Range-based livestock production in Turkmenistan

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Abstract

Turkmenistan retains a centralized system of livestock production in which many critical assets are owned by the state. Though technically in the temperate zone, the country's climate is harsh and unstable. Groundwater resources are unevenly distributed, leaving many potential grazing areas seasonally inaccessible due to lack of drinking water for livestock. This paper summarizes the results of a three-year study of rangelands, livestock production, flock economics and land tenure at two study sites, one in central and the other in eastern Turkmenistan. The results of this study suggest that pastoral communities in Turkmenistan have coped remarkably well with the institutional changes that followed the demise of the Soviet Union, and with the country's persistently unstable climate and scarce natural resources.

Keywords: Turkmenistan, Central Asia, pastoralism, grazing systems, agricultural reform

Introduction

Turkmenistan has preserved more of its Soviet agricultural legacy than almost any other part of the former USSR. In Turkmenistan the state owns almost all agricultural land and maintains large collective farms that supply critical commodities, such as wheat, cotton and meat, in response to state production targets and procurement orders. Following the dissolution of the Soviet Union and market reforms in China, centralized agricultural regimes of this kind are increasingly rare. The object of this paper is to describe how this system works in the pastoral sector of Turkmenistan.

The paper argues that the system works because, contrary to expectations, it is effectively decentralized. Despite state controls, herders have considerable freedom to fashion husbandry systems that are adapted to their individual needs and local resource availability. The result is a remarkably constant level of livestock output irrespective of variation in natural resource endowments and herd sizes. There is also evidence that the system supports equitable livestock distributions, with small herds growing more consistently than large ones over the study period.

Administrative organization of the livestock sector

The present organization of the livestock sector resulted from reforms following presidential decrees in the 1990s.

In 1994 and 1995 presidential decrees transformed the Soviet collective (*kolkhoz*) and state (*sovkhoz*) farms into farmer associations or *dihan birlishik.* The new associations took on the assets of the old Soviet farms and adopted the old farm boundaries. What did change after the Soviet era was the way agricultural production was organized inside these farms. Arable farm land was no longer worked collectively, but was subdivided and leased to individual families. Instead of a salary, these farmers now sold the produce of their lease holdings, either at controlled prices to the government or on the open market (Lerman and Brooks, 2001). In the pastoral sector, leasehold contracts pertained not to land plots but to herds of state-owned

animals, which became the responsibility of individual shepherd families. Like leasehold farmers, these shepherds no longer received a salary from the state or the collective farm. They were instead entitled to a proportion of the offspring of the herd under their care, in return for bearing the costs of herd maintenance and assuming all risks if animals died or were lost. Unlike cotton and wheat marketing, which was characterized by both input and output price distortions, shepherds and the state transacted their business on a barter basis, each side taking its income in live animals. Shepherds were free to sell their produce on the open market, and neither the state nor the collective farms provided shepherds with subsidized services or inputs.

The adoption and standardization of the contract leasing (*arinda*) system took several years to work out. In the late 1990s herding contracts were not uniform, and the share of a herd or flock's offspring that belonged to the shepherd differed according to agro-ecological conditions or by administrative region (see Lunch, 2004, for the period up to 1999). In 1999 officials briefly considered paying shepherds a salary calculated on the value of their share of flock output, rather than in live animals. In the late 1990s it was also unclear who should provide inputs like supplementary fodder and veterinary services. Some collective farm managers said that provision of these services for state-owned flocks should be their responsibility, but few of the shepherds keeping state-owned animals received enough inputs from the collective farms and most depended on their own resources.

By 2000 there was in place a uniform national system of livestock leasehold. Shepherds with breeding flocks were the single most common type of contractor in the livestock sector. The terms of their contracts assumed a 95% lambing rate with half of the lamb crop going to the shepherd and half to the association. For example, for a flock of 1000 ewes, presumed lamb production would be 950 with, at weaning, 475 head going to the shepherd and a similar number to the farmer association, with the association having first claim to female animals. The shepherd bore all risks. Inputs, such as fodder, veterinary services or water transport by tanker truck, could be purchased by the shepherd from the association, and payment deferred until the end of summer when lambs were counted, separated and accounts settled. The shepherd was also free to obtain these inputs on the open market. The shepherds were responsible for shearing and kept all wool, and were entitled to slaughter a set number of animals for home consumption and to receive advances on their 'wages' prior to weaning.

By 2000 three different kinds of large farms owned livestock - specialized livestock farms, arable farms in which livestock keeping was an ancillary activity, and district-wide 'shareholder stock associations'. Transformed into farmer associations, the specialized livestock and arable farms were the institutional descendants of Soviet-era collective and state farms. The shareholder stock associations were new and were created by presidential decree in 1999 to address the problems of keeping animals on farms that were involved predominately in irrigated farming. In the middle to late 1990s, livestock populations on these arable farms had declined. To stem these losses, it was decided to take state-owned livestock away from arable farms, which were only marginally interested in pastoral activities and which had scattered livestock holdings that were difficult for the central authorities to supervise. Livestock collected from these farms were pooled into a single operation that managed all the state-owned livestock and pastures in a district (*etrap*), the lowest level in the national administrative system.

Shareholder stock associations were the largest operations in the livestock sector. In Mary Province, for example, there were nine shareholder associations, each covering a single

district of the province, with holdings averaging 84,000 head of sheep per association in 2003. The shareholder stock association for the District of Bayram Ali north and west of Mary town was typical. It was formed in 1999 from about 70,000 sheep and 246,000 ha of pastures appropriated from the district's ten wheat and cotton farms. By 2003 the association had increased its holdings to 84,000 head, kept in 85 separate flocks, but had supplied its shareholders - the farms from which it had initially taken stock and land - with only 1000 head. The low dividends paid to the shareholding farms followed an explicit government policy to minimize animal sales and slaughter in order to expand the size of the national flock. In winter, association flocks grazed pastures about 100 km from Bayram Ali town; in summer the flocks moved to distant pastures in the mountains and foothills near the Afghan border. Pastures near the Karakum canal were not used by state-owned animals and were available for use by herds and flocks owned privately by people living along the canal.

Methods and field sites

Agro-ecological and socio-economic research was carried out at two sites - one on a collective farm in Mary Province (*wilayat*) in eastern Turkmenistan, and the other in the pastoral portion of the District (*etrap*) of Gokdepe, in Ahal Province close to the capital city of Ashgabat. Work at these sites included a livestock census and survey of livestock husbandry practices, in-depth interviews with shepherds, farm managers and district-level officials, and the analysis of statistical data available from state organizations.

The field site in Mary Province included all of the Ravnina village *dihan birleshek*, or farmer association, located in Baydram Ali District. Ravnina village is located about 100 km to the north and east of Mary city along a paved road and with good rail links to the city. About 260-270 families - roughly 1850 people - lived in the association's territory - including the population herding in the desert, living in hamlets at stops along the railroad line, and in the central village. The farm, which receives about 140 mm of precipitation per year, consists almost exclusively of desert pastures, is 346,000 ha in size and is traversed by 45 km of the Karakum canal. Ravnina *dihan birleshek* was a specialized livestock production farm and only a few families on the farm engaged in any cultivation aside from irrigated backyard gardening. In 2004 the farm kept about 26,000 head of state-owned sheep in 34 flocks averaging slightly less than 800 head per flock. In 2004 families on the farm privately owned about 7000 head of sheep and goats, 100 camels and a couple of hundred cattle.

Fifty-five randomly selected shepherds, keeping both private and state-owned animals, were interviewed in Ravnina in 2003 and 2004. A standard questionnaire was used to collect information on herd composition and size, herd movement patterns over the last year and the use of fodder. Intensive open-ended interviews on a wide range of subjects related to livestock-keeping were conducted with selected shepherds and farm staff. Officials responsible for livestock were also interviewed in Bayram Ali District, where Ravnina is located.

The second study area consisted of the pasture areas that make up the northern two-thirds of Gokdepe District. Gokdepe town, the administrative center of the District, lies about 50 km west of the national capital of Ashgabat on paved roads along the Karakum Canal. The pastures belonging to the district stretch about 150 km to the north of the canal into the Karakum desert. At the time of the study, eleven collective farms with their headquarters and main settlements along the canal held northern pastures. All of these collective farms were primarily engaged in arable agriculture, but held some state-owned sheep and camels under

the care of shepherds permanently resident in the pasture areas. Pasture areas and settlements north of the canal were accessible only by unpaved desert tracks.

Using the same questionnaire that had been developed for Ravnina, ninety-two interviews with randomly selected state and private shepherds were conducted along a north-south transect that began at the northern fringe of the district's settled zone and ran north to the northern boundary of the district. The transect included 20 settlements ranging in size from a single family to just under 40 families. The pastures covered by the transect supported approximately 21,000 head of sheep and goats, 2000 camels and, in the most southern settlement on the fringes of the cultivated zone, 130 cattle. Intensive open-ended interviews were held with the managers of collective farms, district-level government staff and shepherds between 1999 and 2004.

To estimate flock performance twenty sample flocks were also selected in each study area. The sample flocks were chosen to reflect the distribution of sheep and goats in flocks of different sizes in the study communities. The flocks were visited approximately every three months from August 2001 for eighteen months. During each visit live weights were recorded on a sample of up to 30 sheep in each flock, in the morning prior to the animals going out to graze. For flocks of less than 30, all animals were weighed. For those of more than 30, a representative sample was monitored. For mixed flocks of sheep and goats of over 50 animals, the species were chosen roughly in proportion to the species in the whole flock. To ease identification monitored animals were ear-tagged.

A specialized livestock farm: Ravnina

At the time of the Soviet Union, Ravnina village and farm was one of two specialized livestock farms in the district of Bayram Ali. When the district-wide shareholder stock associations were formed in 1999, specialized pastoral operations, like Ravnina, were permitted to keep their animals and their independent identity.

In the late Soviet period Ravnina state farm employed around 300 people. By 2004 the association employed about 30 people, half in the farm's engineering section as drivers, watchmen, mechanics and pump operators, and the other half consisting of managers and office staff - the director, accountants, economists, veterinarians and secretaries. Thirty-four shepherds kept state-owned association sheep on contract. Aside from the farm itself, there were roughly another 100 salaried employees living in the village and working at the local school, health post and on the railroad.

Ravnina village is a station on the railroad line between Mary and Charjev and owes its existence to the railroad. In 1882-3 the railroad arrived and people started to settle in the vicinity. But the village was not founded until 1927 when the Soviet authorities confiscated livestock from rich owners in the neighboring province of Lebab on the other side of the Amu Darya River, and resettled both animals and shepherds in the new village. Initially Ravnina was a department within a neighbouring state farm, but it became an independent state farm in 1932 and was subsequently upgraded to a Karakul sheep breeding station in 1966. In 1963 the village was supplied with piped water from the Karakum canal. In 1996 the farm was re-established as a farmer association.

The pastures operated by the farm are bisected by the Karakum canal. Ravnina village and roughly a quarter of its pastures lie north of the canal. These northern pastures were occupied

primarily by privately-owned livestock belonging to village residents. The remaining pastures south of the canal contained about 40 wells constructed between 1932 and 2000 and varying in depth from about 20 to over 100 metres. Shepherds keeping association animals, usually a flock of 500-900 head resident year-round at a single well, occupied these pastures.

Mean annual rainfall in Ravnina is about 143 mm. *Haloxylon aphyllum, H. persicum*, *Calligonum setosum* and *C. divaricatus* dominate the vegetation north of the canal and around the village itself. The vegetation of the rolling dune country in the pastures to the south of the farm is dominated by *Calligonum eriopodum, Ephedra strobilacea, Salsola richteri* and *Astragalus unifoliolatus*. Dry matter yields varied from a low of 250 kg/ha near the village to 650 kg/ha on the southern rangelands (Gintzburger *et al*., 2005).

Figure 1 shows the numbers of state-owned sheep on the farm from 1940-2004. Several phases in the farm's development can be detected from these figures:

- From 1940 to the early 1960s there was a steady increase in small ruminant numbers, which peaked at 67,000 head in 1962. There is little evidence that the digging of new wells led to these increases in stock numbers. Instead, the grazed area which was accessible to water was relatively constant over the 1950s and the stocking rate in this area increased.
- 1969 was a disastrous year for which no flock size figure is available. Old farm managers recall that in 1969 after losing about 27,000 animals the farm had about 23,000 head. The reason for the mortality was a severe winter, which proved a turning point in the farm's management strategy. Thereafter it focussed on fodder collection as a buffer against winter weather. Also, in the 1970s fodder collection was mechanized, which substantially increased the amount that could be harvested. Adequate fodder provision was calculated to be 150 kg per head of livestock. Despite these precautions, total flock size never again equalled that of the early 1960s. When total numbers began to increase in the late 1990s, they were again reduced by a severe winter.
- When records resumed again in 1970, there was a steady two-decade-long increase in flock size from about 30,000 to around 40,000 head. During this period, extreme weather events - either good or bad years - had no consistent or visible impact on stocking levels. This result conforms to the opinions of experienced shepherds who assert that there is no reason for poor years to become disasters if precautions have been taken to collect sufficient winter fodder. During this period, growth in sheep numbers was contained by a high offtake - roughly 5000 head annually for meat to the government, 5000 head as breeding stock for other farms, and 10-15,000 karakul lamb pelts per year.
- 1999 was another year for which no records were kept. Up to 14,000 sheep may have died in that year. When record-keeping resumed again in 2000 the flock was down to 20,000 head, whereas it had stood at 45,000 in 1998. Heavy snowfalls occurred in late winter when the sheep had already moved to fresh pasture and would not return to eating the dry standing material which was all that was available after snow covered the ground for a week to 10 days. The weather was, therefore, a genuine problem, but it need not have been a disaster according to most shepherds. This was a period of transition to the current *arinda* system of contract flock management. At this point the collective farm was responsible for fodder provision but in fact had collected very little, and shepherds were being erratically paid. The poor weather revealed underlying institutional problems.
- After the crash in 1999, sheep were in good condition because of the decline in their numbers, and the contract herding system paid shepherds well and there was no confusion over the responsibilities of shepherds and farm managers. Flock numbers were again rising and abandoned wells were being re-opened to accommodate newly created flocks.

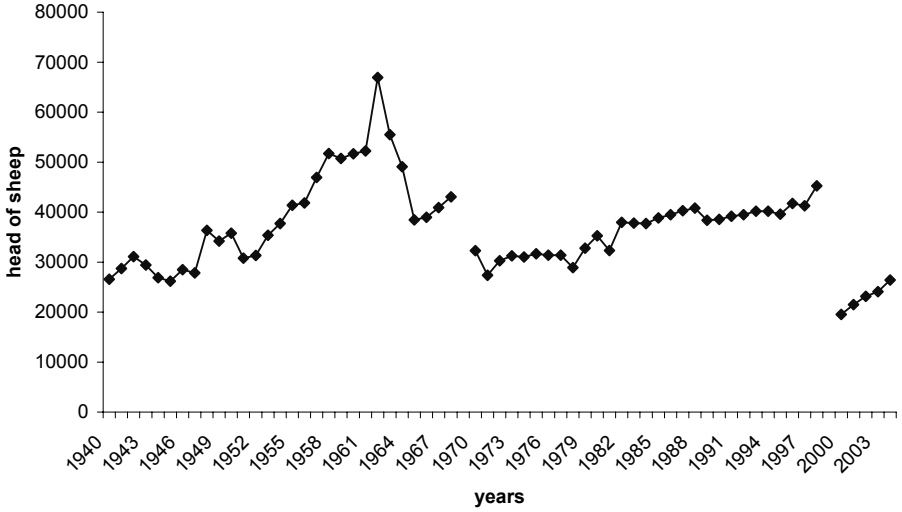

Figure 1 State-owned sheep numbers in Ravnina, 1940-2004

Table 1 documents two geographically separate systems of livestock production on Ravnina Farm. Pastures south of the canal were occupied by over 30 flocks of state-owned sheep combined with the private animals owned or cared for by the shepherds looking after the state animals, a total of about 26,000 sheep. Sampled herds averaged over 900 sheep equivalents and generally occupied a single well each. In contrast, with the exception of one recently established government flock and the farm's collective camel herd, all animals north of the canal were privately owned. These private flocks were small but increased in average size as one moved further from the central village. In the village itself, average holdings were 38 sheep equivalents typically consisting of about 30 head of sheep and goats and a small number of dairy cows for household milk consumption. Herds in outlying hamlets were substantially larger (at 70 sheep equivalents) and those based in isolated farmsteads or mobile camps were larger still (at 227 sheep equivalents per holding). In total, about 7000 sheep equivalents were kept north of the canal.

The government flocks south of the canal were managed very differently than the private flocks to the north. The contrast is starkest when village-based flocks are compared with those at wells in the southern desert. Per head, village animals received about fifteen times more feed supplements than the desert animals - 78.9 versus 5.3 fodder units per sheep equivalent, respectively (Table 1). This supplementary feed was also used very differently in the two locations. In the village, supplementation was a regular feature of animal diets, and all animals in village flocks were supplemented for nearly five months of the year. In the desert, feed supplementation was reserved for emergencies when snow prevented grazing or was given selectively to weak, pregnant or lactating animals for less than two months per year. On average, desert rations consisted of camel thorn (*Alhagi persarum*) for bulk plus one additional feed item of higher quality, such as alfalfa, a feed concentrate or grain; village rations were based on camel thorn and two additional high-quality feed items.

Table 1 Herd size, forage availability and fodder use in Ravnina: 2003-4

	Wells[1]	Outside village[1]	Hamlet[1]	Main village[1]	s.e.d.[2]	P value
Number of sampled herds	15	9	4	27	-	-
Sheep equivalents per sampled herd[3]	971	247	70	38	-	-
Small ruminants per sampled herd	792[4]	227	52	30	-	-
Pasture production (kg DM/ha/year)[5]	448	415	415	379	-	-
Stocking rate (ha/sheep equivalent)	4.5[5]	7.1	9.6	5.0	-	-
Pasture production (kg DM/year/sheep equivalent)	2016	2946	3984	1895	-	-
Fodder units/sheep equivalent[6]	5.3	13.2	20.6	78.9	9.5	<0.001
Fodder cost/sheep equivalent (in manat)[7]	5943	4108	2958	30441	5521.5	<0.001
Cost/fodder unit (in manta)[7]	1046	140	82	353	290	<0.001
Number of kinds of fodder used[8]	1.9	1.8	2.0	2.9	0.47	<0.01
Flocks in which all animals received fodder	7%	33%	100%	100%	0.13	<0.001
Months of regular winter feeding	1.8	1.7	3.0	4.8	1.23	<0.001

Notes:
[1]Wells = Association wells in pastures south of the Karakum canal; Outside village = households occupying isolated farmsteads north of the Karakum canal; Hamlet = settlements of 6-12 households at railroad stops along the line; Village = the central village of Ravnina
[2]Standard Error of the Difference
[3]Estimated live weights of livestock species were converted into sheep equivalent units by a multiplication factor based on the estimated mean live weights derived from FAO (1989). 1 SEU or LU was deemed to be equivalent to a 45 kg Karakul ewe. 1 camel = 4.6 stock units; 1 cattle = 3.6 stock units.
[4]Shepherds were allowed to keep their private animals at the desert wells with the state flock. On average 136 of the sheep and goats in each flock were privately owned.
[5]Estimates based on Gintzburger *et al*. (2005).
[6]One Soviet Fodder Unit is equivalent to the total nutritive value of 1 kg of dry oats (Zhambakin, 1995). The following conversions were used for other types of fodder: 1 kg of camel thorn = 0.3 of a fodder unit (fu); 1 kg alfalfa = 0.45 fu; 1 kg maize = 1.24 fu; 1kg of wheat = 1.16 fu; 1 kg cottonseed residues = 0.66 fu; 1 kg wheat bran = 0.71 fu; 1 kg crushed straw = 0.21 fu; 1 kg maize stems = 0.15 fu; 1 kg natural grasses = 0.3 fu; 1 kg of kombicorn (feed concentrate) = 0.71 fu.
[7]$1.00 USD = 22,000 Turkmenistan manat at the informal exchange rate in 2003-4.
[8]Typical types of fodder are listed in note 6.

Transportation costs explain part of the difference between northern and southern feeding regimes. Cost per fodder unit could be up to ten times higher in the southern desert than in the northern areas where supplies could be obtained cheaply from nearby farming communities or urban markets. Village shepherds also complained about poor quality and over-used village pastures, which forced them to purchase feed supplements to compensate for poor natural grazing. Estimates of pasture production (annual plant and ephemerals biomass) revealed a steady north to south gradient of rising productivity, with the least productive pastures north of the village and the most productive around the southern-most wells (Gintzburger *et al*., 2005). However, stocking rates around the village were very similar to those at the wells, largely because village flocks walked further to their pastures. As a consequence, estimated pasture production per stock unit was roughly similar around both the wells and the village, which does not explain why shepherds complained about poor grazing conditions in the vicinity of the village. The most likely explanation is that village flocks had to walk further to their pastures, and that these pastures provided a flush of productivity in spring followed by dearth in summer and winter due to a relative absence of perennial and woody vegetation.

Despite the differences in feeding regime, there were no significant differences in the live weights of adult female sheep between those from the wells and those in village flocks 48.0

kg vs. 48.4 kg; s.e.d. 0.58). There was a significant difference ($P<0.01$) in goat live weights between those from the wells and those in village flocks (38.6 kg vs. 41.9 kg; s.e.d. 0.98).

Gokdepe district

Ahal Province, which includes the national capitol of Ashgabat, was exempted from the reorganization that created shareholder stock associations in the late 1990s. Unlike the rest of the country, in Ahal Province arable farms continue to own and manage livestock as an adjunct to irrigated farming. Gokdepe District illustrates this arrangement.

In 2003 Gokdepe District contained fourteen farmer associations situated along the Karakum canal, primarily involved in wheat and cotton production. These farms owned a total of over 23,000 sheep and goats and 3500 camels, kept on over 4000 km^2 of rangeland. The bulk of this grazing land lay within a rectangle roughly 30 km wide in an east-west direction that stretched from the canal north into the Karakum desert for about 150 kilometres. Farms tended to own between two and four discontinuous blocks of grazing land, and to have herds scattered throughout the northern part of the district.

Rainfall is higher at the southern than in the northern desert pastures - 140 mm per annum in the south versus 110 mm in the north. Groundwater is also more plentiful in the south, as waste water from crop irrigation is channelled into canals that feed marshes and lakes in the desert. Although parasite-infested, this waste water is abundant in the southern sand-clay desert and freely available for watering stock, in contrast to the limited supplies of well-water available elsewhere.

To the north, vegetation in the sand desert is dominated *by Haloxylon persicum, Carex physodes, Ephedra stroboliacea* and *Aristida pennata*. Average DM yields are 211-239 kg/ha with an available fodder portion of 88-107 kg/ha (Khanchaev *et al*., 2004). Vegetation in the sand-clay desert at the south end of the transect has been modified by grazing and by the removal of *H. persicum* for fuel-wood. Dominant species are *Calligonum rubens, Salsola richteri*, and *Carex physodes*. Average total dry mass production is 187 kg/ha per year, with an available fodder portion of 99 kg/ha/year (Khanchaev *et al*., 2004). Mean production figures are, however, deceptive. Over a three-year period that included both drought and good rainfall years (2001 to 2003), DM yields varied threefold at sampling sites along the transect (Khanchaev, 2005).

Human settlements and livestock population levels along this transect are directly correlated with water availability. Areas that offer more water and better quality water have attracted more settlers and more livestock. In the far south, where water was freely available, residents owned about 19 sheep equivalents for every km^2 of pasture accessible from their settlements (Table 2). In the far north where water was scarce and of poor quality, local residents kept many fewer animals relative to the pasture area available to them - 7.6 sheep equivalents per km^2. In two middle grazing zones, both water availability and stock densities were intermediate.

When feed is in short supply, the herder has several options: to move the animals to the feed, to move the feed to the animals, or to move water where it is needed. The husbandry practices described in Table 2, i.e. nomadism, fodder provision, water transport, and changes in herd composition, therefore compensate for the aggregation of stock around plentiful water supplies. In zones of heavy stock concentration, herds and flocks spent less time in the

immediate vicinity of the village, thereby reducing stocking rates around settlements. Fodder provision further closed the gap between the amounts of natural forage available from lightly- versus heavily-used pasture areas, and trucked water opened up fresh pastures in areas where natural water supplies did not exist. Finally, the choice of herd species influenced local stocking densities and feed availability. Camels roam widely around settlements on a daily or weekly basis, but become attached to home ranges that are incompatible with long-distance seasonal migration. Sheep are the opposite, with restricted daily movement but the capacity to migrate long distances.

At the south end of the transect, water for livestock was abundant, stocking densities were high, and it was the supply of natural forage that limited further expansion in herd numbers. Local herders responded by using fodder on a regular basis, trucking water, migrating seasonally, and by specializing in sheep that were adapted to long-distance migration. At the opposite extreme was the area at the far northern end of the transect, a cluster of isolated wells deep in the Karakum desert. In this area livestock numbers were restricted by the small quantity of poor quality, saline water that was available. Herders in this zone pushed their wells hard, maintaining more animals per working well than communities elsewhere along the transect. But the density of animals owned by residents was low relative to available grazing, and aside from keeping many camels, herders employed none of the husbandry practices that were used elsewhere to improve feed availability.

Evidence suggests that shepherds were remarkably successful in adapting their husbandry practices to equalize livestock output despite variable resource availability. A total of 1353 small ruminants were weighed quarterly for a year with the sample divided into three groups: flocks based in the southern sand-clay desert and migratory, those based in the southern sand-clay desert but resident year-round, and those based in the southern sand desert. Despite the differences in location and husbandry practices, there were no significant differences in adult sheep weights (43.3 kg vs. 43.9 kg; s.e.d. 0.45) between flocks based in the southern sand-clay desert and migratory, those based in the sand-clay desert but resident all year round and those based in the northern sand desert.

Table 2 Water and feed availability and husbandry practices by herding households in Gokdepe District, Turkmenistan 2002-3

Grazing zone	Southern sand-clay desert	Northern sand-clay desert	Southern sand desert	Northern sand desert
Water availability	Abundant, fresh surface water	Fresh well water	Fresh and saline well water	Saline well water and runoff
Grazing area around settlements (km^2)	377	710	707	974
Resident sheep equivalents per working well	2830	283	293	974
Stocking rate (sheep equivalents per working well	146	175	169	200
Total sheep equivalents owned by residents/km^2	19.3	11.2	12.9	7.6
Stocking rate (sheep equivalents/ km^2)	10.9	6.9	6.8	7.6
Proportion of sheep and goats	0.95 (n=22)	0.56 (n=9)	0.52 (n=12)	0.59 (n=13)
Proportion of camels	0.05 (n=10)	0.44 (n=10)	0.48 (n=15)	0.41 (n=7)
Proportion of migratory flocks	0.68	0	0	0
Proportion of flocks using trucked water	0.68	0.89	0.58	0
Proportion of sheep regularly receiving fodder	0.23	0	0.08	0
Proportion of camels regularly receiving fodder	1.00	0	0.08	0

Equity and taxation

Twenty flocks in Ravnina and twenty in the Goktepe study area were sampled four times annually in 2001-2002. Over this period, 25 flocks grew in size and 15 became smaller, and the propensity to either expand or contract was correlated with their initial size (Table 3).

Table 3 Growth and decline in size of flocks

Initial flock size	Decrease in flock size (%)	Increase in flock size (%)
1-150 sheep equivalents	13	87
150+ sheep equivalents	71	29

Based on a single year of observations in an extremely variable climate, these results are inconclusive but suggest that greater differentiation in herd wealth was not occurring in the communities studied during the short time they were monitored.

The egalitarian ethos of rural Turkmen undoubtedly played a part in sustaining small herds. A contributing factor may also be the way that the contract (*arinda*) herding system taxed the pastoral sector. Shepherds, herding for the state, surrendered half of the offspring of their flocks, equivalent to an income tax rate of 50%. Private flocks were not taxed. The actual tax rate for the pastoral sector as a whole therefore depended on the balance of private versus state animals. In the Gokdepe sample, sheep holdings were evenly divided between private and state animals, giving an average pastoral income taxation rate of about 25% of animal offtake, with shepherds liable for herding expenses but the beneficiaries of dairy and fibre production. In Ravnina, where state-owned animals constituted about 80% of the holdings, the comparable taxation rate was just under 40%.

Conceived of as a taxation system, contract herding does not apportion the tax burden evenly. While the state may have claimed up to half of the income of contract herders, private herders paid nothing. The all-or-nothing nature of the *de facto* taxation system encouraged the growth of small private herds. As a general rule, the pastures adjacent to large agricultural settlements were set aside for grazing by private animals, while more productive but distant pastures were occupied by state-owned herds. This system worked well for the private owners of a few dozen sheep and goats, who wanted to keep their animals around the village, did not need extensive pastures for their flocks and could afford to offset poor grazing by providing feed supplements for a small number of animals. The system was less advantageous for large private flock owners who wanted secure access to extensive pastures. This access could only be obtained by caring for state animals, which gave the shepherd the privilege of pasturing private and family-owned animals alongside the state-owed flock. In this way the *de facto* tax burden fell disproportionately on larger herd owners or on extended kin groups that had to herd state animals in order to secure better grazing rights.

Conclusion

The large agricultural enterprises, state ownership of livestock, and contract herding system of independent Turkmenistan have a long regional history. Referring to Mongolia, Humphrey and Sneath (1999) observed that:

In some respects the change from a 'feudal' to a collective organizational form was a less radical change than the one currently underway as the government attempts the transition to a market economy. In both 'feudal' and collective periods there were centralized, commandist politico-economic units that regulated residence, the use of pasture, and extracted a surplus through right to livestock…. Like the feudal lords and the monasteries before them, the collectives organized movement, single-species herds, and allocated pasture.

Humphrey and Sneath (1999) were arguing that hierarchical institutional forms persisted in the transition from feudalism to socialism in Mongolia. Much the same point can be made for the transition from socialism to state-dominated capitalism in contemporary Turkmenistan.

The dominant role of the state in arable farming has been judged as, at best, a mixed success in Turkmenistan (Lerman and Brooks, 2001). State involvement in the pastoral sector has, thus far, been more successful. The contract herding system was uniform, reasonably transparent and deemed by most shepherds to be a fair payment system. It avoided price distortions by paying shepherds in live animals and provided material incentives for those who exceeded their contractual obligations. On a day-to-day basis most decision-making had been delegated to the shepherds to devise husbandry systems and to obtain the inputs that they needed in their particular circumstances. These arrangements resulted in remarkably constant levels of productive performance despite differences in herd sizes and local variations in pasture and water resources. The state has remained ultimately in control through its ownership and command over the allocation of natural resources.

Acknowledgements

Research in Turkmenistan was supported by the European Commission Inco-Copernicus RTD Project ICA2-CT-2000-10015 Desertification and Regeneration: Modelling the Impact of Market Reform on Central Asian Rangeland (DARCA), Macaulay Institute, Aberdeen, U.K.

References

FAO (1989) Animal Genetic Resources of the USSR. N.G. Dimitriev and L.K. Ernst (eds.) Food and Agricultural Organisation Animal Production and Health Paper 65, FAO, Rome. 517pp

Gintzburger, G., S Saidi and V. Soti (2005). The Ravnina rangelands in Turkmenistan: current vegetation condition and utilisation. Unpublished report, the DARCA project. CIRAD-ECONAP, Montpellier, 75pp.

Humphrey, C. and D. Sneath (1999). The end of nomadism? Society, state and the environment in Inner Asia. Duke University Press, Durham, 353pp.

Khanchaev, K. (2005). The results of vegetation monitoring in Goktepe. Unpublished report, the DARCA project. Macaulay Institute, Aberdeen, 11pp.

Khanchaev, K., C. Kerven and I.A. Wright (2004). The limits of the land: pasture and water conditions. In: C. Kerven (ed.) Prospects for pastoralism in Kazakstan and Turkmenistan: from state farms to private flocks. RoutledgeCurzon, London, 194-209.

Lerman, Z. and K.Brooks (2001). Turkmenistan: an assessment of leasehold-based farm restructuring. World Bank Technical Paper No. 500. Europe and Central Asia Environmentally and Socially Sustainable Development Series, Washington, D.C., 68pp.

Lunch, C. (2004). Shepherds and the state: effects of decollectivisation on livestock management. In: C. Kerven (ed.) Prospects for pastoralism in Kazakstan and Turkmenistan: from state farms to private flocks. RoutledgeCurzon, London, 171-193.

Zhambakin, Z. A. (1995). Pastbisha Kazakhstana (Pastures of Kazakstan). Kainar, Almaty.