Population, Nomadic Pastoralism and the Environment in the Mongolian Plateau

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The purpose of this paper is to examine the relationship between population, economic activity and the environment in the Mongolian Plateau. This analysis provides a valuable case study for several reasons. First, it elucidates a specific ecosystem—the steppe—that has not received much attention in the literature and a traditional economic activity consistent with such environment: nomadic pastoralism. Second, the Mongolian Plateau is shared by two entities, with two different economic and social organisation: the Republic of Mongolia and the Inner Mongolia Autonomous Region of the People's Republic of China. Third, these two entities have also experienced two different population dynamics that have resulted in different population densities and population pressure on natural resources. Fourth, environmental degradation does not seem to be a problem in the Republic of Mongolia, while in Inner Mongolia the quantity and quality of the grasslands are in decline.The argument discussed here is that the difference in resource depletion and environmental degradation between the two regions is mainly the result of different population dynamics, which has resulted in different human and animal population densities.

INTRODUCTION

Views on the possible consequences of population growth and densities on the environment range from completely negative, even devastating, to decidedly positive and highly advantageous. For neo-Malthusians, popu-

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lation growth is a major, if not the main cause of environmental degradation and destruction (Ehrlich & Ehrlich, 1990). It places increasing demands against the planet's finite natural resources and limited carrying capacity. On the other hand, population growth is perceived as a source of increased efficiency and economies of scale, as well as a major determinant of technological innovations. Human ingenuity will be able to expand the Earth's carrying capacity and make possible increases in living standards and environmental improvements (Simon, 1990). The discussion of the relationship between population and environment has taken place at a very high aggregate or macro level; the relationship, however, seems to be highly conditioned by the particular characteristics of the ecosystem and modulated by a society's institutional structure (McNicoll, 1989; Pingali, 1989). To understand the association between population end the environment, analysts require a number of case studies encompassing a wide range of experiences (Cassen, 1994). These should be undertaken in countries that have different ecosystems, are at various stages of development, and have diverse modes of adjusting population growth to limited natural resources.

The purpose of this paper is to examine the relationship between population, economic activity and the environment in the Mongolian Plateau. This analysis provides a valuable case study for several reasons. First, it elucidates a specific ecosystem—the steppe—that has not received much attention in the literature and a traditional economic activity consistent with such environment: nomadic pastoralism. Second, the Mongolian Plateau is shared by two different entities, with two different economic and social organisations: the Republic of Mongolia and the Inner Mongolia Autonomous Region of the People's Republic of China. Third, these two entities have also experienced two different population dynamics that have resulted in different population densities and population pressure on natural resources. Fourth, environmental degradation does not seem to be a problem in the Republic of Mongolia, while Inner Mongolia has been experiencing a rapid and substantial process of land degradation.

The argument discussed here is that the difference in resource depletion and environmental degradation between the two regions is mainly the result of different population dynamics, which has resulted in different human and animal population densities. The relationship between demographic factors and ecological outcomes is not a simple one. The effect of population changes on the environment is modulated by macroeconomic variables, notably institutional factors and agricultural policies. Although the analysis presented in this paper focuses mainly on demographic dissimilarities between the pastoral societies in the two regions, institutional

and policy factors are also recognised as relevant for the explanation of environmental differences.

Located in the heart of Central Asia, the Mongolian Plateau is the cradle of the Mongolian nation. It has an hyper-continental climate, with low precipitation, long winters, with average temperatures below freezing for seven months of the year, and intense solar radiation. More than half of the area is underlaid with permafrost. In spite of the negative climatic conditions, the land is particularly suitable for extensive livestock breeding. In fact, the geographical characteristic of the Mongolian Plateau that has shaped its economy and culture is the steppe. Extensive nomadic pastoralism has been a major determinant of the Mongolian way of life and main economic activity from ancient times until now. Traditional herds include cattle, horses, camels, goats and sheep.

By the mid-1300s the Mongolia of the great Khans disintegrated and entered into a long period of internal strife. In 1691 Mongolia ceased to exist as an independent political entity and became a frontier province of China. For the following two and a half centuries the country became a backward, traditional and impoverished society, with an economy based on subsistence nomadic animal husbandry. China controlled directly the southern half of the original Mongolia. The northern half had a little more autonomy, but also was under political and economic control from China. The Chinese revolution in 1911 gave the northern territories the opportunity to claim independence. This was ultimately attained in 1921, and a constitutional monarchy was established, but it was abolished following the ruler's death in May 1924. In November of the same year, with the ratification of the First Constitution, the Mongolian People's Republic was founded. The southern part of what was originally Mongolia continued under Chinese control and in 1947 it became the Inner Mongolia Autonomous Region.[1]

A system of centrally planned economy in the Republic of Mongolia dates from the late 1930s. The following decades witnessed a dramatic process of economic and social transformations, a strengthening of ties with the former Soviet Union, increasing industrial and mining activities facilitated by Soviet aid and the organisation of the pastoral economy in the form of collectives. In spite of the substantial economic and social changes, and in spite of collectivisation, extensive management strategies persisted in the livestock sector and animal herding continued being practised in a semi-nomadic form. By 1990, like other former socialist countries, Mongolia began a process of transition toward a free-market economy with the subsequent liberalization of the livestock economy. At present, the Republic of Mongolia has an area of approximately 1.5 million

square kilometres and a population of 2.3 million; population density is one of the lowest in the world: 1.3 persons per square kilometre.

Inner Mongolia has an area of approximately 1.2 million square kilometres. The greater impact on this region has been the heavy migration of Han farmers that has taken place since the late nineteenth century. The population of Inner Mongolia is almost 22 million people, out of which less than 20% are Mongolians. Between the late 1950s and early 1980s, the government stimulated migration of Han farmers and urged them to expand cultivation, particularly of grain, into mountains and grazinglands. Industrial and mining activities also experienced a substantial expansion. The region is rich in coal, cement limestone and siliceous clay. However, animal husbandry is the foundation of the region's economy. As in the Republic of Mongolia after the revolution, Inner Mongolia's herders were organised into collectives and continued using extensive nomadic livestock management strategies. With the system of "household responsibility" implemented during the 1980s, pastoralist families got back ownership of the animals and obtained user rights for sedentary grassland fields. The government considered nomadism as a backward activity and something to be gotten rid of, and encouraged herders to settle in sedentary villages. Fenced pastures began to emerge in the previously unlimited steppe. At present, herders still move their herds seasonally to collective grasslands practising a form of semi-nomadism in which movements are done with reference to a sedentary centre.

HUMAN POPULATION, ANIMAL POPULATION AND CARRYING CAPACITY

The existence of a positive relationship between population density and agricultural intensification in a crop-agriculture context has been demonstrated by Boserup (1965; 1981; 1996; see also Pingali, 1989; Ruthenberg, 1984). Population densities have also a major role on intensification in pastoral societies. Intensification in this case will depend on the degree of direct addition of energy inputs into the livestock production system (Briske & Heitschmidt, 1991; Sheehy, 1993). In an extensive system, particularly important is the relationship between population size and the size of the herd. Research carried out on nomadic pastoral societies in different ecological settings has revealed the importance of this relationship (Stenning, 1959; Leeds, 1965; Dahl & Hjort, 1976; Dahl, 1981; Horowitz, 1981; Thebaud, 1995). On the one hand, the size of the animal population must provide for food requirements and, on the other, population size has

to equate the labor needs for the appropriate care of the herd. However, the balance between human and animal populations cannot be explained entirely in terms of subsistence exigencies and labor capacity; also important is the formation of domestic groups (Lefebure, 1979), particularly when the productive unit is an independent nuclear household as is the case in most nomadic pastoral societies (Khazanov, 1978).

Households and herds grow along parallel lines. Each stockbreeder seeking to set up a new production unit is faced with several requirements: he needs to aquire livestock, gets married, must be able to increase the size of his herd, and beget heirs (Lefebure, 1979). A newly married couple receive animals from the herds of their families of origin, customarily through pre-inheritance and dowry. The initial herd received after marriage has to grow substantially in the following years, both to satisfy the food requirements and to accumulate animals to give as pre-inheritance or dowry to their own children. An additional child poses pressure to breed more animals for the extra food requirements and also for him or her to receive when he or she marries.

When a nomadic society experiences a rapid population growth, usually as a result of a decline in mortality, the number of households expeciences a substantial increase. This also means an increase in the absolute number of productive units. More children survive up to age of marriage and, accordingly, more productive units are formed. Assuming that natural resources are abundant, the number of animals may experience a considerable increase as a result of this process. The newly formed households will try to maximise the size of the herds. In an extensive pastoralist system this is feasible through skilful management of the demography of the herds. For example, in order to limit culling and accelerate the natural growth of the herd, herders try to increase milk production by keeping a large number of females. Another strategy is to focus for a few years on herding small ruminants, mainly goats and sheep, because their rate of growth is much higher than that of large ruminants. Eventually, small ruminants are sold and more cattle, camels and horses can be purchased (Thebaud, 1995).

A major limitation to the increase of human and animal populations in a system of extensive pastoralism is the *carrying capacity* of the grasslands. Without any input, as is the case of livestock breeding carried out in natural pastures, any portion of land can produce only a finite amount of vegetation (biomass) per year. Of this material only a certain quantity can be consumed by the herds without impairing the capacity of the pasture to regrow in the next year. A moderate consumption corresponding to small herd may result in a faster regrowth; a larger herd, however, grazing above a certain level, will prevent regrowth. Each year a given amount of grass is

produced and only a limited proportion can be eaten or harvested in that year. If a large amount is consumed then the root systems of the natural pastures are damaged and the ability of the grass to regrow is reduced. The outcomes of the deterioration of the root system are substantial soil loss through erosion and a subsequent decrease in soil quality.

An initial solution adopted by nomad pastoralists is an horizontal expansion, that is, to move the herd longer distances seeking new pastures (Goldstein & Beall, 1994; Horowitz, 1981). If population keeps on growing, the strategy of expanding the grazing area will soon become exhausted. The availability of grazing land may be insufficient because of natural conditions or the distances that the herd needs to be moved are too long. The exhaustion of an horizontal expansion forces the pastoral society to incorporate energy inputs into the livestock production system. In order to increase the amount of off-take from the herds, it becomes necessary to overcome environmental or seasonal vegetation constraints to livestock production. Watering facilities are developed or improved in areas formerly not used or used only occasionally because livestock lacked access to drinking water. More vegetation is harvested to be used as supplementary feed during winter and spring periods of forage deficiencies (Sheehy, 1993). As the process of intensification advances, a small part of the nomadic population chooses to settle and become engaged in sedentary agriculture. This increases the supply of vegetable food for the human population and fodder and crop residues for the animals. Hence, storage facilities are also developed. However, in exchange for inputs to overcome constraints there is less livestock mobility and flexibility.

Further increases in population density and animal numbers demand increased inputs to the livestock production system to maximise off-take from livestock. Intensification proceeds by the development or adoption of new technologies such as irrigated artificial pastures, increasing fodder crop production, improvements in fodder storage facilities and management, and breeding livestock with higher genetic potential rather than environmentally adapted livestock. A larger proportion of the population becomes engaged in sedentary farming in order to produce harvested fodder and crops grown to elaborate concentrated food. As more land is used for crop farming, nomadic pastoralism is beginning to be replaced by sedentary animal husbandry (Boserup, 1965).

Slow population growth in pastoral communities constrains the formation of new productive units and, therefore, the increase in the number of animals. Furthermore, a situation may arise in which the size of the herd surpasses the labor capacity of the human population. Nomadic pastoralism is not a labor-intensive activity (Horowitz, 1981), but insufficient labor

is a major problem because it directly affects the mobility of the herds. It is when the animals are moved in search of pastures and water, that the herder needs to allocate more labor. Mobility constraints caused by lack of labor prevent sufficient watering and feeding of animals and, therefore, the herd's productive and reproductive capacity will diminish. Nutritional stress will substantially reduce the fertility of the animals. The number of animals will decrease until it reaches an amount conmensurate with the labor force supply.

Population growth in pastoral societies can transform the grazinglands and the livestock management systems in ways that lead to permanent gains in economic productivity. However, in many cases population induced intensification has resulted in environmental deterioration end even abandonment of land. Instead of increasing the carrying capacity of the grasslands, intensification results in ecological degradation. The magnitude and severity of this problem depend on the resilience of the ecosystem under human impact and also on the extent of institutional rigidities (Pingali, 1989; McNicoll, 1989). In some cases productivity improvements are obtained by the transfer of agricultural technologies developed elsewhere. In fragile ecosystems these technologies can put substantial strain on the ecosystem and result in soil deterioration. For example, replacement of native grass species by high yield imported pasture species may initially increase productivity but it may destroy the original grass root system that prevents topsoil depletion by wind and rain. In other cases institutional innovations needed to continue a population induced intensification may not take place or occur at a very slow pace. If institutional rigidities prevent increases in the introduction of technical inputs directed to increase the productivity of the grasslands, the growth of the herd may result in substantial ecological damage caused by overgrazing. The effect of human and animal population growth on intensification of pastoral systems, as other population-rural development relationships, is modulated by the society's institutional structure and specific patterns of social organisation (McNicoll & Cain, 1989).

THE REPUBLIC OF MONGOLIA: *NEGDELS* AND NOMADS

Animal husbandry has always been the the main productive activity of most of Mongolia's population and the backbone of Mongolia's economy. After the revolution, several attempts were made to organize the pastoral economy in the form of *negdels* or pastoral cooperatives. This was achieved only by the beginning of the 1960s. Private ownership of livestock was

restricted, private property of land abolished, and all production supplied to the State (Milne et al., 1991; Cooper & Gelezhamtsin, 1993; Mearns, 1993; Potkanski & Szynkiewics, 1993; Neupert, 1996).

The rural population was employed by collectives (*negdel*), which was the economic unit responsible for managing livestock activities and supplying inputs, consumer goods and transport services to its members (Neupert & Goldstein, 1994; Neupert, 1996). In spite of collectivisation, the organisation of production in the pastoral economy experienced little change. For example, herding remained pastoral and nomadic and the basic unit of production continued being the household. A major difference from the past, however, was that *negdel* memebers became waged workers. A monthly salary was paid to each person in the household who was involved in some productive activity. Households were permitted to own a small number of animals that could be sold or used for their own consumption.[2]

During the past five decades, some intensification of productive factors has taken place in the Republic of Mongolia's livestock sector. However, inputs have been limited to the construction of winter shelters in some cooperatives, water wells and production of some winter fodder. Some endemic and parasitic diseases have been controlled, but veterinary services are insufficient and deficient (UNIDO, 1993). Animal husbandry continues being a labor intensive activity that keeps on using extensive management strategies.

As suggested before, in Mongolia, the steppe ecosystem is intact and has remained, in general, ecologically stable except in specific small areas, usually near urban agglomerations (Sheely, 1993). The key factor to explain this ecological stability is the population dynamics experienced by the country during the past five decades that, in turn, have resulted in a moderate expansion of the herd. A limited growth of the human and animal populations in rural areas allowed adaptive livestock grazing management strategies, that is, mobile use of grazinglands by environmentally adapted livestock. A process of intensification, conducive to sedentary animal husbandry, which would have probably been ecologically disruptive, did not take place mainly because of low human and animal population densities.

In spite of being modest, the improvements introduced in the livestock sector should have resulted in a consequential expansion of the national herd. Nevertheless, the increase has been quite moderate. Between 1930 and 1990 large livestock (cattle, horses and camels) increased by 42.5 % (from 4.0 to 5.7 million), sheep declined by 3.7 % (from 15.7 to 15.1 million) and goats increased by only 25.6 % (from 4.1 to 5.1 million). The

Sheep Forage Unit, or SFU, is a measure that makes it possible to express the size of herds containing diverse species in a common unit. It is based on the food requirements of the different species relative to sheep (a horse corresponds to 7 sheep, a goat to 0.9 sheep, a cow to 6 sheep, and a camel to 5 sheep[3]). Expressed in SFU, the increase during the 60 years period under consideration was 25.6 % (from 44.0 to 55.3 million) (State Statistical Office of Mongolia, 1994a; Honhold, 1995).

It is likely that a major limitation to the growth of the national herd has been a supposedly innate inefficiency of the collective or *negdel* system. Poor productivity would have been the result of the official ideological commitment to abolish capitalist competition and exploitation by eliminating the profit motivations and market mechanisms. Herders did not have to make major efforts to live relatively well because the *negdel* system guarantees a reasonable livelihood without demanding a high productivity (Milne et al., 1991; Potkanski, 1993; Goldstein & Beall, 1994). Although this explanation seems reasonable, other factors also need to be considered. As suggested above, a relevant one is the population dynamics experienced by the country during the past five decades.

A combination of economic and political instability as well as high mortality rates limited population increase in Mongolia until the first half of this century (Neupert, 1992; 1994; Randall, 1993). By the beginning of the 1950s fertility had increased substantially which, combined with declining mortality, resulted in unprecedented rates of growth. Total fertility rates fluctuated between 7 and 8 children per woman. By the mid-1970s, however, fertility began to experience a slow but sustained decline which, during the 1980s, significantly accelerated. By the end of that decade the total fertility rate was approximately 4.5 children per woman. This fall continued during the 1990s; the official estimate for 1993 is 2.5 children per woman (State Statistical Office, 1994b). In spite of this descending fertility trend, population growth has been substantial. The large cohorts born during the period 1950–1980, who have already begun their reproductive careers, drive a comparatively high rate of growth for the next three to four decades. When a population has a large and young base, it takes a generation or more for declining growth rates to offset the numerical effect of high growth rates in the past.

Natural population growth has been considerable in rural areas. However, because of high rates of rural-urban migration, the expansion of the rural population was modest compared with that experienced by the total and urban populations. Between 1960 and 1990 the average annual rate of growth for the total population was 2.6% while for rural areas only 1.3% and for urban areas 4.2%. The total population increased from 968 thou-

sand to 2.2 million during this period, the rural population from 631 thousand to only 924 thousand and the urban population from 337 thousand to 1.2 million. Changes in the size of the economically active population in rural areas in general and in the pastoral economy in particular are also important for this analysis. Between 1960 and 1990 the economically active population in agriculture increased by only 0.7% per year (from 254 to 256 thousand). The population engaged in animal husbandry declined by 34.0% between the same years (from 228 to 150 thousand) (State Statistical Office of Mongolia, 1991). The main determinants of this substantial decline will now be discussed.

Socioeconomic development in Mongolia began to be planned through Soviet-type five-year economic plans after War World II. The government established that livestock breeding should be the basic branch of Mongolia's economy. However, Mongolian leaders and policy-makers also agreed with planners and economists in the Soviet Union that regarded industrialisation as a desirable objective and the only real foundation of economic and social development within the framework of a socialist state. During the 70 years of socialist rule, the economic plans were directed to develop an industrial-agricultural society (Milne et al., 1991). All economic plans stress the necessity to industrialise as the only way to achieve development and progress (Bawden 1968; Academy of Sciences, 1991; Milne et al., 1991).

A major problem in implementing the economic plans was the spatial distribution of the population. By the 1950s only a small proportion of the population was concentrated in urban areas and its absolute number was insufficient to start developing an industrial sector. To meet the growing industrial labour demands, rural-to-urban migration was encouraged. This was not difficult since the higher standard of living in the cities attracted large numbers of rural families. The living conditions of the rural population under the collective system had improved with respect to the situation during the first decades of the century; however, economic opportunities and conditions were much better in the city than in the countryside, particularly for the younger generation educated in the network of provincial schools (Neupert & Goldstein, 1994).

As mentioned earlier, the basic productive unit in the Mongolian collective system was the domestic group. However, household formation and, therefore, the addition of new productive units was limited by intense rural out-migration (Neupert, 1996). The State created an extensive educational system. Boarding schools were established in all rural districts to make posssible the enrollment of nomad families' children. The costs of education, accommodation and board was assumed by the State. The edu-

cational system gave to herders' children a way of upward mobility and, at the same time, provided workers for Mongolia's urban sector (Goldstein & Beall, 1994). Only a few children stayed in the pastoral economy as herders, limiting the process of family formation that is necessary to expand the size of the herds.

As mentioned before, under the collective system the size of the private herd that a family could own was restricted. This fact limited intergenerational transfer of animals, removing, therefore, from herder families the need and motivation to increase their herds. Children moved out of the pastoral economy through education and large private herds were not allowed. The collective system motivated herder families to increase production with bonuses, free trips, medals, titles and honours; it also penalised inefficiency and mediocre production. However, incentives and disincentives were not significant enough to result in differences in the standard of living of those who excelled and those who underfulfilled (Goldstein & Beall, 1994), and they never replaced the strong incentive imposed by the exigency to expand the number of animals for the intergenerational circulation.

In spite of the moderate rate of growth experienced by the rural population and the absolute decline experienced by the herding labor force, the total population increased considerably: between 1960 and 1990 it experienced an increase of 122%. Consequently, the national demand for food also increased substantially. This increase compelled the livestock sector to expand production; however, as mentioned above, production increase in the Mongolian extensive livestock system would have required a larger rural population increase. The govenment did not want to risk the industrial development plans with labor shortages by reducing the transfer of labor resources from the livestock sector to the non-agricultural sector. The answer would have been to increase labor productivity in the pastoral economy. However this would have been achieved only by increasing resources directed to the sector and/or by improving the efficiency with which such resources were utilised. This would have been possible only by advancing into an intensive, sedentary livestock management system. Significant investments would have been necessary, such as intensive production of fodder, artificial pastures, storage facilities, pens to confine animals, watering wells, etc.

Instead of intensifying the livestock sector, the Republic of Mongolia government opted for a process of intensification in the crop-farming sector. Starting in the 1960s, arable farming became a significant rural economic activity. It was developed despite the country's unfavorable geographical and climatic conditions. Enormous mechanised state farms were

established. They specialised in the production of grain and some vegetables able to replace animal products (Academy of Sciences, 1991; Warden and Savada, 1991; UNIDO, 1993; Neupert & Goldstein, 1994; Neupert, 1996). The strategy to replace extensively produced meat and milk with intensively produced cereals was apparently successful (Honhold, 1995; Neupert 1996). Thus, Mongolia's economy was able to adapt to a rapidly rising population without intensification in the livestock sector. This policy also prevented an excessive culling of animals that might even have resulted in a reduction of the animal population. State procurement of meat increased moderately during the past three decades: between 1960 and 1990 procurement increased from 135.6 to 175.3 thousand tons, that is, by only 29.3 % (State Statistical Office, 1991: Table 4.15). During the same period population more than doubled (it increased by 122 % during the 30 year period).

One possible explanation of the government's option for an intensification of the crop-farming sector instead of one in the livestock sector is that the technology and capital equipment for an intensification of farming activities were readily accessible from the Soviet Union. However, technologies for animal husbandry intensification were more difficult to obtain. A second explanation is that the government probably viewed agricultural diversification as similar to industrialisation, that is, an appealing development objective. Unfortunately, very little has been published about collectivisation in Mongolia except in official and very general terms. It is relevant to note, however, that the government developed a crop-farming sector only to satisfy the internal demand and not to produce for massive exports. A major goal was to become self-sufficient in the production of wheat (Academy of Sciences, 1991).

In the pre-collectivisation pastoral system, herds depended exclusively on standing forage during winter; hence, the central management strategy of herders was to fatten the animals as much as possible during the summer so they could endure the long winter with only senescent vegetation (Mearns, 1993; Potkanski & Szynkiewics, 1993). After collectivisation and with the introduction of crop farming, hay crops began to be produced and some winter fodder became available in most collectives (Templer, Swift & Payne, 1993). Nevertheless, production was modest and not enough to replace winter grazing on standing forage and to eliminate nomadic movements (Neupert, 1996). Fodder is used primarily as a reserve for contingencies and to provide some nutritional supplement to the animals in winter. The introduction of crop farming, fodder crops and some progress experienced by the pastoral economy can be pondered as an intensification of technological factors. However, this intensification was not directed to-

ward the implementation of a sedentary management system. Rather, it was a by-product of the intensification induced in the farming sector. It was used mainly to reduce the uncertainties of the nomadic pastoral production system (Neupert, 1996).

It is important to mention that the development of crop agriculture had a limited ecological impact in Mongolia because it covered only a small part of the total grazingland. It is estimated that the total agricultural area of the country is 125,656,000 hectares. In 1990, 124,285,000 hectares were natural meadows and pastures and only 1,371,000 hectares were devoted to crop-farming (1.1 %) (State Statistical Office of Mongolia, 1991, Table 4.19). As mentioned above, the objective of the development of crop agriculture was only to satisfy the internal demand for cereals.

INNER MONGOLIA: FARMERS AND HERDSMEN

A major change experienced by Inner Mongolia has been the substantial in-migration of Han Chinese. It has changed many aspects of the native Mongolian society: population densities, ethnic composition, social and economic structures, language, customs and ecological environment (Ma, 1993). Between 1912 and 1990 the Han population of Inner Mongolia increased from 1.2 to 17.3 million (Ma, 1992). According to the 1990 Population Census of China, the total population of Inner Mongolia was 21.5 million out of which only 4.2 million were Mongolian, that is, 19.5 % (CSCPRC, 1992b).[4]

During the Mao Tse-tung period (1949–1976), all areas of Chinese public and private life were influenced by his doctrines. A leading idea was that human will, organisation, and labor can overcome all obstacles, including the limitations of the natural environment. Consequent with this belief, migration of large numbers of peasants into marginal frontier areas was promoted. Many of these areas had been devoted for centuries to animal husbandry, but it was considered that they should be reclaimed for more productive and efficient uses such as growing grain. In Inner Mongolia, beginning with the Great Leap Forward (1958–60) and during the following two decades, the policy was to expand cultivation into grazinglands. In this process, large numbers of Han farmers settled in the region and some attempts to sedentarise Mongolian herders were made. In warm, moist years, especially in the southern areas, agricultural efforts succeeded. This seeming achievement encouraged further efforts to expand crop agriculture. However, in the long run the dry and cold climate has caused agricultural production to be poor and unpredictable (CSCPRC, 1992b).

Numerous industrial and mining enterprises have also been developed in Inner Mongolia. For example, Wuhai, a city located in the southwest of the region, is a major industrial and mining center (coal and chemicals) in China. However, the livestock sector is the foundation of the region's economy. Of the labor force, 59% is employed in the agriculture sector, accounting for 46% of the annual income of the region (Buhe, 1987; Li, 1989).

At present, human land use in Inner Mongolia varies along a gradient that runs from lands dedicated mainly to marginal rain-fed cropfarming in the warmer, wetter southern areas to grazinglands in the cooler and drier north. As temperature and moisture decline, agriculture changes into a combination of pastoral and crop-farming activities (CSCPRC, 1992b). In this zone, animal husbandry is completely sedentary, usually confined to the feeding of animals in pens. Finally, in the coldest, driest areas of the North, extensive pastoralism is the most important rural economic activity. This zone is the largest one and livestock breeding reigns supreme.

According to government figures, both the quantity and the quality of the grasslands are in decline. In 1989, Inner Mongolia had 86.7 million hectares of grassland, of which 18.7 million hectares, or 21.6%, were considered as "unusable." Another 29.9 million hectares, or 34.5% were assessed as "deteriorated" or "seriously deteriorated." Only 38.1 million hectares, or 43.9% were considered usable and in good condition. It is estimated that between 1965 and 1989 deteriorated grasslands have increased by 28.7 million hectares (CSCPRC, 1992b). Recent reports estimate that pasture capable of supporting optimum livestock production is declining by over 60,000 hectares per year and desertification is expanding by 340,000 hectares per year (Sheehy, 1993).

The literature on grasslands in northern China suggests that the main factors that have contributed to ecological damage in Inner Mongolia are the conversion of pasture to cropland by Han Chinese on the one hand and overstocking, overgrazing, and other irrational rangeland management practices adopted by the Mongolian pastoralists on the other (CSCPRC, 1992a).

In the grassland environment, topsoil is held by a grass root system. It forms a tightly-woven net that prevents soil loss through wind or water erosion. Ploughing inevitably destroys the root system, which is not replaced by the plants cultivated, such as wheat. Strong winds in both winter and spring blew away the topsoil that used to be held by grass root system. In some areas, ploughing and watering brought up salt and alkali that used to be more than 1 metre below the surface (Ma, 1993). The grasslands rapidly lose soil as well as humidity, and become a semi-desert.

In spite of the magnitude of in-migration, and the efforts to expand cultivation, the region has less than 5 million hectares of cultivated land, which is approximately 5.4% of the agricultural land and 4.1% of the total area of the region. Therefore, although crop farming has contributed to the environmental degradation of the environment, it does not seem to be the main determinant. The expansion of agricultural activities may have devastating effects on a restricted area but little relevance for the grasslands as a whole. More important appears to have been the substantial increase in livestock numbers. According to 1989 data the grazing livestock in Inner Mongolia corresponds to 72.1 million SFU (20.9 million sheep, 9.3 million goats and 7.2 million large livestock). Considering the grassland area mentioned above (86.7 million hectares), density is 0.82 SFU per hectare of grassland. Between 1952 and 1988 the total number of animals in Inner Mongolia almost tripled, from a little more than 26 million SFU to more than 72 million (CSCPRC, 1992b). For comparison, in 1990 animal density in the Republic of Mongolia was only 0.44 SFU per hectare and between 1930 and 1990 the herd increased by 25.6%. The present number of animals in Inner Mongolia appears to have exceeded a sustainable level and, by far, exceeded traditional stocking rates.

Why has the herd increased so much in Inner Mongolia? Why have animals reached such large numbers? The number of animals grazing in the region by the time of the Communist ascendancy (1949), after decades of chaos and war, was undoubtedly low. The years of stability and peace after the revolution contributed to a substantial increase of the herd. It seems that the economic reforms of the early 1980s have also contributed to the increase, in particular, the "household responsibility" system, which transferred animals from collectives to private households. This was followed by the "double responsibility," which not only distributed animals to individual households but also leased land for the growing of fodder. In exchange, the herders are required to sell at fixed prices to the state live animals and animal products in quantities stipulated in the contracts that give them control over these assets. After providing to the state the contracted quotas, herders are free to sell surplus meat and animal products on the open market (CSCPRC, 1992b). With the countrywide development of a market economy, pastoral products such as wool, meat, leather, cashmere increased. This situation would have greatly stimulated herdsmen to increase animal numbers (Ma, 1993). There is little doubt that the factors mentioned above have stimulated increases in the herds, but other factors appear to have also had a major effect.

Contrary to the case of the Republic of Mongolia, during the past four decades the population engaged in the Inner Mongolia's pastoral economy,

namely Mongolian herders, has experienced substantial increases. Between 1953 and 1990 the Mongolian population of Inner Mongolia has increased from approximately 1 million to 4.2 million; this corresponds to an average annual increase of 3.6% (Li, 1989; CSCPRC, 1992b). A major reason for this substantial growth has been mortality decline, especially infant mortality improvements, that took place everywhere in China. It is also important to mention that venereal diseases, endemic among Mongolians in the past, were controlled during the early 1950s (Randall, 1993). In addition, local minority groups in China were initially exempted from the stringent birth control policies adopted by the government to limit Han couples to one child. This policy has contributed significantly to the natural increase of the Mongolian population (Li, 1989). In 1985, however, minorities with one million or more people were forced to conform to the one-child policy (Gladney, 1991). According to the 1990 census, the total fertility rate of the Mongolian population was 2.2 children per woman (Yusuf & Byrnes, 1994).

Through the household registration system established in 1955, the Chinese government strictly controlled internal migration, especially from rural to urban areas (Goldstein & Goldstein, 1985). The government policy was to limit spatial movements out of the rural areas although rural to rural migration was not restricted. As a result, most Mongolian families remained in the rural areas as herders. Hence, the natural increase of the Mongolian population had to be occupationally absorbed by the livestock sector with the consequent pressures to expand the herds. The labor required by the development of urban industrial centres in the region was supplied mainly by Han in-migrants. More recently, the rising prices of pastoral products contributed to substantial income improvements among herder families, making labor movements out of the livestock sector economically irrational. Although systematic information is not available, studies conducted in some villages suggest that it has been common for Mongolian families to move from villages with a large proportion of Han in-migrants, and therefore dedicated mainly to crop agriculture, to villages which had high proportions of Mongolians still engaged in animal husbandry, where it is easy for them to remain herdsmen (Ma, 1993).

At this point it is important to pose a question that has a direct relevance to the environmental deterioration that Inner Mongolia is experiencing: has the pastoral economy experienced a process of intensification?

The Inner Mongolia pastoral economy experienced a process of intensification that, although greater than in the Republic of Mongolia, was also limited. As in Mongolia, collectives were introduced in the pastoral areas replacing the feudal system that historically prevailed in the region. In Inner

Mongolia they were introduced during the 1950s. Herding strategies were based on extensive nomadic pastoralism and, as in Mongolia, did not experience major changes with the process of collectivisation. Movements were seasonal and very frequent although covering only short distances. Families stayed in one camp no longer than two months but movements did not cover more than 4 or 5 kilometres. This type of nomadic movement continued during the 1970s (Li, Ma & Simpson, 1993). However, since the mid-1980s the seasonal movements have changed into a semi-nomadic pattern as a result of a process of intensification. Major aspects of this process have been the building of permanent houses for the herder families, development of water supplies, construction of shelters, pens and facilities for hay storage. Villages multiplied in pastoral areas as centers of economic and productive activities. Sedentary fenced fields to harvest hay began to emerge by the mid-1980s as part of the double responsibility system. However, most of the grazinglands remained as common-access natural pastures. As mentioned before, in some areas, Han farmers developed completely sedentary agriculture production centers. In most cases, they combine agriculture with sedentary livestock breeding. Livestock is a secondary activity and animals are fed mainly by crop by-products such as straw and stems. There is limited production of cultivated fodder for the livestock sector. In some areas European breeds were introduced as a replacement for less productive but adapted livestock (see Sheehy, 1993; Ma, 1992; CSCPRC, 1992; Pasternak, 1996).

Although the process of intensification experienced by the livestock sector in Inner Mongolia is evident in some aspects, as a whole it was limited, at least when compared to the growth experienced by the human and animal populations. It is important to remember that intensification in a context of extensive pastoralism means the utilisation of increasing amounts of energy inputs into the system to supplement or to replace those inputs available in the natural pastures. However, in zones where production remains focused on livestock as the primary production enterprise, extensive nomadic management practices are still used in vast rangeland areas that are held in common. The most common pattern is a form of semi-nomadism with seasonal migration of grazing animals in order take advantage of distant grassland during autumn and winter and return in spring to a fixed home base.[5]

Environmental problems of Inner Mongolia are the result of the lack of consistency between the process of intensification experienced by the pastoral economy and the growth of the animal and human populations. There is a serious imbalance between numbers of livestock and sources of nutrition. The number of animals has grown rapidly in recent decades,

while the production of additional nutritional inputs has not experienced a parallel increase. As previously explained, in an intensive livestock system, these additional energy inputs are produced by the agricultural sector, usually as harvested fodder and crops grown to produce concentrated feeds. They can also be produced by the livestock sector itself, by increasing the productivity of the grazingland by seeding improved pasture species to allow high intensity grazing by livestock on artificial pastures.

This intensification did not take place in Inner Mongolia for two reasons. First, the natural environment of Inner Mongolia, climate and soil in particular, has been responsible for restricting the development of crop-farming to just a marginal agriculture, with meagre and erratic outputs and low productivity. Environmental constraints appear to have also made difficult the production of fodder in artificial pastures by the livestock sector itself. Through the double responsibility system, sedentary grazing areas were assigned to individual herder families. Hay cutting on a relatively large scale takes place; however, little or no inputs have been introduced to improve productivity in these sedentary fields. In any case, considering the unfortunate experience of the farming sector, it seems quite difficult to raise the productivity of the steppe's grazinglands. In addition, high-yield artificial pastures could have degraded even more the ecological stability of the grasslands. Second, there have also been institutional limitations. The growth that the herds experienced during the past four decades took place within a general economic and policy context with limited introductions of new technological inputs directed toward increasing nutritional resources for the animals. Rural development in the region has focused more on developing an extensive sedentary agricultural production system similar to that in temperate China. The government's priority was directed to convert steppe areas into cropland. The agricultural sector was regarded as the primary level of production, aimed at the production of grain for human consumption, and not as a secondary production level directed to the livestock sector. Being a minority in their own land, Mongolian herders did not have the power to influence agricultural policies and decision making. The local and central governments have never implemented policies aimed at introducing the technological inputs necessary to equate the intensification in the livestock sector to the increases of the human and animal populations. Considering the harsh environmental conditions of the steppe, this intensification would have required major investments that policy makers were not willing to make in an economic activity that has never received priority attention in China.

Since sedentary agriculture has not been able to provide sufficient additional nutritional inputs, these had to be obtained in the natural pastures

by overgrazing and overstocking. The resilience of the grazinglands seems to be particularly weak. It was not possible to increase the size of the herds without disrupting the stability of the ecological system. The stress put on the environment to obtain additional nutritional inputs as a result of the increasing number of animals has been a major factor responsible for the degradation. In other words, too many people and too many animals are pressing hard on a fragile ecosystem; the number of animals has been steadily rising, while the resource on which they depend has not been increased enough through intensification.

A simplified and impressionistic exercise may be used to illustrate the point. It has been estimated that the average plant material produced per year by the natural pastures in the region corresponding to the Republic of Mongolia is 377 kilograms per hectare (Honhold, 1995). Of this amount, half is required to maintain the pasture species: 188 kilograms per hectare. If the same figures are used for the Inner Mongolia grazinglands, the region would produce 16.3 million tonnes per year of potential feed for grazing animals (considering that its grazingland area is 86.7 million hectares). This is an optimistic figure since substantial portions of these grasslands are substantially deteriorated and even unusable. It is estimated that one sheep consumes 1 kilogram of forage per day; thus one SFU requires 365 kilograms per year. Therefore, Inner Mongolia could potentially support the equivalent of 44.7 million SFU per year. The grazing livestock in Inner Mongolia corresponds to 72.1 million SFU, that is, there are 27.4 million SFU over what would be a sustainable level of grazing in natural pastures. This excess livestock should be fed by additional nutritional inputs produced as harvested fodder or by high intensity grazing in artificial pastures. In order to accomplish this, the equivalent of approximately 10 million tons of forage per year should be produced. It does not seem possible that this amount of nutrition can be obtained without the introduction of major investments aimed at increasing substantially the productivity of the grazinglands through technical inputs; nor can it be grown in just 5 million hectares of marginal agricultural land.

It is interesting to compare these figures with the Republic of Mongolia. With 121 million hectares of grassland, the country can produce 22.8 million tonnes of potential feed for grazing animals at a sustainable level. Therefore, Mongolia can support the equivalent of 62.5 million SFU. Since the 1994 animal population was the equivalent of 55.5 SFU, 90% of the potential offtake is being used, leaving 10% for expansion.

The effect of grazing on the Inner Mongolian grasslands is complex and it merits further research. It has even been proposed that current stocking rates are not abnormal or excessive and, therefore, grazing is not hav-

ing any major impact on the environment (CSCPRC, 1992a). Nevertheless, the existence of heavily grazed areas registered in several studies show a level of degradation that gives cause for concern (Zhang, 1992; Wang, 1992; Ma, 1992; 1993). Although general and simplified, the example presented above clearly suggests that with the present level of stocking, without substantial nutritional supplements from sedentary agriculture, grazing animals are consuming an amount of forage well over a sustainable level.

It is important to note that, according to some studies, a major factor in environmental degradation in Inner Mongolia has been that the grazinglands are free, uncontrolled and overused resources (CSCPRC, 1992a). This is the notion of the tragedy of the commons, which explains grassland degradation as the inevitable outcome of stocking privately owned animals on public or collective land (Hardin, 1968). The benefits of each animal belong to the owner, whereas the cost to generate those benefits must be shared by all (the cost is a decrease in the amount of grazing available by one animal ration). Private benefit usually exceeds private cost; therefore, it is convenient for owners to keep on adding animals to their herds, resulting inevitably in overgrazing and deterioration of the common grassland. In the case of Inner Mongolia, some believe that this would have been avoided with a policy aimed at expanding the double responsibility system by increasing private use of grassland. This would have transfered to individual herders the cost of grazingland degradation and, therefore, created interest among them in maintaining a balance between land and animals. It is also considered that the regulatory authority of natural resource agencies has not been adequate and that they have not been provided with the means to enforce scientifically estimated stocking levels (CSCPRC, 1992a). Recent studies on common pool resources have examined the conditions under which individual owners in rural communities will respect collective rules for use of common resources (National Research Council, 1986; Ostrom, 1990). Where members of the communities do not follow similar production strategies, where there are large wealth or status differentials within the community, where belonging to the community has few benefits, and especially where rules about resource use and management do not exist, it is unlikely that common resources such as pasture can be sustained. Most case studies conducted in pastoral communities in Inner Mongolia suggest that conditions are not favorable to sustainable livestock breeding (Ma, 1992; Ma 1993; Ly, Ma and Simpson, 1992; Pasternak, 1996; Pasternak & Salaff, 1993).

It seems that, in fact, diverse factors have contributed to the environmental instability that Inner Mongolia is experiencing. However, the population increase experienced by the pastoral population has been the most

important single factor. Under conditions of moderate population growth (as a result of low fertility or high out-migration rates), animal numbers would have experienced lower increases; therefore overstocking and overgrazing, the direct causes of environmental degradation, would not have occurred. Open access to grazinglands in a context of low human and animal population densities does not seem to be a threat to environmental stability.

The discussion in this section has focused mainly on overgrazing and overstocking as major determinants of the environmental deterioration of Inner Mongolia's steppe. The transformation of grasslands into croplands appears to have also contributed to the environmental degradation. However, as noted above, the limited area brought into cultivation has been small and, therefore, crop-farming has not had an overall degradation effect as significant as the increases in animal densities. It seems that the available literature has magnified the effect of crop-farming because of its more direct and evident negative ecological impact, but, as suggested before, overgrazing seems to be a much larger problem in Inner Mongolia.

CONCLUSIONS

The collapse of the industrial sector and the privatization of agricultural activities that occured after the 1990 reform movement are the two main economic changes that are strongly affecting the Republic of Mongolia's pastoral economy. As a result of these changes two important characteristics of rural development are emerging. Firstly, significant investments in agriculture are not likely in the near future. Internal capital is limited because of the economic crisis that the country is experiencing, and financial help received from developed countries is being used to keep the deteriorated economic and social infrastructure functioning. Therefore, substantial modernization in the livestock sector cannot be expected, at least during the next ten or twenty years. Secondly, the livestock economy is increasingly relying on independent family productive units and less on collective organisations. The official agricultural privatization plan is encourageing an organisation of production in the livestock sector based on family production. Collectives, in the form of private shareholding companies, will probably continue to exist, but they will focus more on marketing than on production itself.

Future significant job creation in urban areas is unlikely because of the economic crisis. Cities will stop attracting the rural population as was the case in the past. Actually, urban areas have suffered more that rural areas

from the economic crisis. The collapse of the Republic of Mongolia's industrial base seems to have ended the rural-to-urban migration stream. There is even some evidence of an urban-to-rural migration stream. As a result of the crisis, a significant number of people is moving from cities to the countryside where at least employment and subsistence are assured (Neupert, 1996). A lasting urban-to-rural migration stream is unlikely, but the present population redistribution trends suggest that the labor force engaged in the pastoral economy is substantially increasing.

The past slow process of family formation that limited the expansion of the herds will change. Moreover, the expected rapidly growing rural population is likely to determine strong pressures to expand animal numbers. Mongolians have centuries of experience in animal breeding and there is little doubt that they will be able to manage the herds well enough to increase animal numbers up to a new equilibrium between animal and human populations. The main limitation, however, will be that imposed by the carrying capacity of the grazinglands.

In spite of being a large country with enormous pasturelands, the carrying capacity of the Republic of Mongolia's grasslands is limited. The Mongolian livestock economy is likely to reach a point of nonsustainable stocking rates as early as the end of the present decade (Honhold, 1995; Neupert, 1996). Rapid human and animal population growth within an extensive management livestock system may have devastating environmental consequences, as it has been the case in Inner Mongolia. However, the Republic of Mongolia has always been, and is, a mainly pastoral livestock society. Because of this, there is a strong conservation ethic that recognises the idea of sustainable use of the grasslands. Mongolian agricultural policy-makers and producers acknowledge that the livestock production system should be sustainable to maintain ecological stability and that such a stability is essential for the future of the pastoral sector.

The situation in Inner Mongolia is much more complex and difficult. Agricultural policy-makers have acknowledged the ecological problems that the region is experiencing. However, there have not been serious attempts to modify the livestock production system and other conditions to reduce ecological degradation (Sheely, 1993). In addition, in Inner Mongolia, a major problem is that modifications to the present agricultural policies would have substantial social and political ramifications and, therefore, it is more comfortable for agricultural policy-makers to continue the present policies.

In Inner Mongolia, extensive, and probably irreversible, ecological damage has already been done. Population growth of the Mongolian population in the region has been substantial and, what is more important, this

population growth was occupationally absorbed mainly by the livestock sector. This brought substantial pressures to maximise animal numbers and the herds did in fact experience a significant expansion. Environmental and institutional constraints, however, prevented a process of intensification aimed at increasing the carrying capacity of the steppe. The result was that the increasing number of animals led to substantial environmental degradation (Sheehy, 1992).

A major conclusion that can be derived from the previous analysis is that, both in Inner Mongolia and in the Republic of Mongolia, policies toward the livestock sector should include population considerations. It is not proposed here that the solution to present environmental problems in Inner Mongolia and possible future problems in Mongolia is a drastic reduction of the population in the pastoral areas. What is suggested is that any technical or institutional measure implemented to solve environmental problems will have little effect if population growth is not taken into account.

There are several population issues to consider. Although fertility has experienced substantial declines both in Mongolia and in Inner Mongolia (Neupert, 1994; Li, 1989; Yusuf & Byrnes, 1994), population will continue to grow substantially. The high natural growth rates experienced by these populations in the past will maintain high rates of growth for the next three to four decades. The working age population will undergo a particularly significant and rapid increase. In other words, high rates of natural population growth in the pastoral economy for at least the next twenty years will be inevitable because of the relatively large percentage of young people in today's population. This provides a built-in momentum for further population growth, even as the number of children per family declines.

The most urgent task is to find solutions for the rapidly growing working-age and marriage-age population and the probable subsequent increase in the number of new families. As discussed previously, it is through the process of family formation that population growth affects the expansion of the herds. Out-migration can be considered as a possible alternative. Forced migration is, obviously, out of the question. At present, with the new rules regarding freedom of movement and even at a remarkably high political cost, it would be impossible to control the size of the population by forced out-migration in the pastoral areas, both in Mongolia and Inner Mongolia. Creation of economic opportunities to attract families to other places such as urban localities is also unrealistic considering the economic crisis that Mongolia is experiencing and China's general policy to limit rural to urban movements.

Solutions should be based on creating conditions that avoid the nega-

tive effects of population pressures on the ecological stability. Therefore, answers to the environmental problems of the regions should be based on policies directed to accommodate human and animal population increases within the context of limited resources and without resulting in ecological degradation. One possibility, although costly, would be to increase the carrying capacity of the grazinglands through technical inputs. For example, western intensive livestock production systems can be transferred to the grasslands. However, considering the low level of resilience of the steppe, this alternative is likely to fail and cause even grater ecological instability (Sheehy, 1993). Likewise, applying measures derived solely from technical environmental and ecological considerations isolated from the economic and social aspects of pastoral societies is both undesirable and unrealistic (Sheehy, Stuth, Hamilton & Conner, 1991).

The first step, both in Mongolia and in Inner Mongolia, should be to develop a grazing management system conducive to longterm ecosystem stability and based on integrating environmental information and livestock production decisions. This requires an awareness by both herders and the policy-makers that environmental constraints impose an upper limit on livestock production that cannot be crossed. Starting from reliable information, it is most urgent to set stocking densities for the different areas of the two regions that are equal to or below the carrying capacity of the land and to establish a livestock management system compatible with such stocking densities.

Having established regulations regarding the use of the grasslands and a suitable management system, it will be necessary to develop a strategy to accommodate economically the excess population that will exert pressure to increase the herds. One possible way to accomplish this could be by creating nonherding employment in pastoral economic areas. A policy to provide cooperatives or individual families with credit to develop small-scale agro-industrial enterprises linked to livestock activities may substantially increase nonherding employment within the pastoral economy. This is not an easy alternative and will demand substantial economic and political governmental attention to the sector. However, unless measures are taken, the pastoral economies of Mongolia and Inner Mongolia will have little hope of sustainable development and of breaking the link between population growth and resource degradation.

It is also important to remember that the transition from collective to private livestock breeding is resulting in both winners and losers. Rural poverty problems are increasing both in Mongolia and in Inner Mongolia (Cooper & Gelezhamtsin, 1993; Harper, 1994; CSCPRC, 1992). A concentration of livestock property may have negative ecological consequences

since wealthy herders will be in a strong position to use better pastures, forcing small herders towards unsustainable grazing practices. Therefore, government policies towards the pastoral economy should also include interventions to reduce the vulnerability of poor households.

A major policy problem in the Republic of Mongolia is that the effect of population growth on the environment has not been recognised. After the 1990 reform movement, the official pronatalist policy that had been implemented for the past 40 years was discontinued and a family planning program begun. However, the idea that a large population is best continues to be a deeply rooted conviction of the Mongolian government (Neupert, 1994) although the current rate of population growth is considered unacceptable. Still, most policy-makers cannot imagine that population problems may exist in a country with such a low overall population density and that substantial population growth may impinge on the process of sustainable development of the pastoral economy. On the contrary, a slowdown of population growth is considered as a limitation to the growth of the animal population and, therefore, to the development of the livestock sector (Neupert, 1996). Evidence from Inner Mongolia suggests the opposite.

Currently, the most vital need for both Mongolia and Inner Mongolia, is to recognise that a major determinant of environmental degradation in the steppe is the increase of human and animal densities and the urgent necessity for nonherding job creation within the pastoral economy. Technical answers to ecological instability, reforms to the livestock management system, strict norms regarding the regulation of stocking densities, and intensification of technical inputs are alternatives worth being considered. However, unless the problem of population pressures on the limited resources is solved, other solutions are likely to have a limited effect.

ENDNOTES

1. Other groups of Mongolian people live inside Russia (Buryatia) and in other regions of northern China. However, the Republic of Mongolia and Inner Mongolia concentrates most of the Mongolian population of Central Asia.
2. Mongolian herders are in reality semi-nomads. They move short distances with reference to a permanent settlement (the *negdel* centre) and within an area decided in advance (Goldstein and Beall, 1994). Even before collectivisation nomadic movements did not involve long-scale movements (Bawden, 1968). However, movements are made by the whole household and also include the transport of the dwelling unit. Transportable shelters are essential to the Mongolian pastoral management system and, in the freezing cold of Mongolia, are a matter of survival. The Mongolian *gerh*, or *yurt*, is impressively adapted to this. These are demountable and portable round tents, usually made of felt, which can accommodate a family of four to eight members.
3. These values correspond to the Mongolian Sheep Forage Unit. There are other standard

measures to express the size of mixed herds in a common unit, for example, the Mongolian Bod Unit, the Australian Sheep Unit and the Tropical Livestock Unit. All of them are based on the food requirements of different species relative to a given animal.

4. Migration of Han Chinese to the northern border region is a relatively recent trend. Previous to the past century it appears to have been moderate. By the 19th century it increased somewhat by the great population expansion in China in the 18th century (see Durand, 1960); still, it did not involve large-scale movements of people. Since the late 19th century migration of Han farmers increased considerably, and substantially accelerated during the periods of the Great Leap Forward (1958–60) and the Cultural Revolution (1966–71) (Li, 1989). Redistribution of Han Chinese to Inner Mongolia in particular, and the northern frontier in general, has been the result of government initiatives stemmed from clear strategic, economic and political motivations. The government, has long seen the security of the border between China and the former Soviet Union along the country's northern frontier to be of particular concern to the nation's territorial integrity. Therefore, a major motivation to stimulate migration to the northern frontier has been to secure control over strategically sensitive areas. Another reason has been the assimilation of minorities. Most of the country's ethnic groups are concentrated in the border regions. Migration of Han Chinese to these regions was expected to promote the assimilation of the minority people. A no less important official motivation to promote migration to the North has been to alleviate population pressures in the densely populated southeast, especially in cities overburdened by population numbers (Li, 1989). Economic reasons, however, appear to have been the most relevant official motivation.
5. Herdsmen families remain in their permanent homes during spring and summer (middle of March to the end of August). In most cases, permanent settlements are located in the spring pastures. During this period, they carry out the activities of spring and summer such as calving and lambing. This is a crucial time for adequate nutrition, shelter and care of young stock. By the end of the summer, the men or young couples of the family drive sheep and goats to the winter pastures for fattening for a short period (10 to 20 days). The cattle remain at the permanent settlements. During the beginning of the autumn they make short movements out of the permanent residences (2 to 4 kilometres). These movements are restricted by the lack of water resources out of the settlement. By the end of autumn (late October), when snow is available for water, families move to the autumn pasture and stay there until the end of December and then they move to winter pastures (Ly, Ma, and Simpson, 1993).

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