KAZAKH NOMADS, RANGELAND POLICY AND THE ENVIRONMENT IN ALTAY:

INSIGHTS FROM NEW RANGE ECOLOGY

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Abstract

Core features of Chinese rangeland policy are the settlement of pastoral households, the subdivision of rangelands into individual household parcels and the derivation of maximum stocking rates. This approach is implicitly based upon conventional rangeland science, the applicability of which to highly variable environments is being increasingly questioned by new range ecology theory. This paper considers the degree of environmental variability in an extensive pastoral area of Altay, northern Xinjiang, assesses the extent to which institutional arrangements are able to accommodate environmental variability, and discusses the implications of this for rangeland policy.

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1. INTRODUCTION

There is a widespread perception that rangeland degradation problems in China are serious and worsening[3], and that overstocking is the principal cause. Overstocking in turn is often attributed to a 'tragedy of the commons' situation that arises from private livestock grazing on 'common' lands[4]. The solution of the state, embodied in its national rangeland policy, is the settlement of pastoral households and the allocation of rangeland to the individual household level. These measures are believed to give herders the incentive to stock rangeland within carrying capacity but, in the advent that they don't, financial penalties for overstocking are thought to act as an ultimate deterrent. Chinese rangeland policy, particularly its emphasis on delimiting household rangelands and assigning a 'carrying capacity' to them, is grounded in the theory and concepts of mainstream range management. In the latter, forage availability is primarily governed by livestock numbers. The challenge for the range manager is to 'balance grazing pressure against the natural regenerative power of the plants, thereby maintaining a stable sub-climax which yield[s] a steady and profitable flow of animal products' (Behnke and Scoones, 1993:3). Carrying capacity marks the stocking rate at which such an equilibrium can be achieved. If carrying capacity is exceeded for a number of years, decreased forage availability will result in increased livestock mortality, which in turn will allow vegetation – and equilibrium - to be restored.

The applicability of mainstream range management to regions subject to high environmental variability has been increasingly challenged (Behnke and Scoones, 1993; Ellis and Swift, 1988). In such regions, climatic factors governing plant growth, especially rainfall and temperatures, are not constant and may have a more significant impact on plant growth than the marginal impacts of different stocking densities. Thus it is climate, not past or present stocking densities, that principally governs rangeland productivity in any one year. Furthermore, there are both conceptual and measurement

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[3] According to official sources, some 90% of China's rangelands are degraded to some degree, including 42% moderately to seriously (SDPC, 1996: 82-94; SEPA, 1998).

[4] For example, see: Li and Duo, 1995; Longworth, 1993; NRC, 1992; Tuoman, 1993; Yu et al, 1996; Wang, 1995.

difficulties associated with the calculation of carrying capacity. Ecological carrying capacity can only be defined with reference to the management objectives of the herder and his/her associated animal exploitation strategy: there is no single objective ecological carrying capacity. The accurate measurement of carrying capacity is difficult in a stable environment and becomes a particularly problematic exercise in highly variable environments. In the latter, there is the problem of distinguishing between climate-induced changes in vegetation and more permanent changes. Other characteristics of rangelands and their use in highly variable environments also compound the problem of measurement: spatial heterogeneity in vegetation; seasonal use patterns; and the simultaneous grazing of diverse livestock species on the same rangelands. With reference to African savannas, Bartels et al (1993: 100) goes as far as to argue: “Let us admit the problems with the carrying capacity concept, and stop trying to apply it”.

According to new range ecology, ‘opportunistic management’ is more appropriate than conventional range management in regions characterized by high environmental variability (Behnke and Scoones, 1993: 28-30). Features of opportunistic management, that are evident in ‘traditional’ pastoral systems, include the seasonal migration of livestock and high but fluctuating stocking rates. Policy needs to support such opportunistic strategies. Land tenure policy, for example, needs to facilitate mobility and flexible access. Strengthening marketing systems to enable rapid de-stocking in adverse years represents a more appropriate strategy for rangeland management than the attempted calculation and enforcement of carrying capacities. A final implication of new range ecology is that there is a need for pastoral administrations to re-orient their approach away from regulation and control, and towards monitoring key events and assisting herders to cope with them. This in turn implies the devolution of authority over resource use to herders and pastoral groups (Swift, 1995).

The extensiveness and aridity of China’s northern rangelands render them susceptible to the application of new range ecology but so far surprisingly few people have undertaken this endeavor. Ho (2001) applies new range ecology to the case of sedentary agro-pastoralism in Ningxia province. Despite the existence of a non-equilibrium system, as indicated by high rainfall variability, Ho found no statistical evidence of a relationship between precipitation and livestock numbers, a central proposition of new range ecology. One of the explanations given for this is the strong institutional presence of the state at the township level in China, vis a vis the case of much of dryland Africa. This enables the state to deliver veterinary support, fodder on credit and other services that buffer the impact of natural disasters on livestock numbers (Ho, 2001:120-121). In a study (Cincotta et al, 1992) of transhumant pastoralism in Qinghai province, the authors likewise conclude that the presence of government services, imported forage and markets somewhat decouples livestock production systems from environmental variability. Given the presence of such institutions for dealing with environmental variability, the need for opportunistic management is somewhat negated. Nevertheless, both studies acknowledge that new range ecology offers useful insights into an understanding of grassland ecology and livestock production in China.

The purpose of this paper is to make a modest contribution to the literature on new range ecology in the Chinese context by considering its application to Altay Prefecture, in northern Xinjiang. It draws upon six months field research undertaken in Buerqin County, particularly two Kazakh pastoral villages within this county, in 1998[5]. The paper is divided into five sections, including this introductory section. In the second section an outline of pastoralism in the study area and case study villages is given. The degree of environmental variability in the area and its relationship with livestock numbers is assessed in the third section. A relatively high degree of environmental variability is found, though not enough to decisively indicate that rangeland ecology is in disequilibrium. Next, in the fourth section, the extent to which rangeland policy can and does help accommodate environmental variability is considered. Conclusions are drawn in Section Five.

[5] Buerqin County and the two Kazakh villages were briefly visited again in March 2001.

2. STUDY AREA

The general area in which the study has been conducted is Altay Prefecture (hereafter Altay) in northern Xinjiang. Pastoralism still forms an important source of livelihood in Altay, with the pastoral population constituting some twenty two percent of its total population of 550,000 people[6]. Most pastoral communities are Kazakh by ethnicity, with their descendants having migrated east from present-day Kazakhstan as early as the mid-eighteenth century (Svanberg, 1988). Despite a rapid increase in the Han population since 1949, Kazakhs still account for some fifty percent of Altay's total population[7]. Pastoralism is the predominant form of land use, with rangeland accounting for some eighty one percent of Altay's total area compared with cropland's two percent[8]. Mobility is an inherent feature of pastoralism in Altay. Herders use different pastures on a regular, seasonal basis, migrating between summer pasture in the Altay mountains and winter pasture in the Junggar Basin, up to 160 kilometres away (see Map, last page). In the foothills in-between and on the edge of the Junggar basin lies spring-autumn pasture. The winter base of most households is also located at the edge of the basin, next to the natural flood plain of rivers where hay is harvested or, in the case of 'settled' households[9], alongside their irrigated plots.

This study focuses on one county of Altay, Buerqin County, the pastoralism of which is similar to that found in other counties of the prefecture. Within Buerqin county, intensive fieldwork was conducted in two Kazakh pastoral villages, Ak Tubeq and Sarkum. These are typical pastoral villages in Altay, both in terms of their Kazakh ethnicity and their natural resource endowments. Ak Tubeq has a greater population than Sarkum but, at 264 households, is still relatively small by Chinese standards (see Table 1). Both villages have similar areas of rangelands but Sarkum has more on a per capita basis. Sarkum's greater natural resource endowments is reflected in its greater wealth, with its households

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6 Statistics Division, Altay Prefecture, 1995 data.

7 The Han population increased from 1,000 to 237,000 between 1949 and 1995, with their proportion of the total population increasing from 2% to 43% over the same period (Statistics Division, Altay Prefecture).

8 Land Division, Altay Prefecture. Figures based on a 1991 land-use survey.

having some 26% more livestock and 17% more income per capita than their counterparts in Ak Tubeq. The villages differ markedly in their degree of settlement. All the households of Sarkum were settled over 1989-94 under World Food Programme Project 2817, with each getting allocated some four – five hectares of irrigated land for the growing of fodder and other crops. In Ak Tubeq, in contrast, only about five percent of households have been settled and the rest depend only upon hay from natural cutting land and market purchases to meet their fodder needs.

TABLE 1

BACKGROUND DATA ON CASE STUDY COMMUNITIES (1997)

Village	Ak Tubeq	Sarkum
Demographics		
population	1,532	1,045
no. of households	264	218
average household size	5.8	4.8
NaturalResources		
household settlement (%)	5%	100%
natural cutting land/cropland (ha)	435	1,271[10]
winter pasture (ha)	10,500	19,800[11]
summer pasture (ha)	9,639	9,506
spring-autumn pasture (ha)	17,152	10,717
Total pasture (ha)	37,291	40,023
Wealth		
livestock per person	23	29
income per person (yuan)	1,657	1,955

Source: Buerqin County Animal Husbandry Bureau

[9] A ‘settled’ household is one that cultivates artificial pasture and/or other fodder crops on irrigated land. ‘Unsettled’ households, in contrast, just have natural cutting land and have to buy in all their additional feed requirements.

[10] Includes irrigated land (used as cropland and cutting land) but excludes natural cutting land along the Ertis River.

[11] Some of Sarkum’s winter pasture has been allocated to other villages.

3. ENVIRONMENTAL VARIABILITY AND LIVESTOCK DYNAMICS

The single most reliable indicator of a non-equilibrium grazing system is climatic instability, as manifest in low annual rainfall and a high coefficient of rainfall covariance (Behnke and Scoones, 1993: 26). In Altay, the different seasonal pastures have different rainfall patterns. The Altay mountains, where summer pasture is located, receive an average of 630mm of rainfall per annum, whereas spring-autumn and winter pasture only receive on average 126mm and 210mm respectively[12]. Average monthly rainfall peaks in the summer months and is lowest during the winter months. Annual rainfall is quite variable in spring-autumn pasture, the driest (see Figure 1 below), ranging from 59mm (1962) to 220mm (1993) between 1960 and 1997. However, the coefficient of variation in annual rainfall for the same period is some twenty six percent[13], putting it below the thirty percent threshold that is commonly regarded as a definitive indicator of rangeland ecology in disequilbrium. No time series rainfall data was available for winter pasture but given its low annual average rainfall and proximity to spring-autumn pasture, it can be assumed that the coefficient of rainfall variation in winter pasture is somewhat similar to that of spring-autumn pasture. Time series rainfall data for summer pasture is also lacking but, with an average annual rainfall of about 630mm, summer pasture lacks the aridity usually associated with a high coefficient of rainfall variation and rangeland ecology in disequilibrium. Thus in summary, rainfall data suggests that whilst a degree of non-equilibrial dynamics may pertain in spring-autumn and winter pasture, in summer pasture equilibrial dynamics prevail.

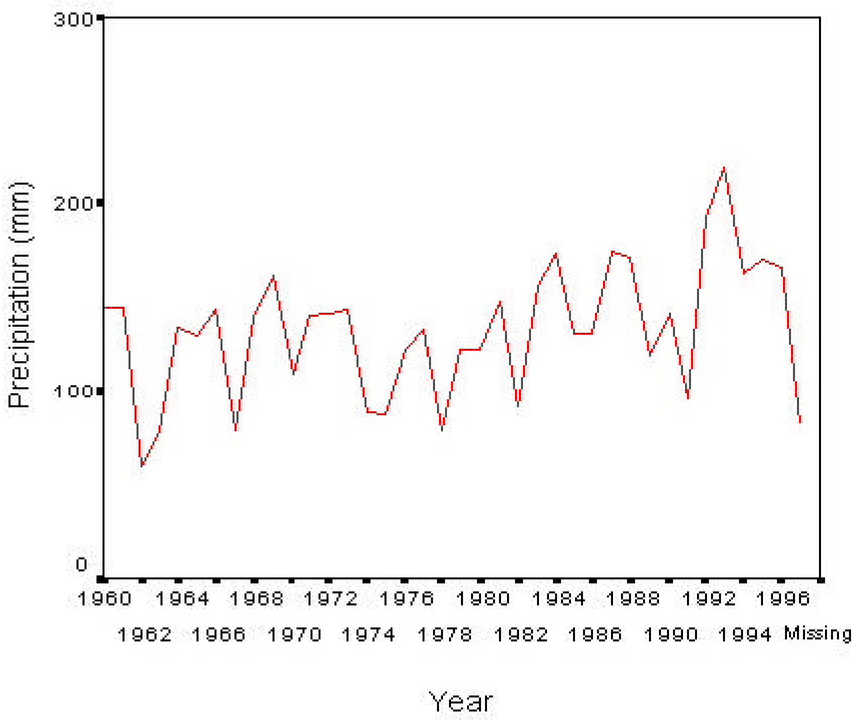
Low rainfall is not the only environmental risk facing herders. Snow storms, cold temperatures and strong winds also pose hazards, particularly during the winter and spring seasons. The winter of 2000-01 was the harshest in fifty years, with nearly thirty snow blizzards passing through and dumping up to 70cm of snow on the desert plateau, where winter pasture is located. Even in a normal year, there is considerable variation in seasonal temperatures. Temperatures in spring-autumn pasture, for example, average

[12] Data for Buerqin County and from the Buerqin County Weather Station.
[13] The coefficient of variation was calculated on the basis of annual rainfall data (1960-97) acquired from the Buerqin County Weather Office.

-16°C in January and 22°C in July[14]. Minimum temperatures of -45°C and maximum temperatures of 38 °C have been recorded in the Altay region.

FIGURE 1:

AVERAGE ANNUAL PRECIPITATION IN SPRING-AUTUMN PASTURE BUERQIN COUNTY (1960-1997)



Source: Buerqin County Weather Station, Altay Prefecture

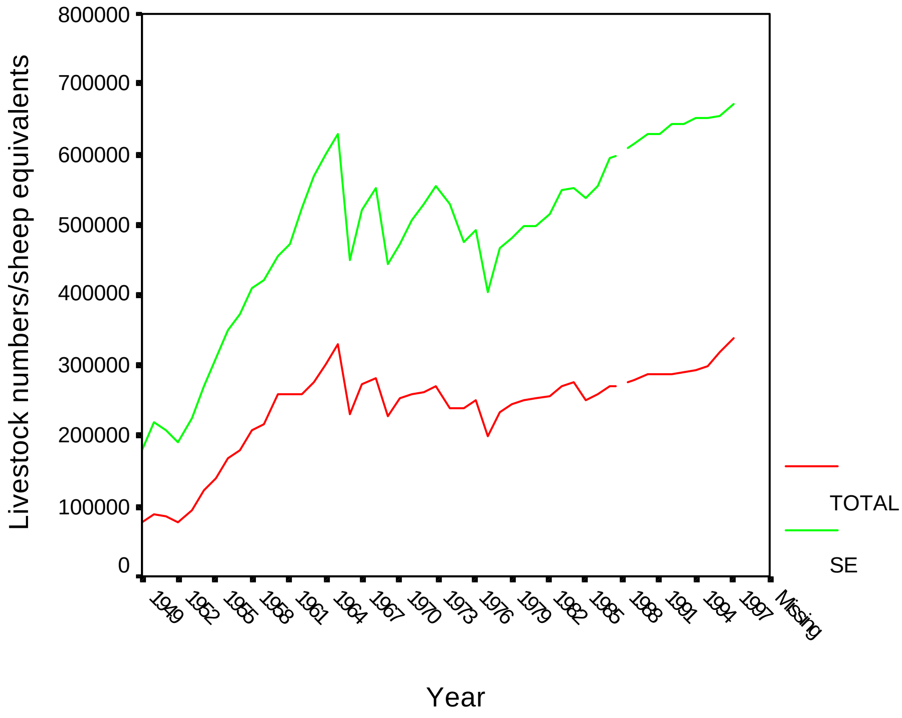
Time series data on livestock numbers in Buerqin County is given in Figure 2 below. Total livestock numbers have risen over four-fold, from 78,000 to 337,000, between 1949 and 1997, and sheep equivalents have nearly risen by a similar proportion. Three general phases can be identified: rapid growth from the early 1950s through to the mid-1960s; fluctuating livestock numbers from the mid-1960s through to the mid-1980s; and a gradual (and decelerating) increase in livestock numbers from the mid-1980s through to

[14] Average of daily maximum and minimium temperatures. Based on 1960-1990 data acquired from the Buerqin County Weather Office.

the present. Significantly, the transition from one phase to another coincides with major political and economic events: the advent of the Cultural Revolution in the mid-1960s coincides with the end of the fast growth phase, and the de-establishment of the communes and privatisation of livestock in the mid-1980s coincides with the return to consistent, albeit slower, growth. Given the absence of any major climatic shifts between these periods (see Figure 1), the three major phases in livestock growth outlined above can not be explained in terms of environmental variability. Neither can environmental variability explain trends in livestock numbers within the major phases. Since 1985, for example, livestock numbers have increased every year, year on year (see Figure 2), despite the high level of rainfall variability experienced during this period.

FIGURE 2:

LIVESTOCK NUMBERS AND SHEEP EQUIVALENTS BUERQIN COUNTY (1949-97)



Source: Buerqin County Animal Husbandry Bureau

The tentative evidence presented above of a lack of correlation between rainfall and livestock numbers can be interpreted in two different ways: environmental variability in Altay is either not significant enough, or it is significant but its impact on livestock population is mitigated by other factors. The perception of herders is relevant here. They unanimously view environmental variability to have a significant impact on forage availability. However, they also report that they cope with exceptionally dry years or cold winters through buying in more fodder, principally corn and hay, for the winter and early spring period, rather than de-stocking. Rural credit cooperatives at the township level facilitate this through extending short-term credit for herders to purchase fodder over winter and early spring, which they repay when they sell their lambs in autumn. The interest rate is partially subsidised and relatively low (approximately 6% per annum) and sometimes the government also subsidises the price of fodder as well. Thus the availability of external feed resources enables herders to somewhat mitigate the impact of environmental variability.

Although rangeland degradation is a contested notion in new range ecology, the long-term increase in livestock numbers in Altay creates the distinct possibility that rangeland is being overused. This is the perception of local officials, researchers and older herders, who perceive rangeland degradation to be worsening, particularly in spring-autumn pasture. Here pasture is under pressure not only because of its dual use every year, including during the critical spring season, but because of its proximity to urban populations and agricultural settlements. Degradation in spring-autumn pasture is partially blamed on the increased number of livestock being raised by agricultural households, which now account for some twenty eight percent of Altay's total 4.4 million livestock[15]. Assuming that rangeland degradation is indeed real and that overgrazing is the primary cause, this suggests the need for the better regulation of rangeland use.

[15] AHB, Altay Prefecture, June 1997 data, excluding pigs and donkeys. Pastoral households account for the remaining 72% of livestock.

4. RANGELAND POLICY AND ENVIRONMENTAL VARIABILITY

Pastoral household settlement constitutes the core of the state's current pastoral development strategy. Settlement entails the construction of irrigated land for pastoral households, on which they mainly cultivate fodder (perennial grasses and corn). By the end of 2000, over eighty percent of the pastoral households in both Buerqin and Altay had been 'settled'[16]. World Food Programme (WFP) Project 2817, which lasted from 1989 to 1994, has been responsible for the settlement of over half of these households. Sarkum village was completely settled under Project 2817 and settlement has generally reduced its demands on, and the duration of its use of, winter pasture. But settled households, with government concurrence, still utilise spring-autumn and summer pasture, if not winter pasture as well. To forgo the use of summer pasture, and implicitly spring-autumn pasture in transit to and from summer pasture, would have been irrationale. Although summer pasture only accounts for 14% of the total useable pasture in Altay, it is four times more productive than the other seasonal pastures (Zhang, 1992: 114-115) and enables the fattening of livestock for sale in autumn or survival and reproduction during the long winter period. Thus settlement Altay-style has no brought about a significant reduction in livestock mobility. This contrasts with the case of much of pastoral Africa, where 'settlement' has been synonymous with household sedentarisation and reduced livestock mobility (Lane and Moorehead, 1995:123-126). Another common concern with pastoral settlement is that it intensifies grazing pressures in the vicinity of settlement areas. In Altay, however, because livestock mobility and the regular seasonal utilisation of pasture have been preserved, this problem appears to be minor.

Government officials often identify the reduction of environmental risk as being a major benefit of pastoral household settlement. Settlement potentially reduces households' exposure to environmental risk by decreasing their dependence on rain-fed natural forage and increasing their reliance on irrigated fodder. It also increases the availability of fodder during the winter and early spring season, the time of greatest seasonal feed

[16] Animal Husbandry Bureau (AHB), Altay Prefecture.

scarcity. Thus in turn can translate into healthier livestock and fewer livestock losses arising from adverse climatic events at this critical time of the year. Increasing fodder availability over winter may also enable a switch to an early lambing season, which in turn increases the age and robustness of lambs before they are exposed to the vulgarities of the climate in spring pasture. Finally, settlement is associated with the building of solid brick livestock shelters that may likewise have favourable impacts on livestock health and survivability.

The official view that settlement reduces households' exposure to environmental risk can, however, be questioned on two accounts. Firstly, the assumption that settlement will necessarily increase a household's fodder production needs to be questioned. In the case of Project 2817 generally, as well as Sarkum village specifically, fodder production in over one third of the settlement area has been debilitated by severe salinity problems. Some of the households in this part of the project have experienced a marginal improvement in their fodder situation, as the original natural cutting land of successfully settled households has been re-allocated in their favour. Other households, however, have experienced no real improvement in their fodder situation. Secondly, anecdotal evidence suggests that the capacity of non-settled households to endure adverse climatic events may be just as high as that of settled villages. Overall livestock losses resulting from Altay's 'storm of the century', the winter of 2000-01, appear to be minimal. An official estimate puts livestock losses at 0.5%. Furthermore, there appears to be no significant difference in livestock losses suffered by the unsettled village of Ak Tubeq versus the settled village of Sarkum. The principle difference between the two is that since unsettled households in Ak Tubeq cultivate less fodder than their settled counterparts in Sarkum, they have to buy in more feed. Thus easy access to fodder, which is underpinned by governmental support, appears to have a greater role in mitigating environmental variability than pastoral household settlement per se.

As with settlement policy, pastoral tenure policy since 1985 has facilitated a continuation of the regular, seasonal use of pastures. When communes were de-established in 1985, rangelands were distributed to small groups of households. Each group received a parcel of land in winter pasture and summer pasture, and two parcels in spring-autumn pasture. Regular dates for movements between the different seasonal pastures are stipulated by the county government and relayed to herders via their village leaders. Village leaders in the field monitor and enforce movement regulations and this is not a difficult task, given the ease at which late or premature movements by households can be detected. Furthermore, movement regulations are based on regular climatic events, principally snowfall, which ultimately govern livestock movements. The possibility of late blizzards in spring makes the premature movement to summer pasture risky. Once they arrive in fertile summer pasture, herders will tend to delay their departure until such time that snowstorms, which render movement difficult, are forecasted. Thus their departure from summer pasture for spring-autumn pasture is also ultimately regulated by snowfall. The movement from spring-autumn pasture to winter pasture is likewise governed by the timing of snow, though snow in this case is a pull rather than push factor. As winter pasture is a water deficit area, livestock can't be grazed there until such time that it snows. The timing of snow in summer and winter pasture varies little each year and leaders in the field have the discretion to adjust the timing of seasonal movements accordingly, thus enabling the full accommodation of this type of environmental variability. The movement of livestock from winter to spring-autumn pasture is not regulated by snow but nevertheless it is strictly monitored and enforced. All livestock need to depart from the villages' winter bases by early spring to ensure the protection of village cutting lands and croplands, which are largely unfenced, during spring and summer.

Another aspect of rangeland policy has been the formal individualisation of tenure. Initially, in 1985, former commune rangelands were distributed to small groups of households. Then over 1995-96 rangelands were formally distributed to individual households via the rangeland contract system. Each household has been given a rangeland use contract, specifying the area of each different seasonal pasture that has been allocated to it and the associated carrying capacity of the pasture. Rangeland use rights have a duration of fifty years and are inheritable. Thus the de jure tenure situation is almost akin to private property. However, the de facto situation is more complicated. Despite the emphasis of pastoral tenure policy on the individualisation of tenure, the group tenure arrangements formed in 1985 have largely persisted (Banks, 2001). The issuance of rangeland use contracts to households in 1995-96 did not generally result in the delineation of household boundaries within group pastures, either in a de jure or de facto sense. Thus the area of pasture recorded in the household contracts is hypothetical rather than actual, and primarily there to enable the calculation of rangeland use fees, which are calculated on a per mu basis[17]. Because the pasture groups are small and socially embedded in close kin relations, the lack of individual tenure doesn't necessarily present problems for rangeland management: the groups could relatively easily overcome the 'problem of assurance' inherent in collective act and regulate their joint use of rangeland. The key challenge, discussed further below, is ascertaining appropriate rules relating to the intensity of resource use.

From a new range ecology perspective, fixed boundaries in rangelands, whether they be village, group or household, can undermine land tenure flexibility and thus the capacity of herders to pursue opportunistic grazing strategies in response to environmental variability. However, in Altay there appears to be a high co-variance of environmental risk both at the regional and community pasture levels and thus reduces the potential benefits of opportunistic grazing strategies. Spatial flexibility in the use of rangelands can't moderate environmental risk because in a dry year all communities and households are facing a reduction in natural forage availability and, if anything, the response of communities and groups/households is to become even more protective of their pasture boundaries. The one exception to the high co-variance of environmental risk is the case of winter pastures: mountain winter pastures are more prone to heavy snowfall than plateau winter pastures. Furthermore, land tenure flexibility in this case can and does moderate environmental risk: livestock are relocated from mountain to plateau pastures during severe winters. Otherwise, however, spatial flexibility in the use of rangelands can't moderate environmental risk. A similar conclusion can be drawn regarding temporal flexibility in the use of rangelands. In a dry year, all seasonal pastures are detrimentally affected and thus the benefits of changing movement dates between different seasonal pastures is likely to be minimal. Furthermore, as described above, the

[17] One hectare = fifteen mu.

timing of snowfall (which is relatively invariant) ultimately restricts temporal flexibility in the utilisation of different pastures.

It should be noted that the assignment of rangeland use rights to small groups or households has not adversely affected inter-seasonal mobility. Stock routes have been delineated to facilitate mobility and, when they are not available for herders to take advantage of, herders reserve the right to transit through others' pastures during their seasonal movements or in order to access water. Mobility is also aided by the general lack of fencing of group or household pastures. Less than one percent of all rangeland is fenced, with hayfields accounting for the major proportion of this[18].

A final dimension of the rangeland contract system is the assignment of carrying capacities to household pastures. Rangelands and rangeland use in Altay exhibit many of the characteristics that, according to new range ecology, make the accurate assessment of carrying capacity difficult: temporal variability; spatial diversity; and utilisation by a range of different types of livestock (cattle, camels, horses, sheep and goats). The government's approach to calculation of carrying capacity is to assign a single carrying capacity to each of the major types of seasonal pastures, with no allowance being made for temporal or spatial variability. Thus the way that the government calculates and uses carrying capacity may render it an inappropriate tool for rangeland management. In addition, the problem of monitoring and enforcing designated stocking rates is a well-known phenomenon everywhere and Altay is no exception. A per head tax on livestock constitutes an additional incentive for households to underreport their livestock numbers. In the field survey undertaken in the case study villages of Ak Tubeq and Sarkum, households on average reported livestock numbers some ten to twenty percent above what they had reported, for taxation purposes, to the government.

New range ecology offers some useful insights into how both resource use rules and their monitoring and enforcement may be improved: administrative decentralisation. Village institutions are already playing an active role in the regulation of seasonal movements

[18] AHB, Altay Prefecture.

between pastures as well as the mediation of disputes. This role could be extended to the derivation of appropriate resource use rules, in conjunction with Animal Husbandry Bureau personnel and rangeland specialists. The monitoring and enforcement of the new resource use rules could also be devolved to the village and pasture group levels, but with the state serving as an overseer. The strong institutional presence of the government at the local level, coupled with the existing systematic recording by government livestock services of, for example, the number of livestock vaccinated and the number of sheep drenched, places it in a good position to be able to indirectly monitor rules relating to the intensity of resource use.

5. CONCLUSIONS

This paper represents a preliminary assessment of the relevance of new range ecology to Altay, a remote pastoral region of northwest China. In the spring-autumn and winter pasture zones, rainfall data indicates the presence of some inter-temporal variation in rangeland productivity, suggesting some applicability of new range ecology. At higher elevations, in the summer pasture zone, rangeland productivity may be less variable and thus the concepts and tools of conventional rangeland management might be more applicable. Livestock numbers are not responsive to overall environmental variability and a major reason for this is that herders are able to compensate for temporal variability in natural forage through cultivating fodder crops and/or purchasing fodder from markets with the support of state credit institutions. The finding that fodder markets and the state help to buffer the impact of environmental variability is consistent with the findings of Ho (2001) and Cincotta et al (1992) for Ningxia and Qinghai provinces in China, and the situation across much of northern Africa (Scoones, 2001, pers. comm.). In addition, the relative smaller degree of environmental variability in summer pasture in Altay, the major fattening pasture, may also help to buffer the impact of variability in spring-autumn and winter pasture.

Spatial variability in the availability of rangeland resources is exploited in Altay through regular, seasonal movements between different pastures, a strategy that new range ecology provides the theoretical underpinnings for. Among other things, such movements ensure the utilisation of fertile pastures in the Altay mountains during the summer months, the only season that they are accessible. Rangeland policy has been implemented in a way that facilitates, rather than undermines, continuing livestock mobility. Settled households still utilise pastures on a regular seasonal basis and although rangeland use rights have been allocated to small groups or households, inter-seasonal livestock mobility has been preserved through the designation of stock routes and the right of herders to transit through others pastures. Although a few government officials talk about the need to 'settle down' livestock, as well as households, this idea thankfully enjoys little support even with government.

It is doubtful as to whether rangeland policy in the Altay context could be more accommodative of environmental variability than it presently is. Because there is a high co-variance of environmental risk across the Altay region, there is little scope for employing spatial variability in rangeland use to mitigate environmental risk. Indeed, villages, groups and households are even more protective of their boundaries in a dry or exceptionally cold year. Temporal variability in rangeland use is ultimately constrained by snow, which occurs at relatively invariant times each year. Thus the scope for changing movement times between seasonal pastures in response to environmental conditions is also quite limited. Given this, the use of fodder markets rather than land tenure flexibility to buffer environmental risk is sensible in the Altay context. However, one aspect of rangeland policy, rules relating to the intensity of rangeland use, could be more accommodative of environmental risk. The carrying capacities specified in the grassland use contracts are fixed, year on year, and thus unable to accommodate temporal variability. Furthermore, the carrying capacities are standardised for large seasonal pasture zones and thus unable to accommodate spatial variability within these zones. Finally, the use of the rangelands on a seasonal basis and by a diverse range of livestock also complicates the task of accurately calculating carrying capacities. New range ecology suggests the need for a more decentralised and adaptive approach to resource use regulation in such situations. Existing institutions at the village level and below provide a sound institutional basis for the adoption of such an approach.

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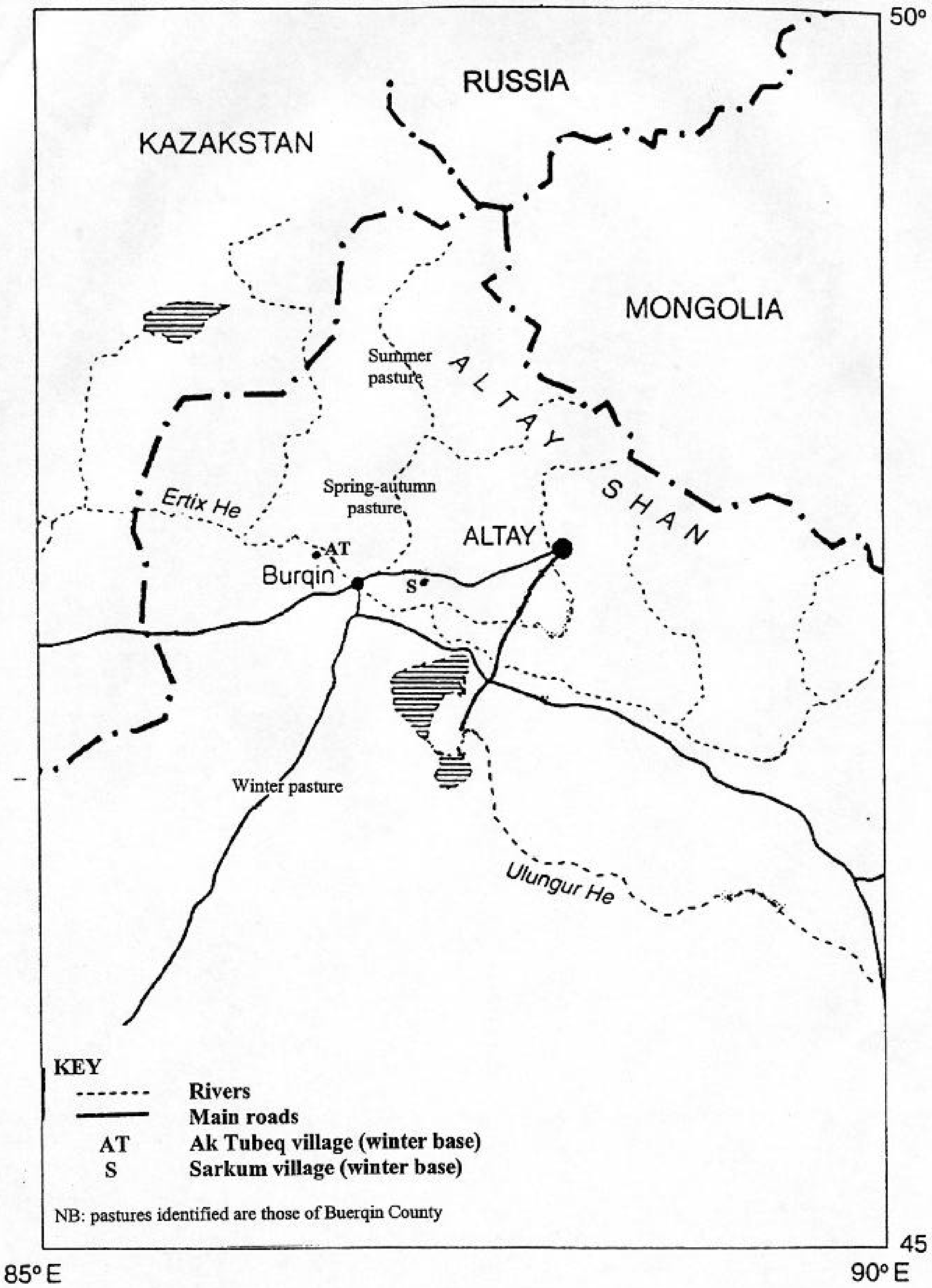
MAP OF STUDY AREA[1]



[1] Map adapted from M. Li, B. Yuan and J. M. Suttie (1996) 'Winter Feed for Transhumant Livestock in China: The Altay Experience', *World Animal Review* 2: 38-44.