. Also, even if land is not individualized, land utilization can be more intensive with high population pressure. Also, notice that individual land tenure may lose flexibility of pastoral management and weaken herders' resilience to a natural disaster.

Thus, we should consider dual means: how government can intervene to make the nomadic livestock production more intensive under an open-access situation and what kinds of additional risk management should be applied under a land tenure system.

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