

# Twenty Years After Decollectivization: Mobile Livestock Husbandry and Its Ecological Impact in the Mongolian Forest-Steppe

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**Abstract** The socioeconomics and the ecological impact of nomadic pastoralism were analyzed using interviews with 87 herder families and secondary information in the western Khangai, Mongolia. The pastoralists had an income above the national average for rural areas in Mongolia. Most herders continued traditional seasonal migration patterns, which involved ca. 10 moves per year over a total distance of ca. 100 km between summer and winter grazing grounds. As elsewhere in Mongolia, the number of goats owned by herders has greatly increased and cashmere has become the main source of cash income. Total livestock numbers rose considerably after decollectivization of the livestock sector in 1992, but in recent years have periodically been reduced by harsh winters, often combined with drought. Due to the high economic risk of these periodic livestock losses, many herders invest in better education for their children to enable them to migrate to the cities.

**Keywords** Nomadic Pastoralism · Livelihoods · Cashmere · Mongolia · Central Asia

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## Introduction

The organization, economics and ecological impact of pastoral livestock keeping in Mongolia received much attention from academic researchers following the decollectivization of the formerly state-owned livestock sector in Mongolia in 1992 (e.g., Edström 1993; Fernández-Giménez 1993, 2001; Mearns 1993; Griffin 1995; Sneath 2004; Janzen 2005; Sternberg *et al.* 2009). This increase in interest was mainly due to the unique situation of Mongolia, in that nomadic pastoralism has remained the prevailing type of land use throughout the country. Thus Mongolia differs from other regions of Central Asia, including Kazakhstan (van Engelen 2011), Inner Mongolia (Sneath 2000; Zhen *et al.* 2010), Xinjiang (Tsui 2012) or Tibet (Tashi and Foggin 2012), where pastoralists have largely become sedentary.

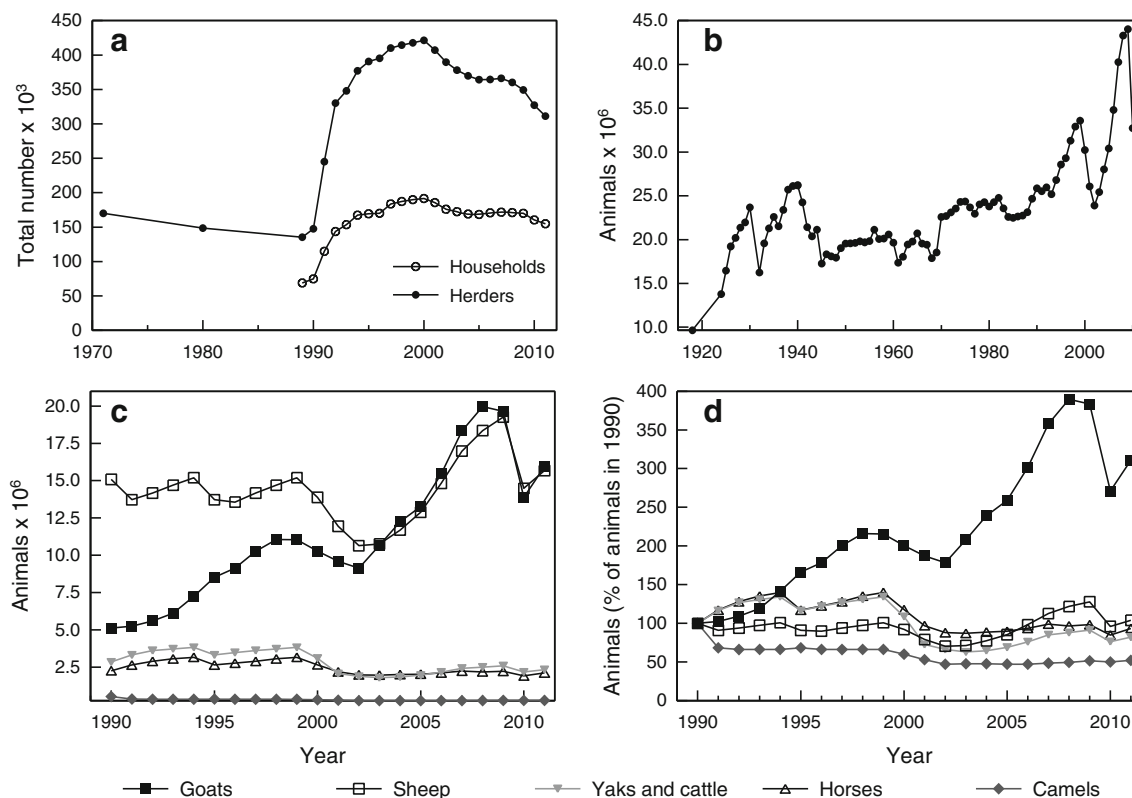
During the first decade after the transition from planned to market economy, the total number of pastoralists in Mongolia increased steadily; in 2000 the number of herders was almost three times that in 1990 (Fig. 1a). The Mongolian pastoralists keep mixed herds of livestock, which commonly consist of sheep, goats, yaks, cattle, horses and (in dry regions) camels. The livestock grazes on common land, which includes grasslands and forests, and is little herded (Lkhagvadorj *et al.* 2013). The total number of livestock reached a historic peak in the early twenty-first century (Fig. 1b). However, the increase of livestock numbers was not continuous, as large numbers of animals died during repeated harsh winters (*dzud*) (Begzsuren *et al.* 2004; Tachiiri *et al.* 2008). The frequency of *dzud* weather conditions increased considerably in the late twentieth and early twenty-first centuries (Fernández-Giménez *et al.* 2012). Following several *dzud* or combined *dzud* and drought years, the number of herders started decreasing from 2001, but in 2011 was still more than twice that of 1990. However,

herders have abandoned their business not only because harsh weather conditions destroyed their livelihoods, but also because of an increase in economic alternatives, e.g., the booming mining industry (Suzuki 2013). This situation contrasts with the early 1990s when people were faced with unemployment and greatly deteriorated living standards (Griffin 1995; Anderson *et al.* 2000). Notwithstanding the temporary reduction of livestock numbers in *dzud* years, the decline of herder numbers during the past decade (Fig. 1a) contrasted with the continued overall trend of increasing animal numbers (Fig. 1b), which must have resulted in increased average herd sizes.

The increase in livestock numbers since the early 1990s was connected with a shift in the relative importance of the individual livestock species (Fig. 1c, d). From 1990 to 2009, the number of goats increased 3.8 times. A severe *dzud* in the winter of 2009/10 reduced the goat numbers, but nevertheless they exceeded that of 1990 by a factor 2.7 in 2010 and by a factor of 3.1 in 2011. Cashmere, made from the fine and soft undercoat of goats that evolved as a response to the cold Central Asian winters, has developed into the key source of cash income for most Mongolian nomads after the access to the world market (Lecraw *et al.* 2005; Lkhagvadorj *et al.* 2013)

and thus been a strong incentive to prefer goats over other species of livestock. Mongolia is the world's second largest cashmere producer (Lecraw *et al.* 2005). However, goats are more detrimental to the vegetation than other species of livestock because they graze herbage more vigorously and they prefer the leaves and needles of woody plants thus contributing to deforestation (Hughes and Thirgood 1982; Sankey *et al.* 2006). Whereas herders at first increased goat numbers while simultaneously reducing sheep numbers, this trend has changed recently; sheep numbers have now reached the high number of goats causing a substantial increase in the total livestock holdings (Fig. 1c). The present numbers of yaks, cattle and horses are slightly lower than in 1990, whereas the number of camels has halved, reflecting their reduced role as pack animals in the pastoralists' seasonal migrations.

The Mongolian herders have to deal not only with significant social, political and economic changes, but also with the effects of climate warming (Dagvadorj *et al.* 2009). The increase in temperature has altered precipitation patterns (Nandintsetseg *et al.* 2007; Dulamsuren *et al.* 2010a) and influenced the growth and regeneration of forests (Dulamsuren *et al.* 2010b), but the effects on the productivity of Mongolia's



**Fig. 1** Development of the numbers of (a) herders since 1970 and nomad households since 1989 (earlier data not available), (b) the total livestock since 1918 in Mongolia (data from Humphrey 1978 and various yearbooks of the National Statistical Office of Mongolia), (c,

d) the numbers of individual livestock species in Mongolia since 1990 (calculated from data from the National Statistical Office of Mongolia): (c) absolute numbers, (d) change since 1990 (livestock numbers in 1990 are set to 100 %)

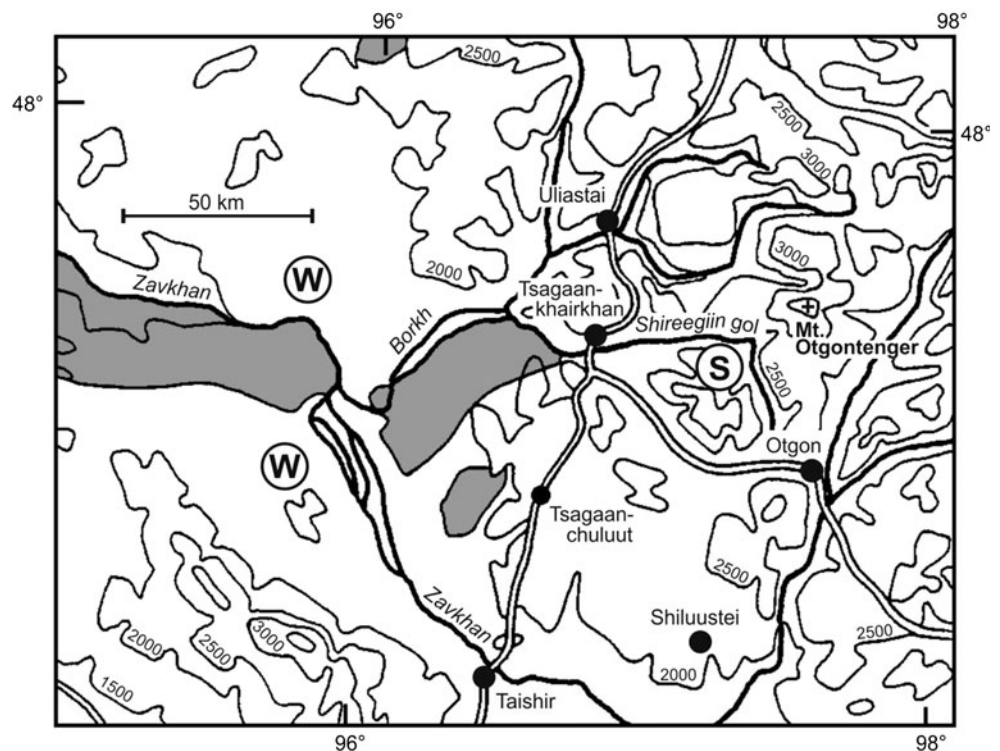
grasslands have been little studied. The ecological impact of pastoral livestock keeping has repeatedly been discussed in terms of rangeland degradation. Increased livestock numbers and reduced mobility have resulted in overgrazing and the degradation of pastures especially in the vicinity of roads and villages (Okayasu *et al.* 2007; Wesche *et al.* 2010). In the forest-steppe where 40 % of the Mongolian livestock is kept on 23 % of Mongolia's rangeland area (Jamsranjav 2009), traditional land use impacts include forest grazing, fuel wood collection and selective logging (Lkhagvadorj *et al.* 2013). This impact reduces the biodiversity of species dependent on ungrazed nutrient-poor sites (Hauck and Lkhagvadorj 2013) or on deadwood or old trees (Hauck *et al.* 2012).

The objective of the present study is to analyze the herder's situation and their ecological impact on the environment in a typical forest-steppe region of Mongolia 20 years after the privatization of the livestock sector. During Communist times, the herders were organized in collectives (*negdel*), where they acted as state employees and specialized in individual livestock species or worked as drivers or administration staff in the collective (Humphrey 1978; Fernández-Giménez 1999). Marketing, moves between seasonal campsites, supply of additional fodder during harsh winters and the maintenance of wells in dry regions were centrally organized (Fernández-Giménez 2002). Based on data from interviews with herders, we assess current organization of livestock husbandry, the degree of their economic security, their impact the environment, and how they themselves perceive their present situation and judge future prospects for their family enterprises.

## Study Area

Field work was carried out in the Khangai Mountains, western Mongolia. The study was conducted in the valley of the river Shireegiin gol (ca. 47°26'–47°32' N, 96°55'–97°59' E) in Tsagaankhairkhan county (*soum*) (2,700 km<sup>2</sup>; 1,430 inhabitants in 2010) in the province (*aimag*) of Zavkhan (82,456 km<sup>2</sup>; 71,800 inhabitants), 30 km SSE of the city of Uliastai (15,700 inhabitants), which is the capital of the Zavkhan *aimag* (Fig. 2). The study area is located in the forest-steppe, which is characterized by the aspect-dependent distribution of forests of Siberian larch (*Larix sibirica* Ledeb.) on the relatively moist north-facing mountain slopes and grasslands on south-facing slopes and in most valleys. The summer camps of most herders were located at an elevation between 1,900 and 2,300 m a.s.l. West of the Shireegiin gol area the dominant vegetation type is semi-desert, including extensive areas of sand dunes, which cannot be used as rangelands, and the semi-desert area is used for winter camps. The Shireegiin gol area is accessible via a dirt road from Uliastai and has no other public infrastructure. The climate in the study region is highly continental with a subzero mean annual temperature (−2.4 °C at the weather station Uliastai; 47°75' N, 96°85' E; 1,760 m a.s.l.) and low precipitation (213 mm in Uliastai) with a strong peak in summer. The mean January temperature in Uliastai is −24 °C and the mean July temperature is 16 °C. The mean annual temperature has increased by 2.5 °C since 1937 ( $y = -68.1 + 0.03x$ ,  $r = 0.48$ ,  $P < 0.001$ ),

**Fig. 2** Study area in the valley of the Shireegiin gol (S), Tsagaankhairkhan *soum*, in the western Khangai Mountains. The herders' summer camps (S) are in the forest-steppe, whereas the winter camps (W) are located in the semidesert. Shaded areas are sand dunes which are not suited for grazing. Double lines are roads, black lines are rivers and black dots represent villages and cities



whereas precipitation has decreased by 50 mm during the same period ( $y=1553-0.69x$ ,  $r=0.48$ ,  $P<0.02$ ).

## Methods

### Interviews and Access to Secondary Information

Interviews with herders were carried out in summer 2011. At that time, 87 herders lived with their households in the Shireegiin gol valley in mobile dwellings called *gers*; these are constructions with a wooden framework, felt roofs and walls, and a circular base area of c. 5–7 m in diameter. Each household lives at a separate place generally with two *gers*, one for living and sleeping and the other for use as a kitchen area. All *gers* in the valley were visited and at least one household was interviewed at home using the Mongolian language without an interpreter. A fixed set of ca. 300 questions was asked in every household. The questionnaire involved queries to the number, age and education of the household members, income and expenditures, livestock numbers, the organization of livestock husbandry and seasonal movements, the utilization of forests, and the herders' perception of climate warming. We further asked for an overall assessment of the herders' present and future economic prospects. The 87 herders included in the survey were residents of Tsetserleg, Onts, Bayanbulag and Agit *bags* (i.e., the smallest administrative subunit in Mongolia) of Tsagaankhairkhan *soum*; other household members were formally resident in Uliastai. Secondary information was obtained by visiting the local governments of Tsagaankhairkhan *soum* and Zavkhan *aimag*. The national Mongolian currency (Mongolian tugrik, MNT) was converted to US dollars (USD) based on the exchange rate of August 1st, 2011 (1000 MNT = 0.791 USD).

### Statistics

The dispersion of data about the mean value is given as standard deviation throughout the paper. Multiple regression analysis is used to calculate the effect of the number of individual livestock species on the household income of the herder families. Statistical analyses were conducted with SAS 9.13 software (SAS Institute Inc., Cary, North Carolina, USA).

## Results

### Population Structure and Education Level

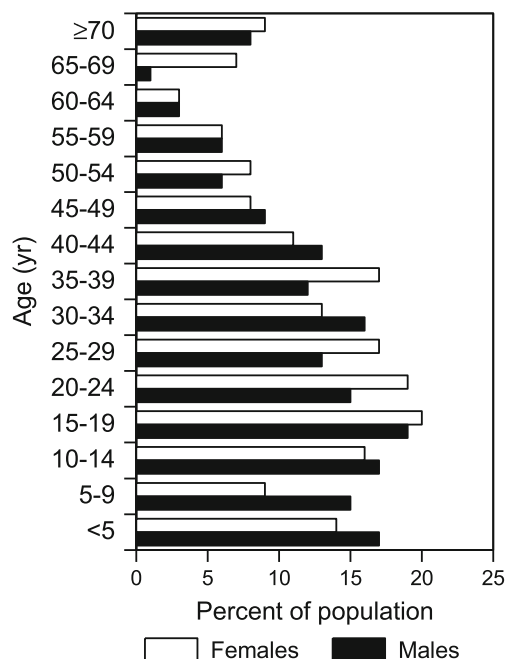
The 87 families had a total of 347 members (170 males, 177 females), with  $4.0\pm 1.6$  family members per household. The age distribution of the population has a near-pyramidal shape in the age groups  $\geq 15$  years, but is slightly constricted at the

base (Fig. 3). Thirty-seven percent of the population was  $<20$ -years old, whereas 28 % of the people were  $\geq 40$  years old. The age distribution agreed well with that of the Tsagaankhairkhan *soum* (not shown), of which the interviewed collective represented 24 %. The crude birth rate was 17.3 for the interviewed households and 16.7 for Tsagaankhairkhan *soum* in 2010.

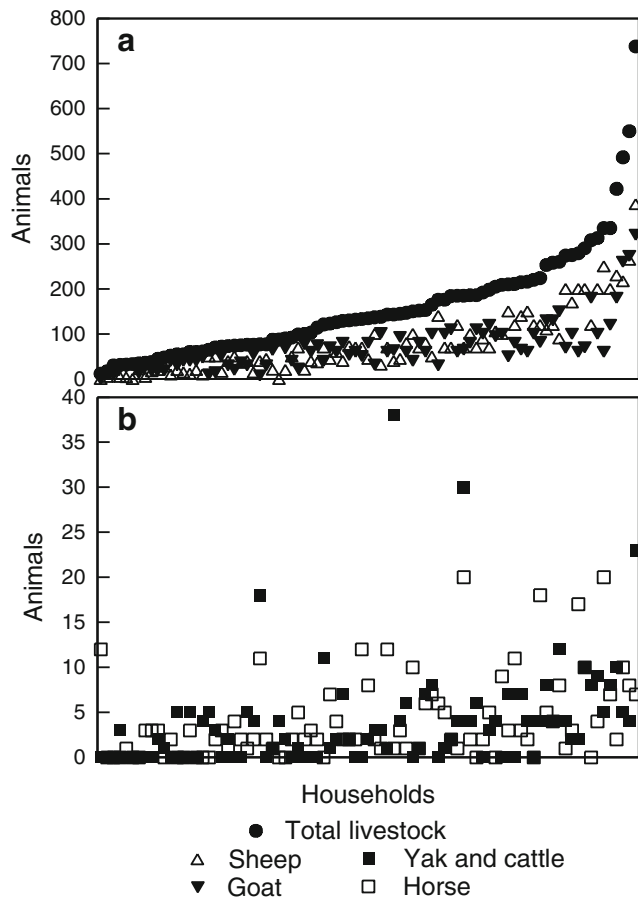
Nearly all  $\geq 8$ -year old persons (98.7 %) were able to read and write, but 38 % of the population left school without graduating. In the recent past, only 1 % of 6 to 14-year old children dropped out of school. Until 1955, the dropout rate was high (86 %), but steadily declined in the following decades to less than 30 % in the late 1970s and early 1980s. In the age group of persons who attended school during the political changes in 1990, 63 % of the pupils left school without graduating. In the period from 1992 to 2000, one quarter of children dropped out of school. In all these periods, more males than females dropped out of school, generally they were forced to help with the family's livestock husbandry (80 %). Other reasons for dropouts included health problems (7 %) or the lack of interest in education (13 %). Among persons above school entrance age, 12 % had finished primary school, 22 % middle school, 10 % high school, and 8 % a vocational school. Six percent of the population had a university degree and further 8 % were university students at the time of the survey.

### Livestock Numbers

The total number of livestock for the 87 families was 13,470 animals (Table 1). Each household owned  $155\pm 122$  animals,



**Fig. 3** Age structure of the population ( $N=347$ ) in Shireegiin gol (interviewed households)



**Fig. 4** Livestock numbers per herder household in Shireegiin gol in 2011. Data are sorted in a sequence of increasing total livestock number per household

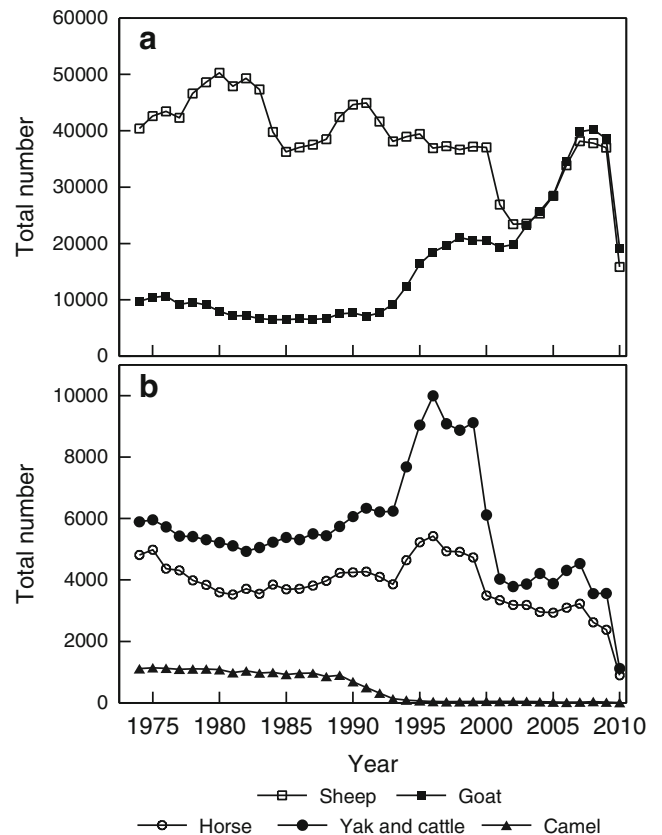
but the herd size varied considerably among the families. The 10 % of families with the largest flocks owned 28 % of the total livestock in Shireegiin gol (Fig. 4a). All families had several animal species, which usually included all species listed in Table 1. Sheep, at 50 % and goats at 45 % together formed 95 % of the total livestock (Table 1). The number of yaks, cattle and horses was not correlated with the total number of animals held by a herder family (Fig. 4b). Yaks

**Table 1** Livestock number in the interviewed households in Shireegiin gol in 2011

	Mean number ( $\pm$ SD) per household	Max. number per household	Total sum
Sheep	78 $\pm$ 72	388	6760
Goat	69 $\pm$ 56	320	6013
Yak and cattle	4.0 $\pm$ 6.1	38	351
Horse	4.0 $\pm$ 4.7	20	346
Total livestock	155 $\pm$ 122	738	13470

and cattle were counted together and accounted for 3 % of the total, as did the horses. Yaks were much more widespread than cattle.

Since the herders themselves usually do not keep an account of their livestock, the temporal development of livestock numbers in the recent past was not available. However, such a statistic was available for Tsagaankhairkhan *soum*: at present, the 13,470 animals kept by the herders of Shireegiin gol constitute 36 % of the total livestock in Tsagaankhairkhan *soum*. The total livestock in this administrative unit changed little between 1974 (62,000 animals) and 1991 (63,000 animals). It subsequently increased to a maximum of 85,800 animals in 2007. The temporal variability of livestock numbers increased considerably since 1991; the coefficient of variation for the total livestock number was 8 % prior to 1991, but 18 % afterwards. The number of goats increased from 7,100 animals to a maximum of 40,240 in 2008 (Fig. 5a). The number of sheep fell from 44,945 in 1991 to 23,430 in 2002, but subsequently increased to the same level as goats. Yak, cattle and to a lesser extent horse numbers increased rapidly after 1993, but returned to pre-1993 levels after only seven years (Fig. 5b). Camels, which were not kept by the herders in Shireegiin gol at the time of the interviews,



**Fig. 5** Development of livestock numbers in Tsagaankhairkhan *soum* between 1974 and 2010: (a) sheep, goats, (b) horses, yaks and cattle, camels

decreased from a stable population of around 1,000 during the 1970s and 1980s to a few dozen after decollectivization.

The livestock numbers were regularly reduced during harsh winters. The severest losses during the past 20 years occurred very recently in the winter of 2009/10 (Table 2), when 55 % of the animals died. Losses occurred across all species of livestock, but were most severe in yaks, cattle and horses. In other winters, substantial losses of livestock affected only single species, while the populations of the other species remained stable. The large ungulates (yak, cattle, horses, camels) were generally more susceptible to *dzud* events than sheep and goats. After the last *dzud* in 2009/10, the camel population in Tsagaankhairkhan *soum* collapsed to 12 individuals.

### Seasonal Migrations

Most herder families in Shireegiin gol pursued a nomadic (78 %) or at least semi-nomadic (22 %) lifestyle. The nomadic and semi-nomadic families differed only in their strategies for spending the winter, with the semi-nomadic families remaining in either the village of Tsagaankhairkhan (10 families) or the city of Uliastai (9 families) (Fig. 2). These families included older herders, who wanted to avoid exposure to the harsh weather, and families who wanted to promote the education of their children by staying closer to the schools for at least that season. The herders who overwintered in town paid fully nomadic families to take care of their livestock along with their own.

The nomadic herders left the forest-steppe of the Khangai Mountains during winter on account of heavy snowfall, and moved to their winter camps in the semi-desert west of Shireegiin gol (Fig. 2). The total distance between the summer and the winter campsites is around 100 km. The winter campsites are permanently assigned to the individual herder families by the local administration. The formal regulation of the ownerships for winter campsites was said to be necessary because of the limited

resources (forage, water) and the vulnerability of the sparse vegetation in the semi-desert. The winter campsites usually cannot be occupied before December, as the herders have to wait for snowfall because there is no other access to water in the semi-desert.

The summer campsites in Shireegiin gol are not regulated, since availability of water and rangeland is not at issue. The winter camps are left in early April and the summer campsites are occupied between late May and early June. En route from the winter to the summer campsites, the herders erect a spring camp about halfway in between. In late August or early September, the herders move to their autumn campsites, halfway to the winter camps, where they wait for snowfall in the semi-desert. During summer, the herders move several times within the Shireegiin gol valley. Individual sites in the valley are consecutively utilized by different herder families. Informants said this was possible because the vegetation usually recovers quickly so the land can be used again for pasture after a short period. Overall, most herders stated that they would move ten times per year, i.e., about six times within the summer rangeland area of Shireegiin gol in addition to the moves between winter, spring, summer and autumn camps. The fully nomadic herders said that their moving pattern has not changed since decollectivization. All herder families owned trucks, which were used for the moves between the seasonal campsites.

### Patterns of Livestock Grazing and Supplementary Feeding

The main grazing areas in Shireegiin gol are the most productive grasslands in the river valley. These areas are more heavily grazed than forests and dry sun-exposed slopes. The herders said that they took their livestock, mostly sheep and goats, as horses, yaks and cattle are rarely if ever herded, to the forest edges for pasture primarily at the end of the growing season and in drought periods when the steppe produces little fresh

**Table 2** Decline of livestock numbers in Tsagaankhairkhan *soum* during harsh winters ('*dzud*') for the past 20 years (percentage of number of livestock surviving winter in original total number of livestock before the winter)

	1991/92	1992/93	1999/2000	2000/01	2001/02	2007/08	2008/09	2009/10
Sheep	93 % 41644	91 % 38094	100 % 37048	73 % 26904	87 % 23432	99 % 37823	98 % 37007	43 % 15846
Goat	108 % 7696	120 % 9246	98 % 20513	95 % 19391	102 % 19815	101 % 40240	96 % 38617	50 % 19207
Yak and cattle	98 % 62111	100 % 6235	67 % 6111	66 % 4027	94 % 3783	78 % 3554	100 % 3564	31 % 1118
Horse	96 % 4100	94 % 3857	74 % 3495	97 % 3342	95 % 3187	81 % 2616	91 % 2378	38 % 897
Camel	64 % 318	43 % 136	106 % 50	96 % 48	104 % 50	148 % 43	58 % 25	48 % 12
Total livestock	95 % 59969	96 % 57568	94 % 67217	80 % 53712	94 % 50267	98 % 84276	97 % 81591	45 % 37080

herbage. Herders are more careful about the sheep and goats because they have a higher risk of wolf predation, which is common in the area. Some herders said that yaks and cattle would preferentially graze in the forest after milking. Field observations suggest that especially the mixed flocks of goats and sheep browse the forest edge every day without the herders' supervision. The goats consumed larch needles even if plenty of fresh herbage was available on the ground, and most of the tree saplings were heavily damaged by the goats. The herders reported a substantial inter-annual variability of pasture quality due to strong variation in annual precipitation. They stated that the summer pastures in Shireegiin gol were of poor quality for approximately 10 years before 2009 due to low precipitation. This assessment is confirmed by data from the weather station in Uliastai that show that the annual precipitation between 1998 and 2008 was 9 % below the long-term average since 1937. In such drought periods, the livestock is kept closer to the river than in wetter periods. According to the herders, the pastures recovered quickly after 2009 during two summers of higher precipitation. The herders did not mention that the recently improved pasture quality coincided with the strong reduction of livestock density due to the *dzud* in 2009/10 (Fig. 5; Table 2).

The herders do not store much hay for winter because the transportation of large amounts of fodder from the summer pastures, where hay is usually cut and dried, to the winter camps is costly and labor intensive. Moreover, the herders stated that the amount of herbage available for hay making was limited. Only 37 % of the interviewed herders prepared hay for the winter. There are no specific hay fields; rather some parts of the rangeland are selected, which are unfenced and also browsed by the livestock. During winter, the horses, especially riding horses, are fed small amounts of bruised grain in addition to their fodder, except for *dzud* years when the herders increase the amounts according to their economic resources. The grain is purchased mostly in the *soum* center and is the only nutrient input for livestock from outside the rangeland ecosystems.

#### Forest Use

Apart from forest grazing, the herders in Shireegiin gol use the forest as a source for fuel, construction wood and non-wood products. Fuel wood collection was the most important economic function of the forests mentioned by the herders. Wood is used for fuel throughout the year. All households, even those moving to the city over winter, prepare fuel wood for the winter, which they take with them either to the winter camps or to the *soum* or *aimag* centers. Most families prepare one truck load ( $8 \text{ m}^3$ ), although families split between the winter camp and the city will prepare two. Fuel wood collection and transportation is important since all herder households move away from the forest-steppe in winter. Much wood is also collected during the move between Shireegiin gol and the winter campsites to

reduce the distance it must be transported. Most herders said that they would transport the fuel wood over a distance of 40–60 km. The herders pay a fee to the local administration of 19800 MNT (16 USD) per  $8 \text{ m}^3$  of fuel wood collected. They are allowed to collect twigs, stumps, downed trees and standing deadwood, but not to fell live trees. Some herders stated that the stock of deadwood has decreased due to its use as fuel. Dung, a traditional fuel in Central Asia, was only used by 22 % of the nomad households in Shireegiin gol. Only 2 % of the families use it throughout the year, whereas 15 % burn it only during winter and 2 % during winter and spring.

The demand for construction wood was low. Not a single family had built a wooden fence or dwelling in Shireegiin gol. Only the families who live in the *soum* or *aimag* centers during winter have erected wooden fences there. The winter campsites were mostly built before 1990 at a time when little construction wood was used per dwelling. Traditionally, timber is logged when a new household is founded after marriage. Marriages, however, have decreased due to the emigration of young people to the cities. The families do not build fences or housing for their own use and none of the interviewed households has fencing for livestock.

Until 2009, fuel wood was an important source of cash income for the herders living in Shireegiin gol. At that time, most families owned old Russian-made trucks which could carry large loads. These trucks were used to take wood for sale to villages in the vicinity and to the city of Uliastai. The herders said that the profit from selling one truck load of fuel wood was ca. 70000 MNT at that time after the deduction of expenses for fuel and permits. Since 2009, the *soum* administration allows wood collection only for personal consumption and the herders apparently follow this rule. As a result of this loss of income, people sold their big trucks and purchased smaller ones that consume less fuel. Logging of live trees for construction wood was prohibited in 2001 by the *aimag* government. The herders mentioned that the mutual social control among the families ensures that the rules against wood sales and the felling of live trees are followed. Any outside attempting to cut timber would be expelled by the local community.

Non-wood forest products included berries (ca. 10 kg per year/family equaling ca. 15000–20000 MNT [12–16 USD]) and medicinal plants. None of the interviewed families sold any non-wood forest products. Nevertheless, every family paid 20000 MNT (16 USD) per year for a permit to gather berries and other plants from the forest and the steppe.

#### Livelihoods

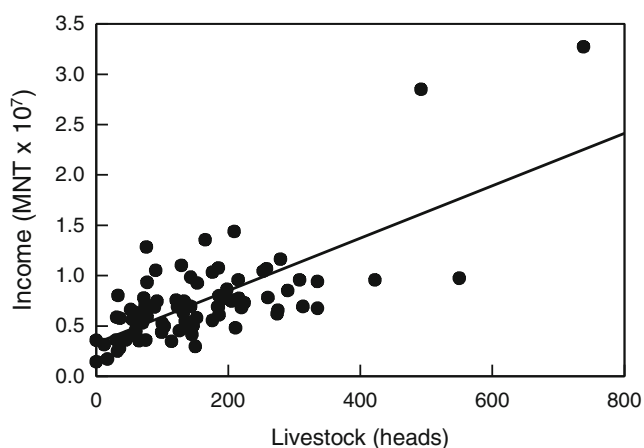
The 87 interviewed families in Shireegiin gol had a mean monthly income of 611529 MNT (484 USD) per household (Table 3) or 153322 MNT (121 USD) per capita. Two-thirds of the herders' income was cash income; the highest contribution came from the sale of livestock products (56 % of total

**Table 3** Monthly cash and non-cash income and expenditures per household in Shireegiin gol

	MNT	Percentage	USD <sup>a</sup>
Total income	611529±368907	100 %	484
Monetary income total	410061±312919	67 %	334
Livestock husbandry	227949±272256	37 %	180
Wages and salaries	49484±110859	8 %	39
Retirement pensions	50736±74428	8 %	40
Disability pensions	3046±12335	0.5 %	2
Grants from government	65478±25566	11 %	52
Non-livestock products	8649±38275	1 %	7
Own consumption of livestock products	201467±86677	33 %	159
Total expenditures (monetary)	355063±205067	100 %	281
Food	61478±22124	17 %	49
Non-food expenses, total	293586±201021	83 %	232
Transportation	39050±14756	11 %	31
Tuition fees	20789±45353	6 %	16
Fuel wood	14646±7495	4 %	12
Hay making and fodder	8282±7437	2 %	7

<sup>a</sup> Based on the exchange rate from 1 August 2011

monetary income). Products other than those related to livestock, such as homemade shoes and clothes, which were sold by very few families and contributed only 2 % of cash income. Some families run small shops in their gers in the summer and in the *soum* center during winter. All other cash income was from pensions (13 % of total cash income), the monthly per capita grant of 21000 MNT (17 USD), which is received by every Mongolian citizen who resides in the country (16 %), or wages and salaries (12 %) earned by individual family members. Retirement pensions are received mostly by people who qualified for them during Communist times, when the herders

**Fig. 6** Annual income of households in the survey versus total number of owned livestock ( $r=0.72$ ,  $P<0.001$ ,  $y=0.33+0.003x$ )

were state employees. One third of the total income of the herder families was non-monetary from consumption of their own livestock and livestock products.

Total household income was positively correlated with the total number of livestock owned by each family (Fig. 6). Multiple regression analysis showed that the number of goats could explain 51 % of the variation in family income (Table 4). Adding other animal species to the model increased the explanatory power of the regression model by up to 5 % only. The strong correlation between the number of goats and household income is due to the sale of cashmere, which contributed 60 % of the total cash income from livestock keeping. The mean yearly production of cashmere was 23 kg per household, which was sold at prices between 50000 and 72000 MNT (40–57 USD) per kg.

While slaughtering animals is important for household consumption, many families had not sold meat within the 12 months prior to the interviews. The herder families themselves eat mostly sheep (ca. 0.6 animals per month) and goats (ca. 0.4 animals per month). Meat is generally sold as live animals. Thirty-five percent of the families from Shireegiin gol had sold 767 sheep for an average price of 35965 MNT (28 USD) per animal in the year before the survey. Twenty-two percent of the households had sold a total of 488 goats at 32654 MNT (26 USD) per animal. Only 9 % of the herders had sold yak and cattle (average price 447600 MNT [354 USD] per animal) and 6 % of the families had sold horses (210000 MNT [166 USD] per animal). If possible, the herders try to sell livestock during spring when the prices are highest. However, decisions to sell animals are seldom

**Table 4** Results of multiple regression analyzing the effect of goat, sheep, yak and horses numbers on the yearly income of 87 herder households in Shireegiin gol

	Independent variables in model	R <sup>2</sup>	F	P
1	Goat	0.51	86.8	<0.001
	Sheep	0.38	51.8	<0.001
	Yak	0.16	16.2	<0.001
	Horse	0.07	6.2	0.01
2	Goat, yak	0.54	49.2	<0.001
	Goat, sheep	0.53	47.6	<0.001
	Goat, horse	0.52	45.7	<0.001
	Sheep, yak	0.43	31.2	<0.001
	Sheep, horse	0.38	25.6	<0.001
	Yak, horse	0.19	9.8	<0.001
3	Goat, sheep, yak	0.56	35.0	<0.001
	Goat, yak, horse	0.55	33.6	<0.001
	Goat, sheep, horse	0.54	31.9	<0.001
	Sheep, yak, horse	0.43	20.6	<0.001
4	Goat, sheep, yak, horse	0.56	26.1	<0.001



market-orientated and are usually not planned much in advance, often motivated by the need for cash, perhaps for family celebrations (e.g., weddings) or investment in children's education, including school and university attendance. Milk was usually used for household consumption (ca. 90 l per month/family) and also given to relatives without livestock living in nearby villages or in the city of Uliastai.

Family income increased with the number of household members ( $r=0.48$ ,  $P<0.001$ ). This is partly attributable to the monthly per capita grant of 21000 MNT, but is also due to the increase in the labor force, as even children are involved in livestock herding. This relationship is indicated by the positive correlation of the total livestock number per family with the number of household members ( $r=0.47$ ,  $P<0.001$ ). The two families with the largest livestock holdings were also the largest in terms of members of the household and the richest in terms of income (Table 5). Overall only four families owned significantly more livestock than the other herders in Shireegiin gol (Fig. 6). Remarkably, only two out of these four families converted their large herd size into high income, whereas the income of the two other families exceeded the average income in Shireegiin gol by a factor of only 1.5 (Table 5).

Cash was used to buy food (17 % of expenditures) or to cover non-food expenditures (83 %; Table 3). Food purchased in addition to household meat and milk production included flour (37 % of the cash expenses for food), vodka (12 %), rice (9 %), candies (9 %), vegetables (8 %), and sugar (7 %). Non-food expenditures include transportation (13 % of the cash expenses for non-food products or services), tuition fees (7 %), costs connected with obtaining fuel wood (5 %) and hay making (3 %).

#### Herders' Perception of Their own Situation and the Environment

The herders reported that the weather and rangeland conditions were unreliable because of drought years, harsh winters, including two heavy *dzud* years preceding the survey period, and resulting shortages of fodder. However, most herders did not consider this as a consistent trend of increasingly deteriorating climatic conditions, probably as a consequence of two recent consecutive summers with sufficient water and herbage after several summers of drought. The drought had not only

affected pasture quality, but also the availability of berries. Not only were forests viewed as a source of wood and other products, but some herders also mentioned that having a forest brings them pleasure and joy. Some even stated that the forest contributed to the availability of water and, importantly, to maintaining a balanced ecosystem. Only one quarter of the interviewees responded to the question of whether there is enough forested area in their environment; 68 % of these affirmed that the forest area was sufficient, whereas 14 % said there should be a moderate increase of the forested area, and 9 % felt that the forested area was insufficient.

Most herders were not very critical about their own living conditions, but all of them agreed that they did not want their children to become herders. Rather, they would prefer their children to get well educated and to work in the cities. Education was highly esteemed, because the herders assess the nomadic lifestyle as hard and risky due to environmental and climate uncertainty, even though they themselves enjoy living in their native region. Therefore, most families were very much concerned to promote the education of their children.

#### Discussion

The trends of livestock numbers in our study area Shireegiin gol, Tsagaankhairkhan *soum*, in the Mongolian forest-steppe matches well with the nation-wide trends for greatly increased goat numbers, the recent halt in the decline of sheep numbers and the moderate decrease of the large livestock species (Fig. 1). These data demonstrate that the trend towards goat for cashmere production (Lecraw *et al.* 2005) and the high significance of sheep for meat production is not merely a phenomenon of the dry steppes and semi-deserts to which these species of animals are better adapted than yaks, but also includes the more humid forest-steppe region. The study area is also representative of the situation in whole of Mongolia with respect to periodic decreases in livestock due to severe weather conditions, showing that the livestock numbers are not in equilibrium with the availability of rangelands in unfavorable years. During the most recent *dzud* in the winter of 2009/10, the Tsagaankhairkhan *soum* was among the regions of Mongolia which were most severely struck by livestock losses

**Table 5** Yearly income and number of household members in the four herder families with the highest livestock numbers in Shireegiin gol

	Total livestock			Goats		Income			Family members	
	Animals	Rank	% of average <sup>a</sup>	Animals	Rank	MNT × 10 <sup>6</sup>	Rank	% of average <sup>a</sup>	Persons	Rank
1	738	1	476	320	1	32.73	1	535	9	1
2	550	2	355	273	2	28.51	2	466	7	2
3	492	3	317	260	3	9.75	14	159	5	24
4	422	4	272	180	4	9.57	17	156	5	24

<sup>a</sup> Percent of means of the total livestock number or the income per household, respectively, of the 87 interviewed herder families in Shireegiin gol

(Fernández-Giménez *et al.* 2012). In addition to harsh winters, the herders in our study area are faced with periodic drought. However, drought alone is less limiting for the livestock, as can be seen from increasing livestock numbers (Fig. 5) despite several consecutive drought years prior to 2009. Begzsuren *et al.* (2004) and Sternberg *et al.* (2009) have emphasized that drought has a particularly negative effect on livestock in combination with harsh winters.

Notwithstanding the unreliable weather conditions, the herders' income in Shireegiin gol is clearly above the national average. The cash of the interviewed households was 147 % of the mean monetary income for Mongolia's rural population in 2010 (NSO 2011). A key factor determining herders' income is the access to the market (Fernández-Giménez 2002). The geographical position of the Tsagaankhairkhan *soum* is favorable in this respect, both because of its proximity to the capital of the Zavkhan district, Uliastai, and because the region kept its key market, the Mongolian capital Ulan Bator, to which livestock for meat consumption is sold as live animals.

During the Communist period, every region had to fulfill a production target for the delivery of meat to a defined area, which was Ulan Bator in addition to the Soviet Union in the case of the western Khangai (Edström 1993). Other regions of Mongolia were designated to deliver their agricultural products primarily to the Soviet Union and lost this key market after 1990 (Sneath 2004). Such areas of Mongolia are economically disadvantaged, as, for example, the Mongolian Altai in westernmost Mongolia, which not only lost its market but also has many remote regions that are too far from the regional markets to gain satisfactory profits (Lkhagvadorj *et al.* 2013).

Most herders in Shireegiin gol maintained the traditional spatiotemporal patterns of moving between seasonal campsites, thereby conserving their rangelands. In the Mongolian Altai, 600 km west of Shireegiin gol, much reduced mobility, insufficient market access, low income and the overuse of pastures and forests were correlated (Lkhagvadorj *et al.* 2013). The relatively high incomes in Shireegiin gol are connected with the widespread ownership of trucks, which facilitates both the marketing of the livestock products and the seasonal migrations.

The disparity in the income among those herder families who owned much more livestock than the average household in Shireegiin gol (Table 5) touches on a topic which is characteristic of the Mongolian livestock sector. Some herders are business-minded, whereas many families are little market-orientated. As in many pastoralist societies elsewhere (Bekure and Chabari 1991), most herders do not define their wealth in terms of income, but according to herd size. While this attitude might be beneficial for the herders' individual contentment, if animals are kept which contribute little to their livelihoods, it acts counter to the sustainability of land use in a marginal rangeland area. However, the lack of entrepreneurial spirit among many herders is also a problem with respect to the food supply for Mongolia's rapidly growing urban population,

which is faced with high and constantly increasing meat prices (Sneath 2004) in a country with a ratio of livestock to humans of ca. 40 to 3 million head. The price increases after decollectivization and price liberalization is mainly due to the collapse of traditional marketing structures (Sneath 2002) and to the increasing export of meat (NSO 2011). The fact that herders' decisions to sell livestock primarily stem from their requirements for cash and not the demand of the market is not likely to mitigate the price increases.

Even though many herders generally enjoy their lifestyle, most of invest a great deal in the education of their children. The herders' widespread desire that their offspring should not succeed them as pastoralists agrees with results of interviews with herder families in the Mongolian Altai (Lkhagvadorj *et al.* 2013). However, in the latter case, most herders were not able to reach this goal both because of economic limitations and because many herders do not speak Mongolian, as they belong to Mongolia's Kazakh minority (Diener 2007). In Shireegiin gol, access to higher education is much easier due to the better economic situation, the lack of a language barrier and proximity to the Mongolian capital; the effect is already visible in a slight basal constriction of the age pyramid (Fig. 3).

## Conclusions

Herder families in Shireegiin gol are economically doing better than the Mongolian average rural household. They still follow traditional migration patterns with ca. 10 seasonal translocations per year, and benefit from a relatively easy market access. These circumstances result in relatively resource-friendly land use practices with, for example, recently reduced wood extraction from the forests. Herders generally do not suffer from a shortage of pasturelands, but are affected by harsh winters and summer droughts, phenomena which are known to have become more frequent in Mongolia in the past decades (Dagvadorj *et al.* 2009; Fernández-Giménez *et al.* 2012). Since unreliable weather conditions imply strong economic uncertainties, most herders' try to give their children better education that will enable them a life in the cities. The potential socioeconomic implications of this widespread wish of the pastoralists not to continue their family businesses into the next generation, which was observed both in the present study and in a recent study in the Mongolian Altai (Lkhagvadorj *et al.* 2013) should receive increased attention by Mongolian policymakers against the background of the high economic significance of the livestock sector at present.

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