Economic, Social, and Technical Analysis of Changes in China's Pastoral Peoples and Grasslands

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Executive Summary

China's GNP per capita is increasing rapidly, particularly in the Eastern Region and especially in large urban centers. The vast Western Region, which makes up two thirds of its land mass, is also the home to most of the ethnic minorities. A large portion of them are termed pastoralists given that livestock rearing is their primary livelihood. The lives and livelihoods of almost all pastoralists on the grasslands, also termed pastoral area or rangelands, have also been undergoing dramatic changes, although much more subtle.

The widening income gap between the Eastern and Western regions is a subject of considerable debate in China. A serious constraint to narrowing the gap is that many pastoralists and integrated livestock/crop farms, at or near a subsistence level, have few options to substantially increase their net incomes commensurate with urban dwellers and larger size agricultural units. The topic is very complex due to a multitude of variables beyond those in cropping areas such as severe ecological issues from overgrazing, and land tenure aspects related to changes from traditional nomadic herding systems.

The principal problem—and the *raison d'être* for the research reported on—is that severe grassland degradation is primarily due to the vicissitudes of human population growth. The larger public policy issue, and a daunting task, is how to reduce, or at least ameliorate land degradation while simultaneously improving income parity with the rapidly developing Eastern Region.

The complexity of different climatic areas and livestock systems covering a vast area led to development of the research project reported on. The primary objective was to determine the efficacy of employing an in-depth data gathering procedure especially developed to analyze pastoral area production structures and associated economics, grassland degradation, and migration as a way to reduce overgrazing, improve the ecology, and determine how household incomes might be sustainably enhanced in concert with national development goals

The objective was met through nine case studies in four diverse project areas spanning China's pastoral area (Map 1). Four are reported on in Part I, and the other five in Part II. The five

case studies in Part II are in Hurquige Gacha, Xilinguole League, Inner Mongolia, on the Mongolian border northeast of Beijing. The four case studies presented in Part I are:

- Nomadic herders in Xinjiang Province in the extreme Northwest of China on the borders of The Republic of Mongolia, Russia and Kazakhstan
- A settled family primarily producing milk in the Tibetan speaking area on the southern end of the Qinghai Plateau in Sichuan Province, north of Chengdu
- A medium size semi-nomadic herder family in Northeastern Inner Mongolia near the border of Russia
- A small size settled family in Southeastern Inner Mongolia

The issues and structures studied emanate from the time New China was born in 1948. By the 1970s, the focus on development resulted in a major emphasis on settlement of grassland herders into houses, initiating an ever-increasing semi-nomadic lifestyle, and more recently a sedentarized livestock system. That segment of former herders affected, now relegated to a regulated lifestyle from their traditional nomadic system, soon realized the negative impact of sedentarization on their grassland resources, particularly due to division of once extensive lands into increasingly small holdings among siblings. Compounding the problem has been lack of knowledge about technical and economic aspects of sedentarized livestock raising in a climatic environment affording very limited alternative range and management improvement strategies. Needless to say there continues to be a wide spectrum of systems ranging from traditional nomadic herders, to families exhibiting great similarities with small size ranchers on the upper Great Plains of the United States.

The all-inclusive case study interview method that combined the Participatory Research Appraisal (PRA) method with a specially designed field use oriented computer program exceeded the author's expectations. As an example, the ample tables are provided to as a way to really understand the benefits from extensive time required on the case study interviews.

Data gathered in the case studies on seasonal grazing, combined with input use as part of the economic analysis, revealed the complexity of the overgrazing and land degradation issues as impact varied considerably between types of operations and management considerations. It is recognized that, as with all studies of this nature, prices, costs and income will have changed since the data collection and analysis. However, the value of extensively reporting them is found through comparison of results between the widely varying systems and structures that are still representative of a significant portion of China's western area.

The case study integration method used in the research provides an unusual composite of detail and overview of production systems, seasonal grazing patterns, relationship of actual use to

mandated maximum use (percent overgrazing if that was the case), cost of production by species and products produced (what might be termed profit centers), evaluation of gender use, and calculation of migration related opportunity costs linked to net income. The only caution is that considerable livestock, range management and interviewing expertise were crucial for success. On the positive side it provided a manageable way to really understand the feelings, frustrations, and desires for personal improvement and rejuvenation of the grasslands by herders that can lead to appropriate policies and legislation.

The method, although time consuming, led to in-depth understanding that pastoral area and herder development is not one of a single plan; rather, a multitude of efforts are needed, just as there is no one solution to overgrazing. An example of the value from extensive time spent gathering detailed data for the cost and returns analysis is exemplified by the finding that reliance on the opportunity cost method as a major indicator for migration decisions has severe flaws as it can lead to incorrect recommendations about benefits of migrating from herding. The solution was found to be in combining it with detailed budgeting that does provide reliable quantitative information about actual economic benefits. It was also determined that the method of combining a computer based program to register data from participatory rural appraisal interviews on-site was indispensable to obtain accurate data, and stimulation of responses and ideas. It was concluded that the case study integration method employed should be considered for use at the global level in addition to China.

Herders in all systems were found to know the problems, but that it was difficult for them to really understand the impact of their short-term actions emanating from their daily issues of simply surviving in a hostile climate. What they were found to really want was an opportunity to participate in the hard, arduous task of decision-making in policy formulation. They all, and particularly the more elderly who lived through the degradation of their areas, clearly understood that the grasslands are a finite resource that has been terribly abused.

The herders realized that tough, yet fair, national and regional level policies, laws, monitoring, strict enforcement and heavy penalties for non-compliance on reduction of grazing pressure are vital to provide the best results for their children and coming generations. Paradoxically, in the big picture, all herders face a commonality problem to some extent because all land in China belongs to all the people. Semi-nomadic and settled herders are users with land tenure rights, and thus are stewards charged with the responsibility of maintaining and improving the land they manage. Likewise, and perhaps ironically, fair treatment for advancement of the grasslands is a responsibility and priority for all Chinese; urbanites and others that will never even set foot on the grasslands.

The broadest conclusion from the case studies is there needs to be a national vision about what the grasslands should represent a few decades hence. Associated strategic planning would include objectives and quantifiable goals about such diverse issues as national parks, control over runaway mindless land grabbing of the most scenic areas, and conservation of the grasslands—which cover 40 percent of China's land mass. A valuable starting point is careful evaluation of policies and programs set forth in the late 1800s and early 1900s for the western United States that resulted in its unparalleled land use policies. In conclusion, the pastoral areas represent a unique opportunity for preservation of an exceptional, irreplaceable part of China.

Key words: China, grasslands, pastoralism, economics, overgrazing, migration, gender

Economic, Social And Technical Analysis of Changes in China's Pastoral Peoples and Grasslands: Part I

Perspectives on Pastoral China for the Research Purposes and Objectives

Forty two percent of China, 400 million km^2, is designated as grassland (including deserts and other areas suitable for grazing livestock, and termed permanent meadows and grasslands in Food and Agriculture Organization of the United Nations statistics). The greatest portion of that area is inhabited by what traditionally have been known as pastoral peoples (Map 1). China has more grassland than any country or region in the world, amounting to 12 percent of the world's total. Its geographic, climatic and animal production conditions are very diverse, ranging from tropical areas in the south to high mountainous zones in the north. The prevalence of grassland in the Western region, general lack of water and other natural resources, and low agricultural productivity are reasons for economic disparity between it and the other two areas of China, the East and Central regions.

There are a number of terms used somewhat ambiguously to refer to pastoralism. For clarity, the term pastoralism is defined here as being the practice of herding as the prime economic activity of a society. Nomads, the traditional foundation of China's pastoral grasslands, are communities of people that move within a regular area following seasonal patterns, and generally returning to a home base for a period of time. Transhumance is the movement of livestock, and the people necessary to tend them, for a season, usually summer, at considerable distance away from permanent homes. The term "transhumance" is occasionally, and incorrectly, used as a synonym for nomadic or semi-nomadic pastoralism.

Sedentism is a term applied to the transition from nomadic to permanent, year-round settlement. Forced sedentism, or sedentarization, is when a dominant group restricts the movements of the nomadic group. The term semi-nomadic, quite widely used in China, is applied to the peoples in the throes of that process.

New China was born in 1948 following protracted civil unrest and World War II, with a focus on national development. That resulted in a major emphasis on settlement of nomadic herders into villages thus initiating an ever-increasing semi-nomadic lifestyle. The next phase was sedentarizing them into permanent houses. Former nomadic herders, now relegated to a settled lifestyle, soon realized the negative impact of sedentarization on their grassland resources.

Rapid population growth has resulted in division of once extensive lands into increasingly small holdings among siblings. Add to that lack of opportunities for migration to urban areas primarily due to language and cultural obstacles from living in very remote areas, coupled with a strong desire to

maintain cultural heritage, and the result has been rough and uneven economic development. Compounding the problem has been lack of knowledge about technical and economic aspects of sedentarized livestock raising in a climatic environment affording very limited alternative range and management improvement strategies.

A critical factor for analysis of grassland production, and pastoral systems in particular, is that they are diverse—and for very good reasons. There is no one solution to China's so-called "pastoral problem" of overgrazing, land degradation and relatively low animal offtake rates (Simpson and Li, *Journal of Range Management,* 1996). However, there are a number of viable, logical interventions that could result in considerable improvement in productivity, income, and range rejuvenation.

Computer Program for In-depth Household Analysis

A composite computer program was developed by Simpson that includes technical production analysis, economics of production, ecological impacts of animal stocking rates such as overgrazing, gender oriented labor use, and migration feasibility analysis. A unique aspect of the model is that it contains multiple species and livestock co-products and, to these authors' knowledge, is the first program that incorporates all features described. The program was designed as an interactive investigative tool to be integrated with the powerful diagnostic tool, Participatory Rural Appraisal (PRA).

The Excel spreadsheet program data entry and calculation section covers 1,700 lines. There are another 800 lines in the report writing section, which is divided into two parts; domestic monetary units, and a selected foreign currency. It is a non-deterministic program that can be used for both data gathering, as reported on in this article, as well as an extension specialist type livestock management and simulation tool. Livestock inventory and actual and optimal grazing units based on seasonal use comprise the technical side. The economic analysis section includes sales and in-kind (family consumption) of livestock and co-products, four levels of costs; direct (i.e. cash or out-of pocket), plus family labor, ownership costs (e.g. depreciation) and capital costs. Purchased inputs, and total and per kg costs of products produced are provided. Net cash and in-kind income are calculated on total, per hour of family labor, and a sheep unit basis. Gender use in livestock activities is included and used in the section on opportunity costs and benefits of migration out of herding.

Four to six hours were found to be required for one household interview in a new area or management system depending on language capabilities, sophistication level of interviewees, record-keeping, interviewer's skill, experience, etc. Numerous parameters such as input costs and sale prices were found to be common to one area so that, once the validity of them was ascertained; they were able to be used for multiple interviews, thus speeding up the interview process. Use of a data collection sheet, and employing the first respondent as a model template for following interviews also sped up data collection and input into the program. Small size nomadic herders with little investment, use of purchased inputs, and greater homogeneity were found to require less interview time than semi-nomadic or settled pastoralists with higher input purchase, management and investment levels.

It was established that despite the model's complexity, use of a quantitative tool such as the computer program was a very efficient and productive method to gather and record both qualitative

and quantitative information. Use of a laptop computer was a major key to success because results from the various sections were immediately available for checking veracity of the data and discussion about management options. Other keys for success were found to be integration of PRA methods, sufficient time to fully explore producer's opinions and interests, and follow-up after both interviewers and interviewees, had time to review and contemplate initial results. Attendance by several friends and other interviewees as well as range management officials as appropriate, was invaluable to stimulating thinking and understanding of issues, and helpful to avoid mistakes in data collection. Participatory Rural Appraisal is a widely used technique and thus is not elaborated on here (Simpson, Li and Li, 2002).

The research data presented in Tables 1-16 is relatively self-explanatory and consequently details on data are kept to a minimum. Rather, the focus is on providing a "composite picture" of the location, type herding system, the herders themselves, and significant findings related to grassland grazing levels, gender use, income and, migration as an alternative to continuing a herding lifestyle. The first case study in Xinjiang Province is quite detailed to facilitate following the more abbreviated explanations on the other three cases.

Ethnic Kazak Nomadic Herders in the Extreme Northwest of China

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Project Area and Land Use

The Northwest project area was located in Xinjiang province, the largest in China, covering about 16 percent of the nation's land surface. It is still remote and desolate with vast deserts and arid plains that end abruptly at high mountain ranges. Only about 1 percent of all China's population live in Xinjiang province, of which about half are Han Chinese. The province is inhabited by at least 13 of China's 56 official national minorities.

Despite the large size of Xinjiang province, only about 4 percent of the nation's 126 million cattle and buffalo are found in it, although it accounts for 17 percent of its ass's (donkeys), and 12 percent of the nation's horses. Xinjiang is known as the land of sheep, and indeed it is for 27 percent of the nation's 142 million head inventory were in that province in 2007 (all the data on livestock numbers are for that year). China has a large milk goat inventory, common in all cropping areas, but only about 4 percent of the nation's goats are found in Xinjiang even though most herders raise them.

The Xinjiang Province pastoralist fieldwork was concentrated about 100 Km northwest of Altay (also spelled Altai) in the tip of the triangle bordering on Kazakhstan, Russia and Mongolia (Map 2). About 60 percent of Altay's 170,000 residents are Han Chinese. Mongolian, Uzbek and Kazak (the dominant one in the research area) are the primary ethnic herder minorities. Altay, as common throughout most areas with minorities, has a diverse number of schools for minorities to choose from depending on their language preferences. An increasing portion of herders in the Altay area are taking advantage of that option by boarding their children in Altay.

The field work, carried out in August 2001, focused on midsize pastoralists who resided at high mountainous elevations about 100 km northwest of Altay. The area, while absolutely stunning, with heavy stands of evergreen trees and rushing rivers, is extremely cold in the winter and even very chilly in summer. Common to this area, the target nomadic herders reside in a base called a "village" during the winter. Small groups of the village's 74 households moved together the rest of the year, often traveling 50-100 km between seasonal pastures. They lived permanently in yurts, which they packed up and moved as they changed pasture types with the seasons. In addition, they moved the entire household several times inside a seasonal pasture as the forage in the immediate area was depleted.

The area covered was extensive and difficult to travel in. Consequently, due to time limitations, and because livestock and grassland specialists with substantial experience were readily available in Altay, most data for an initial, basic model was gathered from officials in the Provincial Ministry of Agriculture. These individuals, found to be very knowledgeable and serious in their work, readily shared their data on various size operations in different parts of the area. They also had difficult-to-obtain census results.

The data gathered from government officials during the arrival in Altay was then checked during the site visit and through interviews with individual producers. The local field livestock officer responsible for the area, who only spoke Kazak, acted as the guide and was assisted by a livestock officer from Altay who served as translator to Chinese. The base for the "village" was quite remote, a five hour drive on very poor roads from Altay. Another day was needed to reach the herders, many of whom were engaged in moving from their summer pasture to their fall pasture.

Livestock Production

Selected production data for all the five case studies in the four regions is provided in Table 1. The "typical" pastoralist modeled in the Altay (titled Northwest, Xinjiang in the tables) area was medium sized, owning 14 mature female cattle, 22 mature female goats, 145 mature female sheep and 11 horses. They also had seven camels, the number being determined by the need to transport their household effects and the dismantled yurt during the many intra and inter seasonal moves.

The medium size household modeled sold 10 calves, 18 young goats and 116 young sheep annually. One cull cow, 4 cull goats and 4 cull sheep were slaughtered for their own use, and others were given to contract workers in the hay producing areas (near the "village") or for helping with lambing and kidding. Milk from cows was divided between suckling calves and household use. Nine kg of mohair was produced and 227 kg of wool. The wool production is relatively high because the fattened progeny were shorn prior to sale.

Pasture use

The optimal amount of land required for one sheep unit was gathered through interviews with officials and producers. Computations using the computer program revealed significant overuse of the pastures. Herd size, compounded by species differences, prevents a very meaningful comparison for analytical purposes. Sheep units were used as a common denominator to arrive at

per unit costs and returns. The standard used was one mature cow equals 5 sheep, one horse equals 6 sheep and 1 camel equals 7 sheep.

The medium size typical producer modeled grazed the equivalent of 6,799 sheep unit months annually, while the optimal amount was 5,236 sheep unit months (Table 2). This means that, on average, the grasslands were overgrazed by 30 percent. In addition, unlike other case studies, overgrazing was about that same level for each season of the year, spring, summer, fall, and winter. Field observations on pasture quality and discussions with range management personnel and other knowledgeable people, as well as study of internal reports about grazing land use in the area, indicate that rangeland throughout the greater Altay area is also at least 30 percent overgrazed.

Family labor use

Analysis of family labor use only on livestock related work by gender and season by the typical mid-size nomadic herders in the Altay area revealed that females played a very important role in the production process. For example, the total amount of time spent per household by females in the Altay case study for one year was 3,647 hours (Table 3). In contrast, the two males, who carried out most of the herding work during the day, spent 4,502 hours. Total hours by the two females on livestock related work was equivalent to 81 percent of males.

Females had onerous obligations because, in addition to assisting in calving, lambing and kidding, they were mainly the ones that milked the cows and processed milk into cream, butter and cheese. Furthermore, a large portion of their time was spent on night guard duty, a very important part of the production process. Sheep and goats were brought near the yurt each evening and someone had to periodically check on them at night, since basically there were no corrals or fenced areas to contain them. Apart from concern about animals straying away, there was the ever-present danger of attack by wild animals.

Sixty percent of female's work was carried out on sheep, which stands to reason since sheep were the largest number of animals. Most of their livestock work took place during the winter, largely because of extensive hours on guard duty. Spring was the next busiest season due to working on peak production activities such as lambing and shearing. Sixteen percent of the time for the household as a whole was spent on cattle, mainly milking, and primarily done by females. There were relatively few goats, so they accounted for just 13 percent of total time. Sheep accounted for 71 percent of total time.

Annual production costs

Four categories of annual cost are shown in Table 4. The first is direct, in effect cash or out-of-pocket expenses. Family labor cost was calculated by using the herder's opportunity cost (detailed and explained later in Table 12). The third category includes ownership costs, such as depreciation on buildings and machinery, added to direct and labor costs.

The fourth category includes capital cost. This is an opportunity cost producers incur by investing their money in their own production unit rather than putting it into an alternative use. Economists argue that this cost should be included in business management, but producers seldom take it into account in their decision-making. In reality, worldwide, few agriculturalists cover all four categories often arguing, for example, that quality of rural life is significant enough that it overcomes opportunities for alternative investments.

The direct annual production cost for the midsize Altay family (in US dollars based on the exchange rate in 2010) was $677 (Table 4). Family labor was significant, raising the total to $1,952, 2.9 times the direct cost. The Altay nomads had virtually no depreciable assets so, when ownership costs were included, the total increased only slightly, to 3.1 times direct cost. The total, when capital costs were included, resulted in 5.3 times direct costs. Capital costs were quite high because these herdsmen had a large investment in camels and horses as well as cattle, goats and sheep.

Cost and sales price per kg produced

Calculation of cost per kg produced for livestock products is very complicated because each animal species yields several products such as milk, progeny, hair or wool, and size varies between species and even within them. In addition, pastoralists generally own a number of different species such as cattle, goats and sheep. Gathering the necessary detailed information on how each of the annual cost categories was allocated (for example, the percent of expenses for salt among species) was tedious and one reason why so much time was required in each interview, and why the strategy employed in the case studies was to have all or most herders being interviewed present as much time as possible during data collection. Altay was the one exception in all case studies as government data formed the basis for the modeling.

Cost of production for each of the cost categories, along with sales prices, is given Table 5. The direct cost per kg was $0.03 for young cattle sold, increasing to $0.10 with family labor. The sale price was significantly higher, $0.41 per kg. Direct production cost per lamb raised was just $0.13, while the sale price was $1.10. Direct cost was $0.04 per kg of coarse wool, while the sale price was $0.29.

The Altay nomad case is different than the other case studies in that not only were sale prices considerably above direct costs for all commodities; they were also above all costs. This very low cost phenomenon exists because these herders spent very little money on livestock production. That is also the reason their net income—particularly including in-kind income—is higher than sedentarized producers, despite lower sales prices. Milk product prices are provided in Table 6.

Breakdown of direct cash expenses

Detailed interviews were carried out to determine the annual direct cost by herders for items like concentrate feed, medicines, salt and minerals. Unlike sedentarized pastoralists, nomadic herders use very few purchased inputs; thus only a few of the categories in Table 7 actually applied to the Altay case study. It was found that 72 percent of direct costs were for animal medicines, very different than the other four case studies. The next significant categories were purchased forage at 7 percent, and other animal feedstuffs, salt and mineral, each at 4 percent. All pastoralists, including nomadic ones, have to pay government taxes, which amounted to 2 percent of direct costs in this case.

Income

Income is divided into two parts, cash and in-kind. Cash accounted for three quarters of combined income (Table 8). Animal sales constituted the preponderance (68 percent) of cash while milk products (essentially none of which were sold by these pastoralists) accounted for almost all the in-kind income. In-kind values were calculated by multiplying personal consumption by prices at which herders could sell excess milk to one another. Mohair was the second largest cash earner, about double that of wool sales.

The typical Altay area medium size nomadic family had a net income of $5,878 at the time of interview in 2001 taking into account only direct production costs (Table 9). As a comparison, it was a third higher than the relatively advantaged sedentarized medium producer case study in Northeast Inner Mongolia. The results are even more noteworthy when all costs are taken into account because, at that level, the sedentarized producer had a negative net income.

The addition of personal use, i.e. in-kind income, being combined with cash income led to dramatic changes in results. The total above direct production cost leaped from $5,878 to $8,169 (Table 10).

Cost and income on a sheep unit basis

Production cost per kg by species, and total production cost and net income for each of the four categories, are useful standard indicators for comparison between livestock producers. The Altay typical medium size producer had 483 sheep units, a direct production cost of $677 and thus a direct cost of $1.40 per sheep unit (Table 11). Net cash and in-kind income was $16.91 per sheep unit on the total income of $8,169.

Opportunity cost and hourly income for migration analysis

The opportunity cost method, one of several approaches to determine whether migration would be appealing to herders, is now presented to evaluate the veracity of different methods. The first step was to calculate what herders could earn from personal non-livestock tasks while remaining in their residence based on their *estimated* hours of labor. In the Altay case males could work in the village's hay and forage production operation or as contract labor for another family at their current location. Females were found to have opportunities for sewing or preparing clothing for other individuals, making handicrafts, preparing felt for yurts out of sheep wool, working for other herders etc. Females *estimated* that they could earn $29 per month ($348 annually) based on a 10 hour work day, 30 days per month, resulting in 3,600 hours annually (Table 12). Dividing $348 by 3,600 hours resulted in $0.10 per hour for the current residence. The same estimation procedure was used for males, resulting in $0.16 per hour. The family weighted average was $0.13 per hour.

The next task was to determine the income that might be earned by migrating, in effect by moving to a new location such as a resettlement area or an urban location. Officials were included in discussions due to limited knowledge by the herders. The female's opportunity cost by not moving to a new location was estimated at $0.15 per hour (Table 12). The corresponding estimated hourly rate was $0.41 for males. The family average was $0.27.

Comparison of research methodologies was a significant case study objective in the part about migration. It is for that reason that estimations of current residence opportunity costs based on *estimations* were obtained as that might be the procedure utilized in a less detailed survey. The *actual* hours spent (Table 3) were then used in the calculations of hourly income. The annual total was 3,647 hours in the case of females (Table 13) rather than 3,600 (Table 12). That was very close; thus the cost remained at $0.10 per hour. The actual time worked by males was 4,502 hours rather than the estimated 3,240, resulting in $0.12 per hour rather than $0.16. The outcome is that for females the increase from $0.10 actual per hour at the current residence to $0.15 with fewer hours

by moving to the new location would seem appealing. For the males, the increase from $0.12 to $0.41 would seem like a significant difference. But, wage rates per hour are not the whole story.

Net income per hour of labor

A problem with relying only on opportunity cost calculations had the serious drawback of not taking the income side of herding into account. Budgeting of costs per hour of family labor based on actual hours spent in production activities and actual income was found to be the most accurate way to determine wage rates. If only cash income is considered net income per hour for the Altay family would have been $0.72 above direct production cost (Table 14). Inclusion of family labor (calculated by estimated annual opportunity cost time using actual hours worked) reduced net cash income to $0.56 per hour. It dropped to $0.54 when ownership costs were factored in, and $0.37 with all four categories taken into account. Table 15 reveals that, when in-kind income is added to cash income, there was a substantial effect on hourly net income as it increased to $1.00 per hour from $0.72 when only direct production costs are taken into account. Net hourly income above all costs was $0.65.

Summary Comparison

Table 16 contains a summary comparison using the various methods of quantitative benefits concerning the possibility of moving to a new location, such as urban living or a relocation site. At first glance, based on the initial two opportunity cost items detailed in the top part of the table, it would appear that Altay herders would be better off by moving to a new location because *calculated* total income would increase 71 percent ($876 to $1,500), the number of hours worked would be reduced 20 percent (8,149 to 5,472), and hourly income would more than double from $0.11 to $0.27.

Detailed budgeting revealed a vastly different scenario. Actual net cash income was found to be $4,602 above direct and labor costs, which was three times higher than gross income from moving to a new location ($1,500). Addition of in-kind income increased actual net income to $6,893 above direct and labor costs, 4.6 times the gross income that could be made by moving. Net cash and in-kind income was a weighted average $1.00 per hour average for the entire Altay herder's family members above direct costs, and the $0.85 per hour above direct and indirect costs, far beyond the $0.27 per hour that could be made from a move. Importantly, the hourly wage by moving would be gross income, meaning that the family would have to locate a place to stay and also pay for food and other living expenses.

Conclusions

One conclusion is that reliance only on the opportunity cost method based on interviews about estimates of hourly earnings can be quite misleading. There is also a substantial difference between net income and gross income. The Altay herders have a home, albeit primitive. Nevertheless, the one that would have to be rented or provided in a new location probably would still be fairly rustic unless heavily subsidized. On the other hand, there would be qualitative factors such as amenities of starting a new life with children living at home rather than boarding in town, and less onerous duties for women such as night guard of livestock, that have to be carefully considered from a quality of life and budgeting perspective.

Nomadism is one aspect of pastoral society. The next case highlights the impact on production costs and income from a sedentarized pastoral family living on the rugged Qinghai Plateau of Southwestern China.

Tibetan Minority Pastoralists in the Qinghai Plateau Area of Sichuan Province

Tibetan Minority Pastoralists in the Qinghai Plateau Area of Sichuan Province

Project Area

Sichuan province, located in the southwestern part of China, has considerable remote and desolate areas, especially on the Qinghai Plateau (also called the Tibetan Plateau), which is a high-altitude arid steppe interspersed with mountain ranges and brackish lakes (Map 3). In addition to the northwestern part of Sichuan it also covers most of the Tibet Autonomous Region and Ladakh in India-controlled Kashmir. Often called the "roof of the world," average elevation is over 4,500 meters covering 2.5 million km that lies between the Himalayan range to the south and the Taklimakan Desert to the north. The southern and eastern edges of the steppe, in which the case study area was located, are grasslands. Sichuan province is inhabited by a number of China's 56 official national minorities, a substantial portion being Tibetan ethnic background, almost all of which live on the Qinghai Plateau.

Despite the large size of Sichuan province, only about 9 percent of China's 106 million cattle and buffalo are found in it. The province has 2 percent of the nation's sheep and 9 percent of its goats, most of which are primarily in the lower elevation areas. Annual data are not available on yaks and yak crosses in the world or in China. But, Porter (1991) reported there were about 12 million yaks in China, which at the time represented about 85 percent of the world's total. Most yaks in China are found in Tibet but there are also a substantial number in Sichuan province, virtually all of which are on the Plateau.

Yaks and Yak-cattle Crosses

Yaks, essentially creatures of high altitudes and cold climates, are vital to people who live at altitudes where domestic cattle cannot possibly survive, and are a species of choice even at lower, albeit still high, altitudes (Porter, 1991). The species was domesticated long ago from the wild yak of Tibet (*Bos (Poephagus) mutus*) of which only a few thousand now exist. The domestic yak (*Bos (Poephagus) grunniens*) or grunting ox is native to the Tibetan Plateau and neighboring countries in the Himalayas and to the Altay ranges of Mongolia. Its main populations are in the mountains and plateau of Western China including the Autonomous Region of Tibet.

Yaks are smaller than cattle. Bulls weigh 300-550 kg and cows 180-350 kg. Hair color covers a wide range, but most are black or rusty brown. Their use depends on location. In more remote areas they are known as "Ships of the Plateau" because they are essential for travel as well as food and clothing. Besides meat, they supply hides and dung (used for cooking fires and heating) as

well as draft power for plowing. The hair, harvested by plucking, has traditionally been a major export and is used for ropes, high quality saddle blankets, bags, and for the tents that herders live in. The under wool is made into felt. Annual yields are about1.6 kg of hair and 0.6 kg of under-wool.

Yak milk is a very important product. The cows are milked from about two weeks after they calve in April or May and continue for about five months. Yield is at its peak in mid-summer, and declines as the grasses dry up. About half of milk production is taken by the calf so that "yield" is only the remainder. Butterfat content varies between 5 and 8 percent depending on environment and management, but averages 6.5-7.0 percent, about double that of cattle. Thus, yields from yak cows, inseminated artificially by semen from domestic cattle bulls, have lower butterfat content, but the quantity is higher. Milk is drunk fresh, fermented or converted into butter and cheese.

Artificial insemination in China is used to mate yak cows to humpless Yellow Cattle bulls to form a yakow hybrid known as the Pian. These crosses are about 3 percent taller and 17 percent heavier than the yak. The lactation period is longer by 21 percent and the milk yields twice as high. The butterfat content is about 6 percent. They are particularly well adapted to the tough climate of the Qinghai-Tibet plateau.

Herder Profile

A specialist from the Sichuan Provincial Grassland Institute (headquarters in Chengdu and substation in Hongyuan, where the research was carried out) served as the research coordinator and Chinese-Tibetan translator. Thanks to him, a mid-size settled producer residing about 15 km from Hongyuan was obtained for the interview in September, 2003 (Map 3). Mr. Do Bo and his family were completely settled and lived in a house. This case was completely different from that of the typical nomads in this area by having a relatively high range of inputs and outputs; but exceptionally beneficial as it provided comparative data on a semi-market system from a very different perspective than that of nomadic herders.

Livestock Production and Land Use (Tables 1 and 2)

The mid-size household interviewed had 132 breeding age yaks of which 90 were mainly for milk, and the other 36 mainly for production of meat or work oriented progeny. In addition, there were 16 mature Pian all of which were milk oriented, along with 9 horses (Table 1). The family resided on 245 ha. There was 233 ha of grazing land of which winter pasture was used 7 ½ months (Table 2). A tent was maintained there to provide shelter to the person taking care of the animals. All animals were brought back to the home site at night throughout the year. It was determined that

care was given to stocking rates as, on average, the pastureland was about 6 percent below the optimum standard for the area although the difficulties of grazing management were evident as summer pastures were under-used 29 percent, while the winter pastures were 17 percent overgrazed.

Gender Use (Table 3)

Analysis of family labor use by gender and season for this household revealed that females played a very important role in the production process. The wife and teenage daughter were occasionally helped by relatives when they had time. The female's main livestock related work was milking and processing milk into cheese, butter and other dairy products. They also assisted in general care of animals, and guard duty at night to prevent theft and attacks by wolves. Time spent by the females was 2.4 times more than the male in the warm season, but their total time was about the same as the male in the cold season (data not shown).

Expenses and Income (Tables 4-11)

Direct annual production cost for the entire operation was $949 (Table 4). As might be expected of a milk product sales operation, family labor was a significant cost, raising the total to $1,481, 1.6 times the direct cost. This producer's capital costs were quite high because of the large investment in buildings and other production infrastructure.

The direct cost per kg was $0.10 for Pian progeny sold, and $0.05 for yak progeny (Table 5). The sale prices of $0.79 and $0.85 per kg for the two species, respectively, exceeded all costs including direct, labor, ownership, and even capital expenses Prices for Pian and yak butter, cheese and raw milk were $2.79, $1.25 and $0.26 per kg respectively (Table 6), far above all four category's processing costs (Table 5). Expenses for purchased forage, building repair and animal medicines were each about 15 percent of total expenses (Table 7).

It is worth emphasizing again that the household interviewed was a significant exception to almost all other herder households on the Qinghai Plateau in that it was located by a road and near a town, and thus had a ready outlet for its dairy products. Sale of milk products was important, but the majority of cash income (54 percent) was derived from sales of progeny (Table 8)

Eighty nine percent ($10,037) of direct net cash income ($11,225) was derived from yaks, not surprising since yaks made up 89 percent of animal inventory (Table 9). Naturally, net income fell as additional cost categories were added. For example, net cash income above family labor was $10,694, although it was still a very significant $6,764 when capital costs were taken into account.

Addition of in-kind income to cash income above direct costs increased the total to $12,937, about 15 percent more than cash only income and the highest level among the four case studies (Table 10).

The Hongyuan producer had the equivalent of 1,301 sheep units counting the Pian, yaks and horses, and direct production cost of $949, which was equivalent to $0.73 per sheep unit, by far the lowest among the four case study herders (Table 11). The family had a combined net cash and in-kind income of $12,937, equivalent to $9.94 per sheep unit, and also the lowest among the three medium operators.

Migration Opportunity Cost and Summary (Tables 12-16)

Female opportunity cost at their current residence based on *estimated* hours of labor only on livestock activities was $0.05 per hour. It was $ 0.06 for males and averaged $ 0.05 for the family (Table 12). Estimates of income by moving to a new location were $0.07, $0.12, and 0.09 for the three categories, respectively. The opportunity costs at the current residence based on actual labor time were $0.03, $0.05 and $0.04 per hour for females, males and family average (Table 13).

The net cash income per hour for family labor was calculated from the economic analysis to be $1.18 above direct costs (Table 14) and $1.36 including in-kind income) (Table 15). It was $0.71 and $0.88 above all four categories of costs for net cash and in-kind combined, respectively.

Family gross income by migrating was estimated to be $504 annually (Table 16). In contrast, their current occupation net cash and in-kind income was calculated to be $12,937 above direct costs, and $12,406 when labor costs were included. That was 25 times more than the estimated gross income from moving. Given their proximity to Hongyuan, moving would have no merit even if something dramatic were to happen, like major destruction of their livestock herd. For example even if half the herd died, given that it was valued at $17,600 (data not shown), they could still survive even though it would take a few years to recoup the losses.

In summary, it was concluded from the opportunity cost and economic analysis that members of this household would be much better off remaining at the current location than attempting to migrate to an urban area. It is also instructive that members of this household essentially could not speak Chinese which, like virtually all herder families on the Qinghai Plateau, would have severely limited their job possibilities. Clearly, this family's situation was an exceptional one, and considerably different than that of nomadic herders typical of the Qinghai Plateau who face a variety of other challenges, much like the Altay semi-nomads.

Ethnic Mongolian Medium Size Herder in Northeast Inner Mongolia

Medium Size Producer in Northeast Inner Mongolia

Project area and Herder Profile

The medium size livestock operation belonging to Dao Bu Chen and his family was located in Wu Bu Lai *Sumu*, about 180 km northwest of Wulanhot (also written Ulanhot) in Northeastern Inner Mongolia (Map 4). It was near the border with Mongolia, and about 350 km south of the Russian border, in a highly productive area due to high rainfall and excellent conditions for forage production.

The Dao Bu Chen family had been settled since New China was founded in 1948. As a result, they permanently resided in a house. Four family members, two females and two males, were associated with the operation, about 1 hour from Wu Bu Lai Sumu by dirt road. They had electricity provided by a wind turbine.

Livestock Production and Land Use (Tables 1-2)

The mid-size household interviewed had 20 mature female cattle, 100 mature goats, 400 mature sheep, and 7 horses when they were interviewed in 2004 (Table 1). The family had crop land, mainly for growing hay in addition to 306 ha of grazing land (Table 2). The cattle were kept near the house and milked twice a day.

High use of technology and management, rental property, and irrigated land that yielded stored winter forage led to 21 percent annual *undergrazing*. The cold winter and spring pastures were 62 and 89 percent overgrazed, respectively, but the warm summer and fall pastures were 66 and 53 percent undergrazed. Ample feeding of stored forage led to the animal's condition being maintained, and minimal longer term damage to pastures.

Gender Use (Table 3)

Analysis of family labor use by gender and season for this sedentarized household reveals that, as in the previous case studies, females played an important role in the production process. In this case about half of their time was spent with cattle in milking and processing milk into cheese, butter and other dairy products. The other half was in helping with goats and sheep, mainly during kidding and lambing season. The annual time spent per household by the two females in the past year was calculated to be 1,355 hours. In contrast, the two males spent 4,620 hours; about 60 percent with sheep, 20 percent with goats and 20 percent with cattle.

Expenses and Income (Tables 4-11)

Direct annual production cost was $8,271, the highest among all four case studies (Table 4). Addition of family labor increased costs to 1.2 times the direct cost. When ownership costs were included, the total rose to 1.4 times direct cost, and adding in capital costs resulted in the total being 2.2 times direct cost. This latter ratio was relatively small because direct costs were so high.

The direct cost per kg was $0.24 per kg of cattle progeny, $0.41 per kg of goat progeny and $0.58 per kg of sheep progeny (Table 5). Sales prices for these three were $1.12, $0.82 and $1.11 per kg, respectively, covering all four cost categories for cattle and goats. Sheep nearly covered capital costs. The family sold milk products not required by the family or for suckling calves at a profit, even including capital costs (Tables 5 and 6).

The Dao Bu Chen family had a relatively well developed operation that included substantial farm machinery; thus, they used considerable purchased inputs resulting in about one fourth of costs being attributed to repairs to buildings, fence, and vehicles (Table 7). They also had contract labor that accounted for 13 percent of expenses along with 9 percent in land rental. Animals accounted for 82 percent of cash income, and 83 percent of combined cash and in-kind income (Table 8).

Prices for all livestock were relatively high in 2004 in the area where the Dao Bu Chen family lived leading to a positive net cash income for all species, even above capital costs (Table 9). Addition of in-kind income increased the combined total by 9 percent on direct costs and 50 percent above capital costs. (Table 10).

The Dao Bu Chen operation had 745 sheep units (Table 11). Direct production cost was $11.10 per sheep unit, the highest of the three medium size producers. That was offset by having $15.90 net cash income per sheep unit, and $17.36 including in-kind income.

Importantly, Dao Bu Chen was the leader in technology and management among the four case studies, largely because of a favorable geographic location. The point is that, in essentially all types of agriculture, the highest net incomes per unit are usually at either extreme of the spectrum; low cost but also low productivity (Xinjiang case study for example), or to those with the high production cost and high productivity due to having the largest synergism from complementary technologies. In contrast, middle level producers usually invest in some technologies, but often fail to obtain the synergism of other carefully crafted complementary technologies and management.

Migration Opportunity Cost and Summary (Tables 12-16)

Female opportunity cost at their current residence based on estimated hours of labor only on livestock activities was $0.22 per hour. It was $ 0.30 for males and averaged $0.26 for the family

(Table 12). Estimates of income by moving to a new location were $0.42, $0.50, and 0.46 for the three categories, respectively. The opportunity costs at the current residence based on actual labor time were $0.52, $0.21 and $0.28 per hour for females, males and family average (Table 13).

The net cash income per hour for family labor was calculated from the economic analysis to be $1.98 above direct costs (Table 14), and $2.17 including in-kind income (Table 15). It was $0.38 and $0.55 above all four categories of costs for net cash and net cash plus in-kind income, respectively.

Family gross income by migrating was estimated to be $1,944 annually (Table 16). In contrast, their current occupation net cash and in-kind income above direct costs was calculated to be $12,936 (6.7 times more than moving), and $11,257 when labor costs were included (5.8 times more than moving.

In summary, it was concluded from the opportunity cost and economic analysis that members of this household would be much better off remaining at the current location than attempting to migrate to an urban area. They had a contract worker that cared for a major part of the crop and livestock work and, while the females still worked on livestock activities, the amount of time was not burdensome. Clearly, this family's situation was an exceptional one, due to the favorable climate and high level of technology employed. A far different scenario is revealed in the next, and last, case study.

Ethnic Mongolian Small Size Herder in Northeast Inner Mongolia

Small Size Producer in Northeast Inner Mongolia

Project Area and Herder Profile

The second of the two project site case studies reported on in Northeast Inner Mongolia was a very small size crop/livestock operation belonging to middle-aged Bao Shan and his wife, located in Mang Lai *Gacha* about 120 km southwest of Wulanhot, close to the Jilin Provence border (Map 4). In contrast to the previous case study that had an abundance of rainfall, access to irrigation water and a high stocking rate, Bao Shan lived in a semi-arid area with limited and low quality irrigation water. The family, ethnic Mongolians, had electricity and were about 2 km from a paved road. They spoke a local variant of Mongolian and could speak, read and write Chinese.

Livestock Production and Land Use (Tables 1 and 2)

This very small-size livestock oriented household had 9 mature female cattle, 25 mature goats, and no sheep or horses when were interviewed in 2004 (Table 1). They sold 3 cattle progeny and 5 goat progeny annually in addition to 20 kg of mohair and milk products, their other primary occupation. The family owned 2.7 ha of crop land, but rented grazing land because they owned none (Table 2). In effect they were crop farmers and consequently fed their animals on crop residues, crop products (mainly maize and hay), and purchased forage and concentrates. The percent over or under grazing could not be determined.

Gender Use (Table 3)

Analysis of family labor use by gender and season for this household revealed that, as in the previous case studies, the female played an important role in the production process. In this case her time was about equally divided between cattle and goats. It was 167 percent of the male's time because a substantial portion of his time was spent in odd jobs and crop production (Table 3). Goats were not milked; rather, most of the time was used in herding. A major part of cattle related time was spent in milking and processing milk into cheese, butter and other dairy products.

Expenses and Income (Tables 4-11)

Direct annual production cost was $1,471, higher than the Xinjiang or Qinghai Plateau case studies (Table 4). Prices for all livestock in the Northeast area were relatively high in 2004, yet cattle progeny sales were a substantial loss commodity for the Bao Shan family due to the very high per kilo production cost ($1.61 above direct costs compared to $0.24 for the other Northeastern producer) (Table 5). Goat progeny sales were also a loss commodity for the same reason

(production cost of $0.83 compared to $0.41 for the other producer). Butter and cheese were profitable despite prices being considerably lower than received by the other Northeastern producer (Table 6).

All of the crops produced were used in the livestock operation. They were accounted for in the budgets as a transfer from the crop profit center of the family operation, to the livestock profit center by valuing them at market prices. About 8 percent of all input costs were for animal feedstuffs from crop activities (Table 7). Another 8 percent went to purchased feedstuffs. The largest portion, 48 percent, was for grazing land rental.

Animals accounted for two thirds of cash income and 69 percent of combined cash and in-kind income (Table 8). The high price of mohair ($35.29 per kg, considerably above all four cost categories) led to it accounting for 27 percent of cash income. Somewhat surprisingly, since the operation was considered milk oriented, those products only accounted for 2 percent of cash income as well as 2 percent of in-kind income.

Net cash income by animal category included co-products such as milk products and mohair as well as live animals. Cattle yielded a net income of $263 above direct costs due to milk product sales making up for losses on progeny sales (Table 9). Goats yielded $650 due to mohair sales making up losses attributable to progeny sales. Total net cash income was $913. Addition of in-kind income to cash income increased the total by about 15 percent above direct costs, to $1,047 (Table 10).

The Bao Shan operation had 144 sheep units. That resulted in a direct cost of $10.22 per sheep unit, slightly less than the $11.10 of the large Northwestern producer (Table 11). The very small size, high feed costs, and other expenses only provided the family $1,047 net cash and in-kind income ($7.27 per sheep unit), well below all other case studies.

Migration Opportunity Cost and Summary (Tables 12-16)

The female's opportunity cost per hour based on *estimated* hours spent in the operation was $0.36 and Bao Shan's about the same, $0.37 (Table 12). The family's total opportunity cost income from their *estimates* of what they could earn in alternative work by moving to a new location was $1,752, equivalent to their average combined opportunity cost hourly income of $0.33.

Opportunity costs at the current residence based on *actual* labor time were much higher than estimates, $0.58 per hour for the female, $1.30 for the male, and $0.85 per hour average for the

family (Table 13). However, a quandary existed for, while income would increase 3.2 times, hours worked would increase 2.7 times.

Net cash income per hour for family labor was calculated in the economic analysis to be just $0.47 above direct costs (Table 14), and $0.54 including in-kind income (Table 15).

Net cash and in-kind income above direct costs for their current occupation was calculated to be $1,047, but just $338 when labor costs were included (Table 16). Moving to a new location was calculated to result in an estimated $1,752, five times more than income when labor costs were included. But the economic benefits were questionable when considering they would have living expenses such as rent and purchased food. Remaining at the current residence had drawback that the family is essentially locked into a small, very high cost operation with little apparent opportunity to pull themselves out of what might increasingly be considered a culture of poverty as China develops. Another consideration is care for the aged. This couple could continue to work and provide for themselves in their own home and community for a long time. If they moved to an urban area they would likely require considerably more care, and from their point of view, quality of life could be diminished.

Summary and Conclusions, Part I

The all-inclusive case study interview method that combined the Participatory Research Appraisal method with a specially designed field use oriented computer program exceeded the author's expectations. It was determined that while considerable livestock, range management and interviewing expertise was crucial for success, the time and effort was well worth it because a treasure trove of information was available for both research and practical pastoral area application. The value of time spent gathering detailed data for the cost and returns analysis is exemplified by the finding that simple opportunity cost based migration analyses would lead to erroneous results.

Data gathered in the case studies on seasonal grazing, combined with input use as part of the economic analysis, revealed the complexity of the overgrazing and land degradation issues as impact varied considerably between types of operations and management considerations. It is recognized that prices and thus costs and income will have changed since the data collection and analysis. However, the systems and structures evaluated are still representative of a significant portion of China's western area. Summaries of these topics and others brought out in the case studies, as well as conclusions on them, are provided in greater length in Part II of this article, which is based on five settled herder case studies in Xilinguole League, Inner Mongolia.

Tables Part I

Table 1. Production data, Part I grassland case studies, China, 2001-2005

Breeding females and work use inventory	Units	Cattle (1)	Goats	Sheep (6)	Horses	Camels/ Yaks
Northwest, Xinjiang (2)	Head	14	22	145	11	
Qinghai Plateau (3)	Head	16			9	132
Northeast Inner Mongolia (4)	Head	20	100	400	7	
Northeast Inner Mongolia (5)	Head	9	25	0	0	
Sales, all progeny						
Northwest, Xinjiang (2)	Head	10	18	116		
Qinghai Plateau (4)	Head	3				33
Northeast Inner Mongolia (4)	Head	12	55	274		
Northeast Inner Mongolia (5)	Head	3	5	0		
Total annual mohair/wool production						
Northwest, Xinjiang (2)	Kg		9	227		
Qinghai Plateau (4)	Kg					135
Northeast Inner Mongolia (4)	Kg		63	306		
Northeast Inner Mongolia (5)	Kg		20	0		

(1) Pian, a cross between catttle and yaks in the case of Qinghai Plateau
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.
(6) Northwest, Xinjiang reported yield of 2.5 kg per matures and 1.5 kg of fattening phase.
Others reported 1.5 kg for matures and no shearing of immatures in fattening phase.

Table 2. Optimal and actual amount of land used per sheep unit by season, Part I grassland case studies China, 2001-2005

Item	Total (1)	Spring	Summer	Fall	Winter
Grazing land available to use (Hectares)					
Northwest, Xinjiang (2)	NA	NA	NA	NA	NA
Qinghai Plateau (3)	233.0		117.0		117.0
Northeast Inner Mongolia (4)	306.0	46.0	107.0	46.0	107.0
Northeast Inner Mongolia (5)	0.0	0.0	0.0	0.0	0.0
Optimal Mu per one sheep unit					
Northwest, Xinjiang (2)		11.64	2.16	11.64	11.76
Qinghai Plateau (3)			4.50		4.50
Northeast Inner Mongolia (4)		7.50	3.00	4.50	10.00
Northeast Inner Mongolia (5)					
Optimal Ha per one sheep unit					
Northwest, Xinjiang (2)		0.8	0.1	0.8	0.8
Qinghai Plateau (3)			0.3		0.3
Northeast Inner Mongolia (4)		0.5	0.2	0.3	0.7
Northeast Inner Mongolia (5)					
Optimal sheep unit months (sum)					
Northwest, Xinjiang (2)	5,236	1,073	1,400	861	1,901
Qinghai Plateau (3)	9,732		4,866		4,866
Northeast Inner Mongolia (4)	10,349	1,104	5,485	180	1,920
Northeast Inner Mongolia (5)					
Actual sheep unit months (sum)					
Northwest, Xinjiang (2)	6,799	1,416	1,714	1,136	2,533
Qinghai Plateau (3)	9,157		3,461		5,696
Northeast Inner Mongolia (4)	8,947	1,790	1,864	1,667	3,626
Northeast Inner Mongolia (5)					
Actual over optimal sheep unit months					
Northwest, Xinjiang (2)	1,564	343	314	275	633
Qinghai Plateau (3)	-575		-1,405		830
Northeast Inner Mongolia (4)	-2,201	686	-3,621	-973	1,707
Northeast Inner Mongolia (5)					
Percent overgrazing (minus sign means under-used)					
Northwest, Xinjiang (2)	30	32	22	32	33
Qinghai Plateau (3)	-6		-29		17
Northeast Inner Mongolia (4)	-21	62	-66	-53	89
Northeast Inner Mongolia (5)	--	--	--	--	--

(1) The total is the total amount of land on which grazing takes place. In most cases it is the total controlled by the producer. In cases where the seasonal areas are the same it is due to estimates.

(2) Nomadic, Medium size, Altar area, Xinjiang Province.

(3) Do Bo, Settled, Medium size, Hongyuan. Sichuan Province

(4) Dao Bu Chen, Semi-nomadic, Medium size, Wu Bu Lin Sumu, Inner Mongolia.

(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia (no owned grazing land).

Table 3. Family hourly labor use by gender and livestock species, Part I grassland case studies, China, 2001-2005

Item	Units	Total	Cattle (1)	Goats	Sheep	Yaks
Annual time spent						
Females						
Northwest, Xinjiang (2)	Hours	3,647	915	547	2,185	
Qinghai Plateau (3)	Hours	5,760	1,144			4,616
Northeast Inner Mongolia (4)	Hours	1,355	661	329	365	
Northeast Inner Mongolia (5)	Hours	1,218	639	579		
Males						
Northwest, Xinjiang (2)	Hours	4,502	365	517	3,620	
Qinghai Plateau (3)	Hours	3,739	238			3501
Northeast Inner Mongolia (4)	Hours	4,620	924	924	2,772	
Northeast Inner Mongolia (5)	Hours	728	364	364		
Females and males						
Northwest, Xinjiang (2)	Hours	8,149	1,280	1,064	5,805	
Qinghai Plateau (3)	Hours	9,499	1,382			8,117
Northeast Inner Mongolia (4)	Hours	5,975	1,585	1,253	3,137	
Northeast Inner Mongolia (5)	Hours	1,946	1,003	943		
Females as a percent of males						
Northwest, Xinjiang (2)	Percent	81	251	106	60	
Qinghai Plateau (3)	Percent	154	481			132
Northeast Inner Mongolia (4)	Percent	29	71	36	13	
Northeast Inner Mongolia (5)	Percent	167	176	159		
Time use by type of animal species						
Females						
Northwest, Xinjiang (2)	Percent	100	25	15	60	
Qinghai Plateau (3)	Percent	100	20			80
Northeast Inner Mongolia (4)	Percent	100	49	24	27	
Northeast Inner Mongolia (5)	Percent	100	52	48		
Males						
Northwest, Xinjiang (2)	Percent	100	8	11	80	
Qinghai Plateau (3)	Percent	100	6			94
Northeast Inner Mongolia (4)	Percent	100	20	20	60	
Northeast Inner Mongolia (5)	Percent	100	50	50		
Whole year total						
Northwest, Xinjiang (2)	Percent	100	16	13	71	
Qinghai Plateau (3)	Percent	100	15			85
Northeast Inner Mongolia (4)	Percent	100	27	21	53	
Northeast Inner Mongolia (5)	Percent	100	52	48		

(1) Pian, a cross between cattle and yaks in the case of Qinghai Plateau.
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan. Sichuan Province
(4) Dao Bu Chen, Semi-nomadic, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 4. Total annual costs and ratios, Part I grassland case studies, China, 2001-2005 (1)

Producer	Direct production cost	Direct and family labor (2)	Direct, family labor and ownership costs	Direct, family family labor ownership and capital costs
	----------US dollars----------			
Northwest, Xinjiang (3)	677	1,952	2,116	3,558
Qinghai Plateau (4)	949	1,481	2,447	5,549
Northeast Inner Mongolia (5)	8,271	9,950	11,371	17,900
Northeast Inner Mongolia (6)	1,471	2,180	2,408	3,304
	----------Ratio to direct costs----------			
Northwest, Xinjiang (3)	1.0	2.9	3.1	5.3
Qinghai Plateau (4)	1.0	1.2	1.9	3.0
Northeast Inner Mongolia (5)	1.0	1.2	1.4	2.2
Northeast Inner Mongolia (6)	1.0	1.5	1.6	2.2

(1) 6.8 Yuan per dollar

(2) Family labor cost calculated by multiplying estimated labor opportunity cost by number of hours actually worked. See later tables and text.

(3) Nomadic, Medium size, Altar area, Xinjiang Province.

(4) Do Bo, Settled, Medium size, Hongyuan. Sichuan Province

(5) Dao Bu Chen, Semi-nomadic, Medium size, Wu Bu Lin Sumu, Inner Mongolia.

(6) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 5. Production cost per kg and sales prices, Part I grassland studies, China, 2001-2005

Item	Sales prices US Dollars	Direct production cost US Dollars	Direct and family labor US Dollars	Direct, family labor and ownership costs US Dollars	Direct, family family labor ownership and capital costs US Dollars
Per cattle calf raised					
Northwest, Xinjiang (2)	0.41	0.03	0.10	0.13	0.28
Qinghai Plateau (3)	0.79	0.10	0.13	0.19	0.36
Northeast Inner Mongolia (4)	1.12	0.24	0.37	0.39	0.71
Northeast Inner Mongolia (5)	1.10	1.61	2.18	2.45	3.57
Per Yak calf raised					
Qinghai Plateau (3)	0.85	0.05	0.09	0.14	0.33
Per goat kid raised					
Northwest, Xinjiang (2)	0.80	0.09	0.25	0.26	0.38
Qinghai Plateau (3)					
Northeast Inner Mongolia (4)	0.82	0.41	0.48	0.54	0.80
Northeast Inner Mongolia (5)	0.69	0.83	1.47	1.58	1.91
Per sheep lamb raised					
Northwest, Xinjiang (2)	1.10	0.13	0.40	0.43	0.69
Qinghai Plateau (3)					
Northeast Inner Mongolia (4)	1.11	0.58	0.68	0.79	1.24
Northeast Inner Mongolia (5)					
Mohair (3)					
Northwest, Xinjiang (2)	44.12	6.10	16.56	17.40	25.09
Qinghai Plateau (3)					
Northeast Inner Mongolia (4)	35.29	14.89	17.55	19.74	29.05
Northeast Inner Mongolia (5)	35.29	13.17	23.37	25.06	30.41
Sheep wool,coarse					
Northwest, Xinjiang (2,6)	0.29	0.04	0.13	0.13	0.22
Qinghai Plateau (3)					
Northeast Inner Mongolia (4)	0.74	0.36	0.42	0.49	0.77
Northeast Inner Mongolia (5)					
Yak hair					
Qinghai Plateau (4,7)	1.21	0.05	0.08	0.13	0.29
Milk, raw, from cows (2)					
Northwest, Xinjiang (2)	0.12	<0.01	<0.01	<0.01	<0.01
Qinghai Plateau (3,8)	0.26	0.05	0.07	0.10	0.20
Northeast Inner Mongolia (4)	0.29	0.05	0.08	0.09	0.16
Northeast Inner Mongolia (5)		0.05	0.06	0.07	0.10
Milk, raw, from yaks					
Qinghai Plateau (3)	0.26	0.02	0.03	0.05	0.11

(1) 6.8 Yuan per dollar
(2) Nomadic, Medium size, Altar area, Xinjiang Province, interviewed in 2001
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province, interviewed in 2003. Pian rather than catle.
(4) Dao Bu Chen, Semi-nomadic, Medium size, Wu Bu Lin Sumu, Inner Mongolia, interviewed in 2004.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia, interviewed in 2004..
(6) Fine wool value in Altar $0.88 per kg.
(7) Fine yak hair $7.35 per kg.
(8) Pian cows.

Table 6. Sale prices of milk products per kg, Part I grassland case studies, China, 2001-2005 (1)

Item	Northwest Xinjiang (2) USDollars	Qinghai Plateau (3) USDollars	Northeast Inner Mongolia (4) USDollars	Northeast Inner Mongolia (5) USDollars
Year data collected	2001	2003	2004	2004
Cow milk products (6)				
Butter		2.79	5.88	4.41
Cheese		1.25	4.41	1.62
Raw milk	0.12	0.26	0.29	
Yak milk products				
Butter		2.79		
Cheese		1.25		
Raw milk		0.26		

(1) 6.8 Yuan per dollar
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.
(6) Pian in the case of Qinghai Plateau.

Table 7. Percent breakdown of direct (cash) expenses, Part I grassland case studies, China, 2001-2005

Item	Northwest Xinjiang (3) Percent	Qinghai Plateau (4) Percent	Northeast Inner Mongolia (5) Percent	Northeast Inner Mongolia (6) Percent
Animals given to employees (1)	(1)	(1)	(1)	(1)
Purchased animal feedstuffs	4.2	4.8	1.1	8.4
Animal feedstuffs from other own activities (2)	0.0	0.0	6.5	8.5
Purchased forage	6.5	15.5	0.0	0.0
Pasture expenses (hay land)	0.0	0.0	12.4	0.0
Hay harvesting cost	4.3	0.0	2.1	2.6
Salt	4.3	2.3	1.8	0.4
Minerals	0.0	0.0	0.0	0.0
Protein Supplement	0.0	0.0	0.0	0.0
Repairs, maintaince infrastructure				
Buildings (only part for business)	0.0	15.5	8.9	2.0
Fence	2.2	7.7	8.9	0.0
Vehicle repair (only part for business)	0.0	0.0	8.9	5.0
Veterinarian other medical products	0.0	7.9	0.0	2.0
Animal medicines	71.9	15.8	12.4	10.7
Gas, water, electric(only business)	0.0	0.0	0.0	0.0
Telephone (only business)	0.0	0.0	0.7	0.0
Vehicle fuel (only business)	0.0	0.0	7.1	12.0
Other fuel (only business)	0.0	0.0	0.0	0.0
Taxes, government management fee	2.2	7.3	5.9	0.0
Marketing costs				
Transportation	0.0	0.0		0.0
Brokerage, other	0.0	0.0	0.6	0.0
Insurance	0.0	0.0	0.9	0.0
Contract labor	0.0	0.0	12.8	0.0
Grazing land rental	0.0	0.0	8.6	48.4
Miscellaneous, other	4.4	23.2	0.4	0.0
Total direct costs	100.0	100.0	100.0	100.0

(1)Not shown as a cost, rather as a reduction in income because fewer animals are sold

(2) Transfer payments to other own enterprise activities such as farming.

(3) Nomadic, Medium size, Altar area, Xinjiang Province.

(4) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province

(5) Dao Bu Chen, Semi-nomadic, Medium size, Wu Bu Lin Sumu, Inner Mongolia.

(6) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 8. Sources of income from sale and personal use, Part I grassland case studies, China, 2001-2005

Item	Northwest Xinjiang (1) Percent	Qinghai Plateau (2) Percent	Northeast Inner Mongolia (3) Percent	Northeast Inner Mongolia (4) Percent
Cash income (sales)				
Animals	67.9	53.9	82.4	65.5
Milk products	0.0	23.2	1.2	1.8
Mohair	4.6		10.5	27.4
Yak hair		10.6		
Wool	1.9		0.8	
Total cash income	74.4	87.7	94.9	94.7
Personal use value (value in kind)				
Animals	3.5	3.7	0.5	3.7
Milk products	22.1	8.6	4.4	1.6
Mohair	0.0		0.0	0.0
Yak hair		0.0		
Wool	0.0		0.2	0.0
Total value in kind	25.6	12.3	5.1	5.3
Combined cash income and value in kind				
Animals	71.4	57.6	82.9	69.2
Milk products	22.1	31.8	5.6	3.4
Mohair	4.6		10.5	27.4
Yak hair		10.6		
Wool	1.9		1.0	0.0
Total cash and value in kind	100.0	100.0	100.0	100.0

(1) Nomadic, Medium size, Altar area, Xinjiang Province.
(2) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(3) Dao Bu Chen, Semi-nomadic, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(4) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 9. Annual net cash income by livestock category, Part I grassland case studies, China, 2001-2005 (1)

Item	Direct production cost USDollars	Direct and family labor USDollars	Direct, family labor and ownership costs USDollars	Direct, family family labor ownership and capital costs USDollars
Cattle				
Northwest, Xinjiang (2)	1,146	966	916	527
Qinghai Plateau (3)	1,188	1,112	967	536
Northeast Inner Mongolia (4)	2,433	2,012	1,940	911
Northeast Inner Mongolia (5)	263	-103	-274	-989
Yaks				
Northwest, Xinjiang (2)				
Qinghai Plateau (3)	10,037	9,582	8,761	6,228
Northeast Inner Mongolia (4)				
Northeast Inner Mongolia (5)				
Goats				
Northwest, Xinjiang (2)	702	540	527	408
Qinghai Plateau (3)				
Northeast Inner Mongolia (4)	2,677	2,329	2,041	819
Northeast Inner Mongolia (5)	650	306	249	69
Sheep				
Northwest, Xinjiang (2)	4,030	3,096	2,997	2,062
Qinghai Plateau (3)				
Northeast Inner Mongolia (4)	6,733	5,823	4,743	520
Northeast Inner Mongolia (5)				
Total				
Northwest, Xinjiang (2)	5,878	4,602	4,440	2,997
Qinghai Plateau (3)	11,225	10,694	9,728	6,764
Northeast Inner Mongolia (4)	11,843	10,164	8,724	2,250
Northeast Inner Mongolia (5)	913	203	-25	-920

(1) 6.8 Yuan per dollar. The categories include co-products other than live animals such as milk products and mohair.
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 10. Annual net cash and in-kind income by livestock category, Part I grassland case studies, China, 2001-2005 (1)

Item	Direct production cost US Dollars	Direct and family labor US Dollars	Direct, family labor and ownership costs US Dollars	Direct, family family labor ownership and capital costs US Dollars
Cattle				
Northwest, Xinjiang (2)	3,255	3,075	3,025	2,636
Qinghai Plateau (3)	1,326	1,249	1,105	674
Northeast Inner Mongolia (4)	3,370	2,949	2,877	1,848
Northeast Inner Mongolia (5)	304	-61	-232	-948
Yaks				
Qinghai Plateau (3)	11,611	11,157	10,335	7,802
Goats				
Northwest, Xinjiang (2)	775	613	600	481
Qinghai Plateau (3)				
Northeast Inner Mongolia (4)	2,677	2,329	2,041	819
Northeast Inner Mongolia (5)	743	399	342	162
Sheep				
Northwest, Xinjiang (2)	4,139	3,205	3,105	2,171
Qinghai Plateau (3)				
Northeast Inner Mongolia (4)	6,889	5,979	4,898	676
Northeast Inner Mongolia (5)				
Total				
Northwest, Xinjiang (2)	8,169	6,893	6,730	5,288
Qinghai Plateau (3)	12,937	12,406	11,440	8,476
Northeast Inner Mongolia (4)	12,936	11,257	9,816	3,343
Northeast Inner Mongolia (5)	1,047	338	110	-786

(1) 6.8 Yuan per dollar.
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 11. Production cost and net income per sheep unit, Part I grassland case studies, China, 2001-2005 (1)

Item	Northwest Xinjiang (2)	Qinghai Plateau (4)	Northeast Inner Mongolia (4)	Northeast Inner Mongolia (5)
Total sheep units	483	1,301	745	144
	----------US Dollars----------			
Direct production cost	677	949	8,271	1,471
Cost per sheep unit	1.40	0.73	11.10	10.22
Net cash income	5,878	11,225	11,843	913
Income per sheep unit	12.17	8.63	15.90	6.34
Net cash & in-kind income	8,169	12,937	12,936	1,047
Income per sheep unit	16.91	9.94	17.36	7.27

(1) 6.8 Yuan per dollar
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 12. Calculations of opportunity cost per hour for one female and one male, and average of both, based on *estimated* alternative income and *estimated* time spent in current operation, Part I grassland case studies, China, 2001-2005 (1)

Item	Estimated monthly opportunity cost (6) US dollars	Annual opportunity cost basis (7) US dollars	Estimated hours per day per person at current operation	Estimated days per month at current operation	Estimated annual per person labor (8) hours	Calculated opportunity cost per person per hour (9) US dollars
		Herder *Estimates* at Current Residence				
Estimated opportunity cost of family labor						
Females						
Northwest, Xinjiang (2)	29	348	10	30	3,600	0.10
Qinghai Plateau (3)	13	156	8	30	2,880	0.05
Northeast Inner Mongolia (4)	59	708	10	27	3,240	0.22
Northeast Inner Mongolia (5)	59	708	6	27	1,944	0.36
Males						
Northwest, Xinjiang (2)	44	528	9	30	3,240	0.16
Qinghai Plateau (3)	15	180	9	30	3,240	0.06
Northeast Inner Mongolia (4)	81	972	10	27	3,240	0.30
Northeast Inner Mongolia (5)	79	948	8	27	2,592	0.37
Average one female and male						
Northwest, Xinjiang (2)		876			6,840	0.13
Qinghai Plateau (3)		336			6,120	0.05
Northeast Inner Mongolia (4)		1,680			6,480	0.26
Northeast Inner Mongolia (5)		1,656			4,536	0.37
		Herder Estimates Move to New Location				
Estimated opportunity cost of family labor						
Females						
Northwest, Xinjiang (2)	37	444	10	24	2,880	0.15
Qinghai Plateau (3)	17	204	10	24	2,880	0.07
Northeast Inner Mongolia (4)	74	888	8	22	2,112	0.42
Northeast Inner Mongolia (5)	65	780	10	22	2,640	0.30
Males						
Northwest, Xinjiang (2)	88	1,056	9	24	2,592	0.41
Qinghai Plateau (3)	25	300	9	24	2,592	0.12
Northeast Inner Mongolia (4)	88	1,056	8	22	2,112	0.50
Northeast Inner Mongolia (5)	81	972	10	22	2,640	0.37
Average one female and male						
Northwest, Xinjiang (2)		1,500			5,472	0.27
Qinghai Plateau (3)		504			5,472	0.09
Northeast Inner Mongolia (4)		1,944			4,224	0.46
Northeast Inner Mongolia (5)		1,752			5,280	0.33

(1) 6.8 Yuan per dollar
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.
(6) The interviewees estimated the monthly income they earn from alternative work at home or in a nearby location. in place of working at the current operation.
(7) Monthly opportunity cost times 12 months.
(8) Hours per day times days time 12 months.
(9) Annual opportunity cost divided by annual hours of work. Note: the opportunity cost per hour is rounded. For example, the Xinjiang female shown as $0.10 is actually $0.09667.

Table 13. Calculations of opportunity cost per hour based on *estimated* alternative income and *actual* time spent in current operation, Part I grassland case studies, China, 2001-2005 (1)

Item	Number of persons in family	Calculated opportunity cost per hour (6) US dollars	Actual annual family labor (7) hours	Total opportunity cost income (8) US dollars
		Actual hours at Current Residence		
Opportunity cost based on actual hours spent				
Females				
Northwest, Xinjiang (2)	2	0.10	3,647	348
Qinghai Plateau (3)	2	0.03	5,760	156
Northeast Inner Mongolia (4)	2	0.52	1,355	708
Northeast Inner Mongolia (5)	1	0.58	1,218	708
Males				
Northwest, Xinjiang (2)	1	0.12	4,502	528
Qinghai Plateau (3)	1	0.05	3,739	180
Northeast Inner Mongolia (4)	2	0.21	4,620	972
Northeast Inner Mongolia (5)	1	1.30	728	948
Total family				
Northwest, Xinjiang (2)	3	0.11	8,149	876
Qinghai Plateau (3)	3	0.04	9,499	336
Northeast Inner Mongolia (4)	4	0.28	5,975	1,680
Northeast Inner Mongolia (5)	2	0.85	1,946	1,656

(1) 6.8 Yuan per dollar
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.
(6) Obtained by dividing annual income by annual hours.
(7) From Table 3.
(8) From Table 12

Table 14. Net cash income per hour of family labor by livestock category, Part I grassland case studies, China, 2001-2005 (1)

	Direct production cost US Dollars	Direct and family labor US Dollars	Direct, family labor and ownership costs US Dollars	Direct, family family labor ownership and capital costs US Dollars
Cattle				
Northwest, Xinjiang (2)	0.90	0.75	0.72	0.41
Qinghai Plateau (3)	0.86	0.80	0.70	0.39
Northeast Inner Mongolia (4)	1.54	1.27	1.22	0.57
Northeast Inner Mongolia (5)	0.26	-0.10	-0.27	-0.99
Yaks				
Qinghai Plateau (3)	1.24	1.18	1.08	0.77
Goats				
Northwest, Xinjiang (2)	0.66	0.51	0.50	0.38
Qinghai Plateau (3)				
Northeast Inner Mongolia (4)	2.14	1.86	1.63	0.65
Northeast Inner Mongolia (5)	0.69	0.32	0.26	0.07
Sheep				
Northwest, Xinjiang (2)	0.69	0.53	0.51	0.35
Qinghai Plateau (3)				
Northeast Inner Mongolia (4)	2.15	1.86	1.51	0.17
Northeast Inner Mongolia (5)				
Total				
Northwest, Xinjiang (2)	0.72	0.56	0.54	0.37
Qinghai Plateau (3)	1.18	1.13	1.02	0.71
Northeast Inner Mongolia (4)	1.98	1.70	1.46	0.38
Northeast Inner Mongolia (5)	0.47	0.10	-0.01	-0.47

(1) 6.8 Yuan per dollar
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 15. Net cash and in-kind income per hour of family labor by livestock category, Part I grassland case studies, China, 2001-2005 (1)

	Direct production cost US Dollars	Direct and family labor US Dollars	Direct, family labor and ownership costs US Dollars	Direct, family family labor ownership and capital costs US Dollars
Cattle				
Northwest, Xinjiang (2)	2.54	2.40	2.36	2.06
Qinghai Plateau (3)	0.96	0.90	0.80	0.49
Northeast Inner Mongolia (4)	2.13	1.86	1.82	1.17
Northeast Inner Mongolia (5)	0.30	-0.06	-0.23	-0.95
Yaks				
Qinghai Plateau (3)	1.43	1.37	1.27	0.96
Goats				
Northwest, Xinjiang (2)	0.73	0.58	0.56	0.45
Qinghai Plateau (3)				
Northeast Inner Mongolia (4)	2.14	1.86	1.63	0.65
Northeast Inner Mongolia (5)	0.79	0.42	0.36	0.17
Sheep				
Northwest, Xinjiang (2)	0.71	0.55	0.53	0.37
Qinghai Plateau (3)				
Northeast Inner Mongolia (4)	2.20	1.91	1.56	0.22
Northeast Inner Mongolia (5)				
Total				
Northwest, Xinjiang (2)	1.00	0.85	0.83	0.65
Qinghai Plateau (3)	1.36	1.31	1.20	0.88
Northeast Inner Mongolia (4)	2.17	1.88	1.64	0.55
Northeast Inner Mongolia (5)	0.54	0.17	0.06	-0.40

(1) 6.8 Yuan per dollar
(2) Semi-nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Medium size, Hongyuan. Sichuan Province
(4) Dao Bu Chen. Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Small Size, Mang Lai Gacha, Inner Mongolia.

Table 16. Summary, family opportunity cost and net income, Part I grassland case studies, China, 2001-2005 (1)

Item	Northwest Xinjiang (2) US Dollars	Qinghai Plateau (3) US Dollars	Northeast Inner Mongolia (4) US Dollars	Northeast Inner Mongolia (5) US Dollars
Sheep units	483	1301	745	144
		Opportunity cost calculations		
Current location based on actual hours worked (6)				
Total income	876	336	1,680	1,685
Total hours worked	8,149	9,499	5,975	1,946
Hourly income	0.11	0.04	0.28	0.85
Move to new location (7)				
Total income	1,500	504	1,944	1,752
Total hours worked	5,472	5,472	4,224	5,280
Hourly income	0.27	0.09	0.46	0.33
		Economic analysis of current operation		
Net cash income above (8)				
Direct costs	5,878	11,225	11,843	913
Direct plus family labor	4,602	10,694	10,164	203
Net cash and in-kind income above (9)				
Direct costs	8,169	12,937	12,936	1,047
Direct plus family labor	6,893	12,406	11,257	338
Net cash income per hour above (10)				
Direct costs	0.72	1.18	1.98	0.47
Direct plus family labor	0.56	1.13	1.70	0.10
Net cash and in-kind income per hour above (11)				
Direct costs	1.00	1.36	2.17	0.54
Direct plus family labor	0.85	1.31	1.88	0.17

(1) 6.8 Yuan per dollar.
(2) Nomadic, Medium size, Altar area, Xinjiang Province.
(3) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(4) Dao Bu Chen, Settled, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(5) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.
(6) Table 13.
(7) Table 12.
(8) Table 9.
(9) Table 10.
(10) Table 14.
(11) Table 15.

Economic, Social and Technical Analysis of Changes on China's Pastoral Peoples and Grasslands: Part II

Evolution from the Nomadic Pattern

The major production system in China's grasslands (Map 1) has historically been nomadic animal herding. Over time, and especially since China was opened to the outside world in 1978, there has been a major emphasis on settlement of herders into villages or into houses, i.e. an ever increasing semi-nomadic or settled lifestyle in which livestock owners live in houses part of the year. Some pastoralists' operations have even become somewhat similar to ranches found in the Western world. The economic, social and technical aspect of that transition is the focus in Part II.

The case of Hurqige *Gacha* (village) located in North Central Inner Mongolia on the Mongolia border (Map 4) provides a typical representation of changes by herders who have evolved from the nomadic pattern into a semi-nomadic, and for many, a sedentarized one. The transition is also found in other grassland areas. Prior to 1947, the year in which the Inner Mongolia Autonomous Region was established, there was a hieratic system in pastoral areas with quite loose administration at the grass roots level (*Nomadic Peoples*, Li, Ma and Simpson, 1993).[i] The herdsmen's households were proximally located and moved together. The native Mongolian herdsmen in Hurqige *Gacha* had traditionally followed a long-distance nomadic movement pattern as late as 1956 when the *Bage* (a synonym for *Gacha* in Mongolian) was formed and its boundaries fixed. In 1952, a work team was sent by the banner (county) government to the Hurqige area to teach herdsmen to read and write. In 1957, the "collective movement" was introduced into this area. By 1958, all animals had become the property of collectives, which paid the owners to take care of what had been their animals, during the following 25 years. During the commune period, the brigade was responsible for production and financial management as well as development planning. After the commune system was dissolved in 1983 and replaced by *Sumu* (township), and *Gacha* (for brigade), village committees took the place of the former brigade committees, and increasingly played a greater role in administration.

The nomadic seasonal movement in Hurqige *Gacha* gradually evolved into what might be termed a semi-nomadic pattern with semi-settled overtones since the herders still spent much of their time living in yurts and moving them as needed. By the 1970s the government considered nomadism as backward and something to be gotten rid of. Herdsmen were encouraged to build permanent houses and shelters in winter pastures and follow a semi-nomadic mode during the warm grass-growing season.

However, due to water resource shortages or limited grazing land plus the critical time for calving and lambing being in the spring, houses and shelters were actually built in the spring pastures in most of the pastoral areas in Inner Mongolia. Changes in institutions of administration and production accompanied the evolution of the movement patterns.

In 1985, following enactment of the *Grassland Law of the People's Republic of China,* the herdsmen obtained utilization rights for the grassland after getting back ownership of the animals in 1983. The certificates of use right clarified the size for each herder as well as the boundaries. Beginning in 1987 the herders started to build shelters, pens and above ground bunkers for hay storage. By the end of 1992 all had built facilities and also had 35 to 200 ha of fenced pasture in their spring camps. By the time of the case study interviews in 2002 there was 0.5-1.5 km between the permanent homes in those spring and summer "camps" (Ou Li and James R. Simpson, 2002).

Case Study Site

Hurqige *Gacha* is one of four *Gacha* of Shamai *Sumu* located in Dong Ujimqin *Banner*), Xilinguole League (prefecture), in Inner Mongolia Autonomous Region. This *Gacha* of 869 km^2 is on the border with the Republic of Mongolia. The average annual rainfall is about 250 mm, and the vegetation is typical Steppe grassland.

In 1992, at the time of the first study, there were 91 households and 516 people, including Han immigrants who had moved to the *Gacha* in the early 1960s. By the middle 1980s all Han immigrants had moved to the *Banner* town of Xilinhot which lies about 180 km south of the *Gacha*, but still kept their official registration in this *Gacha.* During the 8 years to July 2000 there was a 13 percent growth to 103 herder households in the *Gacha.* All were ethnic Mongolian herdsmen. Besides those permanent households there were more than 80 short-time migrant herders or herder households from a neighboring B*anner* that were employed as herdsmen to look after the flocks of sheep and goats year-round. Most herder households in this *Gacha* hired such herdsmen (a practice that still continues). Livestock owners were essentially settled, but generally spent time living in a yurt during difficult times of the year, and both males and females were very much engaged in the daily livestock work.

All herdsmen interviewed in 1992-93 using the Participatory Rural Appraisal (PRA) method were positive about changes from the shift to a semi-nomadic system. For example, that the sedentary lifestyle had improved living and working conditions, strengthened production stability and provided greater resistance to natural disasters. Living and working conditions of herdsmen were considered to have greatly improved due to their semi-sedentary life and other infrastructure improvement, especially for women. Most households had tractors which the men drove to fetch water and dung (animal droppings) used for cooking fires rather than this just being women's work. In the evening, sheep were often enclosed in pens, which prevented access by wolves so that wives could sleep peacefully with their families rather than getting up during the night to check on their livestock.

Another important impact on attitudes and behavior of herdsmen, not directly caused by the nomadic pattern change, was promulgation of the 1985 Grassland Law that strengthened the land tenure system. As a result, herdsmen developed a confidence in their utilization rights for grassland, and no longer worried about new families taking land from the *Gacha.* However, herdsmen were also aware of some negative impacts. Most considered that the grassland in Hurqige had deteriorated compared to the 1940s, and it was already worse in the 1970s—the Cultural Revolution

period—than in the 1950s. Virtually all the interviewees attributed the reasons for deterioration to the high animal population and over-grazing.

Ironically, and in contrast to widely believed views about degradation of pasture quality, informants said they wanted to maintain their assigned land and pastures in good condition for upcoming generations. All agreed during the 1992-93 interviews that there was still an urgent need to introduce and adopt appropriate technologies in the new semi-nomadic pattern to stop grassland deterioration, and to keep the ecosystem and pastoralism oriented system in a sustainable development manner.

Mongolian herders were found to be aware of the negative impacts of livestock over-population on their grassland resources. But, as long as livestock were their only source of income, and considering the harsh temperate climate that limits production technology adoption, and taking into account ever-increasing production and living expenditures, it was acknowledged it would be very difficult to voluntarily reduce the number of livestock rapidly to proper stocking rates. What the interviewees wanted, and was found to be the same in the following detailed 2002 case studies based on the integrated composite computer program and Participatory Rural Appraisal technique presented in this part of the article, were alternatives presented for further evaluation that could increase living standards as well as improve grassland environmental quality.

Ethnic Mongolians in Five Case Studies in Hurquige Gacha, North Central Inner Mongolia


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Five Case Studies in Hurquige Gacha

The case studies in Part I of this article were each discussed in considerable detail. In contrast, the presentations in this section about Hurquige Gacha are less detailed since four of the five herders interviewed were relatively similar except for sizes, which ranged from medium to very large. One, Aorizhabu, was very small, having just 1 cow, 36 goats, 35 sheep and 13 horses (Table 1). Discussion about that herder is deferred to the later section about migration from herding.

The other four producers (collectively termed "the four") are divided into two parts to enhance ease of exposition, clarity and analysis. The medium one, Da Genpule, had 678 ha of grazing land (Table 2) and 631 sheep units. Animals were of various species and sizes, and their grazing has varying effects on ecology and environment of the land. Consequently, widely utilized conversion factors of sheep units were used in which 7 sheep are equivalent to one camel, 6 equal one horse, 5 equal one cow, and one goat equals 0.8 sheep (totals are provided in Table 11 with the discussion on costs and income).

The two large producers (Enkebayila, who had 1,016 ha and 754 sheep units, and Tumuriqulo with 899 ha and 757 sheep units) are grouped together with Da Genpule for exposition and termed "the three." The very large one, Eridengbilge who had 1,185 ha and 1,628 sheep units, about 2 ½ time the other "three," is referred to separately and serves as a useful comparison of a level that some producers aspire to provided they could obtain the required grazing permits, management knowledge, and capital.

Livestock production

Cattle in all case studies were mainly milking cows from which milk and milk products were primarily for family use, with the remainder for sale. Calves were allowed to suckle after the cows were milked. Production and sale of livestock progeny and the co-products wool, mohair and milk products were in line with the number of livestock inventory. A large amount of additional data on production as well as grassland use generated in the computer program, not presented in the tables, was very useful during the interviews to facilitate discussion and analysis of management alternatives.

Pasture use

"The three," as well as the very large producer, all followed a similar grazing pattern. Comparison of optimal with actual total sheep unit months revealed considerable differences in levels of overgrazing (Table 2). Enkebayila had 8 percent fewer livestock grazing on an entire year

basis than optimal, while Da Genpule and Tumuriqulo were 15 and 10 percent, respectively, overgrazed. The very large producer, Eridengbilge, with a significantly larger number of sheep units than the others, but a relatively small amount more grazing land than the two large ones, was calculated to be 82 percent overgrazed that year. However, that number is deceptive for Eridengbilge made up for nutrient deficiencies through purchased feedstuffs.

Family labor

Each of "the four" had two females and two males in their household (Table 3). The total for the two females in each of the four households was about the same, 1,195-1,360 hours annually. However, males within "the three" had considerable variation, from 2,894 to 4,160 hours annually, explained by differences in sheep units. The 6,017 hours by the two males in the very large Eridengbilge household was also a product of the substantially larger number of sheep units, and extensive use of purchased inputs. Time spent by females, as a percent of males, ranged from 23 to 43 percent, largely related to size of operation. Work carried out by females was primarily related to cattle and their products.

Annual production costs and ratios

Four categories of annual cost are shown in Table 4. It was very important that each one be calculated because there is no single production cost. The problem is that while most producers, and especially less sophisticated ones, only think of cash, in effect out-of-pocket or direct expenses. However, family labor also needs to be accounted for because agriculturalists seldom pay themselves a wage, simply taking part of sales as a return for family expenses. Ownership costs such as depreciation on equipment and infrastructure like buildings and fences are important for long-term analysis of operations. Capital cost, the opportunity cost producers incur by investing in their own production unit rather than an alternative use, is seldom taken into account by producers. However, economists consider it an important element in decision-making because it can have a bearing on the decision to leave an agricultural operation and invest in a non-agricultural pursuit.

Great care must be taken when asking producers for their cost of production. Few can readily give their total much less per kg because they seldom have the data recorded. Even if they do, it is very unlikely that the number would be comparable with other producers. The point is that the method used in gathering data for the research reported on in this article seems tedious, but was necessary to obtain correct results. Family labor was calculated by using the herder's opportunity cost (detailed and explained later in Table 12).

Direct annual production cost ranged from $5,488 to $8,706 for "the three" and $14,233 for the very large producer (Table 4). Family labor added about 12-15 percent. Ownership costs resulted in the ratio to direct costs increasing to 1.5-1.9. Addition of capital cost brought the ratios to 2.3-3.0.

Cost and sales price per kg produced

Calculation of cost per kg produced for livestock products was very complicated due to each animal species yielding several co-products, and pastoralists owning a number of different species such as cattle, goats and sheep. Allocation of expenses was tedious and one reason why considerable time was required, especially for the first interview. The strategy of having all or most of the herders present at that time significantly reduced collection time in subsequent interviews.

The data in Table 5 reveals the large variation between seemingly similar operations due to considerable difference in management. For example, direct production cost per cattle calf raised ranged from $0.40 to $1.64 per kg. Sales prices were the same for all commodities for "the four." Tumuriqulo was the only producer in which the sales price of $0.82 covered direct production cost. The losses on cattle sales as a profit center were covered by the other commodities sold. Milk product prices are provided in Table 6. In the case of cattle, cow milk product sales or for home use helped offset the losses from progeny sales.

Breakdown of direct cash expenses

The high degree of homogeneity among "the four" regarding use of inputs is strikingly shown in Table 7. Purchased forages accounted for about half of direct costs and taxes were second, ranging from 13.5 to 22.0 percent of the total. These taxes were largely based on amount of grazing and crop land in addition to livestock numbers for settled livestock producers, but only on livestock for nomadic pastoralists. Costs for vehicle repair and fuel were the third largest category. All "the four" had fulltime contract employees living on the grasslands herding the sheep and goats. Those contract labor costs were only about 2.5 percent of all costs, in effect a very minor expense considering the improvement on producer's quality of life.

Income

Income is divided into two parts, cash and in-kind (the value of the commodities consumed by the family rather than being sold). Cash income, as a percent of total income, ranged from 85 percent for the medium producer Da Genpule, to 94 percent by Eridengbilge, the very large

producer (Table 8). Animal sales accounted for about 80 percent of combined income for each of "the four."

All producers covered the total of direct plus labor costs for all species when net cash only was taken into account. However, Da Genpule was the only one of "the four" that did not cover ownership costs (Table 9). None of the producers covered capital costs, typical of what is expected among larger scale settled agriculturalists because of the relatively large amount of investment in infrastructure. The economies of size combined with more intense management through purchased inputs are apparent in that, while Eridengbilge, the very large producer, had about double the expenses of the two large producers (Table 4), net cash income was about two and a half times that of the large producer Enkebayila.

The addition of in-kind income expanded net cash plus in-kind income above direct production costs by 40 percent for Da Genpule, 27 percent for Enkebayila, and 30 percent for Tumuriqulo, but just 10 percent for Eridengbilge (Table 10).

Cost and income on a sheep unit basis

Production cost per kg by species, and total production cost and net income for each of the four categories, are useful standard indicators for comparison between livestock producers. However, herd size disparities compounded by species differences prevented a very meaningful comparison for analytical purposes. The solution was use of sheep units as a common denominator to arrive at per unit costs and returns (Table 11). Notable among "the four" is Tumuriqulo, who had the highest cost per sheep unit ($11.50), one of the two lowest net cash incomes ($7.02), and the lowest of combined net cash and in-kind ($9.15). Eridengbilge, whose cost per sheep unit was about the same as Da Genpule, the medium size producer, is another notable one by having had the highest net cash income ($12.30) and the second highest combined net income ($13.57).

Opportunity cost and hourly income for migration analysis

The opportunity cost method was used to evaluate the veracity of different methods about migration options. The first step was to calculate what "the four" herders could earn from personal non-livestock tasks while remaining in their residence. Participatory Rural Appraisal was the principal vehicle for eliciting responses, and found to be very effective. Each of "the four" females *estimated* that they could earn $66 per month ($794 annually) based on an *estimated* 10 hour work day, 30 days per month, resulting in 3,600 hours annually (Table 12). Dividing $794 by 3,600 hours resulted in $0.22 per hour for the current residence. The same estimation procedure was used for

males, resulting in $0.25 per hour. The weighted family averages for each of "the four" was $0.23 per hour.

The next task was to determine the income that might be earned by migrating to a new location such as an urban area. The procedure was the same as for the current residence. Opportunity costs for each of the females by not moving to a new location were $0.37 per hour (Table 12). The corresponding estimated hourly rate was $0.41 for males. The weighted average for the family was $0.39. These results lead to a conclusion that migration would be a great benefit to the family as the average hourly income per family worker would increase 70 percent.

Comparison of research methodologies for migration evaluation was a major part of the case studies. Consequently, the current residence opportunity costs based on *estimations* of hours spent are presented since that might be a procedure utilized in a less detailed type of survey. The actual hours spent (Table 3) were then used in the calculations of hourly income at the current residence provided in Table 13. In the case of females, income ranged from $0.58 to $0.70. The range was $0.13 to $0.27 for the males. The family averages varied from $0.22 to $0.39. These actual hour based results might lead to the conclusion that migration could be marginally beneficial to some and very desirable for others.

Net income per hour of labor by production activity

Dependence only on opportunity cost calculations has the severe drawback of not considering the income side of operations. That way of viewing whether a family would be better off exiting herding is provided in Table 14, in which net cash income and actual hours spent by the family were used to determine the net cash income per hour of labor. Cattle were ostensibly a losing activity for three of "the four." It was determined that milk cows must be kept despite providing marginal or a net cash loss because milk and its products are a major part of their diet. Goats and sheep were both quite profitable. Net cash income per hour above direct production costs ranged from $1.00 to $1.86 for "the three" and was $2.71 for the very large producer.

There was a substantial positive effect on hourly net income when in-kind income was added to cash income, as the range increased to $1.31 to $2.36 for "the three" and $2.99 for the large producer (Table 15). Net cash and in-kind income above direct, family labor, and ownership costs was just slightly less than the $0.39 that Da Genpule and Tumuriqulo families might earn by migrating. However, the $1.25 and $1.74 for the other two was dramatically higher than moving.

These are very useful data not only for migration evaluation, but also for operation management considerations. Income per hour, however, is only part of the story.

Summary comparisons

Table 16 contains a summary using various methods about the possibility of moving to a new location. Family average actual hourly opportunity cost ranged from $0.22 to $0.39 for "the four" at their current locations, revealing great similarities between them despite the size differences. The estimated hourly income from a move to a new location was the same for each of "the four", $0.39 which initially makes it appear that migration would be a viable consideration for all of them.

The second section of the table titled "economic analysis of current operation" contains the actual total net cash income, and net cash plus in-kind income in addition to hourly income and reveals a very different outcome. In the case of Da Genpule, the net cash income above direct costs was $4,444 at the residence, and $6,265 when in-kind income is included. In contrast, the estimated gross income for the family was $2,118 from a move, which would be far below what they were already earning as a net at the residence. Furthermore, the move would have resulted in working 5,472 hours, 34 percent more than the 4,089 they were actually working.

Net cash and in-kind income per hour for Da Genpule was $1.53 above direct costs and $1.30 above direct costs and family labor, far above the $0.39 gross income they might earn from moving. The situation is the same for the other three, in which total net income and hourly income show the overwhelming economic benefits of remaining as herders.

The conclusion from these case studies, plus the ones in Part I, is that reliance only on the opportunity cost method based on surveys or even interviews about estimates of earnings can be quite misleading. The data reveal quite clearly the benefits of detailed budgeting to determine actual conditions of herder families.

Perspectives on Pastoral Livestock Systems and Economics:

Case Study Results

The nine case studies in this article provide a detailed view of various production systems that characterize China's grasslands. The Xinjiang case (Map 2) is typical of the nomadic peoples in which herders move significant distances depending on the season but return annually to a fixed encampment. The five Hurquige Gacha studies (Map 4) illustrate the relation of shifts from nomadic to semi-nomadic, and then to settled life characterized by short-term livestock movements and a variant of transhumance.

The large producer in Northeast Inner Mongolia (Map 4) reflects settled operators living permanently in a house that employ advanced management and a relatively high level of technology adoption, somewhat akin to developed country ranchers. The Qinghai family (Map 3) reveals the value of niche livestock operations. The very small crop/livestock producer in Eastern Inner Mongolia (Map 4) showcases families caught in a rapidly changing and economically developing China.

Correlations of costs, total net income and size

Table 17 is an economics focused summary of the nine case studies arranged by herder operation size on a sheep unit basis. On the cost side, there is a correlation of 0.64 between number of sheep units and direct costs. This result is expected as it simply means that as size increases so do total costs. However, the relationship is -0.12 between number of sheep units and cost of production per sheep unit, meaning that relationship is not a good explanation of economies of size. There is a very high relation between total net cash income and number of sheep units (size of operation), 0.92 above direct costs and 0.94 above direct costs and family labor (Graph 1). Similar to the cost side, the correlation between the number of sheep units per operation and net cash income per sheep unit is relatively weak, 0.35 above direct costs and 0.50 above direct and family labor. The correlation between total net cash and in-kind income above direct costs is 0.93, and 0.95 above direct and family costs. The very high correlations show the strong relationship between income and size of operation.

Correlations between hourly income and size

Net cash income per hour per family had a very strong correlation with number of sheep units, 0.80 for direct costs and 0.85 for direct and family labor (Table 17). They were 0.79 and 0.83 for net cash plus in-kind income per hour.

Conclusions on size and grazing levels of livestock

The very high correlations between number of sheep units and both total and per hourly net income reveal a very strong relation in economic benefits from increasing size. There is no statistical significance due to only having nine observations from varying types of operations. However, the results are very useful when planning policy objectives, particularly related to income parity issues commensurate with non-agricultural families. If, for example, an objective is for settled herders to obtain net cash income above direct costs and family labor of $10,000, about 800 sheep units would be the minimum number. Another example, based on land of the type found around Hurquige Gacha that has an optimal carrying capacity of about 1.4 sheep units per Ha, reveals that about 1,100 Ha of grazing land would be required.

Perspectives on Grasslands, Land Tenure and Overgrazing

The term "grasslands" is not specifically defined in the Grassland Law of the People's Republic of China, effective October 1, 1985 (Ministry of Agriculture, Peoples Republic of China), the one promulgated to cover all of the lands that are, or can be, used for grazing, or in the 2002 Amendment (Ministry of Agriculture, Peoples Republic of China, 2006). These two documents are the basis for proper use of the grasslands and essentially the basis for grassland tenure rights.

Rationale for the 1985 Grasslands Law

> *Article 1. This Law is formulated in accordance with the provisions of the Constitution of the People's Republic of China with a view to improving the protection, management and development of grasslands and ensuring their rational use; protecting and improving the ecological environment; modernizing animal husbandry; enhancing the prosperity of the local economies of the national autonomous areas; and meeting the needs of socialist construction and the people's life.*

Land tenure aspects

> *Article 4. The grasslands are owned by the state, that is, by the whole people, with the exception of the grasslands that are owned by collectives in accordance with the law. Grasslands under ownership by the whole people may be assigned to collectives for long-term use. Grasslands under ownership by the whole people, those under collective ownership, and those under ownership by the whole people that are assigned to collectives for long-term use may be contracted by collectives or individuals for pursuits in animal husbandry. With respect to grasslands used by units under ownership by the whole people, the local people's governments at the county level or above shall register such grasslands, issue certificates to the said units after verification and thus establish their right to use such grasslands. With respect to grasslands under collective ownership and those under ownership by the whole people that are assigned to collectives for long-term use, the local people's governments at the county level shall register such grasslands, issue certificates to the collectives after verification and thus establish their right of ownership of the grasslands or their right to use them. The right to own or use grasslands shall be protected by law and may not be infringed upon by any unit or individual.*

To these authors knowledge there is no definitive study on land tenure issues related to China's grasslands. However, China's cropland tenure issues have been extensively studied and reported on by Roy Prosterman and his colleagues at the National Bureau of Asian Research (NBR) since 1987, culminating with the definitive November 2009 NBR Special Report #18 in which results and recommendations from a seventeen-province survey are presented (Prosterman 2009). In addition, they provide a history of land tenure issues which, while only related to crop farmers, is essential background to understand grassland issues. There are problems unique to the grasslands that almost seem diametrically opposed to cropping areas in which the focus is on formalization of land rights (Li and Simpson 2002). This is due to the nature of grasslands, and particularly overuse

of them to the point that land use rights must be reduced to meet the Grassland Law of 1985 and the 2002 Amendment.

Grassland use and overgrazing aspects

> *Article 12. Grasslands shall be used rationally and overgrazing prevented. Where aridity, degeneration or soil erosion occurs as a result of overgrazing, users of the grasslands shall be required to reduce grazing and re-sow forage grass so as to restore vegetation. Where man-made grasslands have already been established, extra control shall be administered; they shall be rationally managed and used in a scientific way, so as to prevent degeneration.*

Overgrazing and associated land degradation is a serious problem in the pastoralist's sites studied. Field observations on pasture quality, discussions with range management personnel and other knowledgeable people, as well as study of reports about grazing land use in each area indicate that communally grazed rangeland is at least 30 percent overgrazed, and there is widespread overuse in areas where use rights specified parcels have been assigned to individual herders. Moreover, if the optimal grassland condition were considered from the viewpoint of many years ago, for example in Hurquige Gacha, much of China's grasslands are at least 40 to 60 percent overgrazed and seriously degraded.

The extensive interviews during the research revealed that all livestock owners as well as officials recognize the problems and are very concerned about it. The issue in nomadic pastoralist areas (contrasted with semi-nomadic and settled areas) is that the grazing system is a "commonality" problem, analogous to unregulated over-fishing in oceans and lakes. As stated in Article 4 of the 1985 Grassland Law "the grasslands are owned by the state, that is, by the whole people." Consequently, even in the cases where an area is governed by a collective, there is a tendency to "mine" it despite understanding of long-term consequences due to near-term necessities for meeting family and livestock needs, and even survival. In addition, due to human population growth on the grasslands as a fixed resource, division of grazing certificates among children exacerbates grazing pressure. As a consequence in many areas average net family income per family member has decreased. That action has resulted in herder's natural reluctance to reduce animal numbers further to improve rangeland quality even though they would benefit in the longer run.

It was determined that herders from communal areas who have migrated to settlements have commonly been allowed to maintain their animal ownership and grazing allotment. They simply designate a family member to care for the animals or contract someone to do it. In many cases, the settlements are located hundreds of km away from the allotment. Thus, due to natural absentee

ownership tendencies, there is no incentive by resettled herders to reduce numbers, especially since they have little contact with daily operations.

There are very few solutions for typical herder families to increase their incomes and reverse land degradation due to climatic and management skills constraints. One, which China does carry out to a limited extent, is to withhold grazing for an extensive period and in some areas reseed to improve productivity. The drawback, of course, is that families that want to remain herders suffer a decline in income for an extended period. Another option is strict government control on reduced grazing, which also has severe social implications, and is difficult to enforce on lands with individual use rights (Brown, Walden and Longworth, 2008). Some unique suggestions were presented by Wu Zhizhong and Du Wen in their 2008 article in *Nomadic Peoples*. The inevitable unpalatable solution to reducing overgrazing, while simultaneously increasing economic levels to improve standard of living, is to reduce human population and increase size of herder operations. A critical question is: who should leave?

Perspectives on Migration Issues

The Government of China has long recognized that something needs to be done about migration from the pastoral areas, particularly since rapid population increase is a major cause of overgrazing, and ecological rejuvenation and protection are of national and international concern. In the far west there have been resettlement projects to shift nomads to farming areas. State media reported on March 11, 2003 that the Chinese Government would spend hundreds of millions of dollars urging 7 million poverty-stricken people to relocate out of deserts or barren mountain areas in a voluntary relocation scheme over the following decade. The plan was that the government would provide the rural poor living in harsh, remote areas with the necessary assistance to build new homes and find new incomes. Locating, profiling and determining which families should accept relocation, and how to improve the lives of those that remain is a gargantuan task fraught with pitfalls.

The research reported on does not include seriously denigrated areas. Rather, it represents a good overview of land tenure issues in a broader framework in which the pastoral area and its peoples are changing as part of the nation's economic development. It was determined that six of the herders profiled in the nine case studies were sufficiently sound economically and socially that migration would serve no purpose either for the producer families or society in general. Three cases were identified from the nine that warrant study about the feasibility and usefulness of leaving pastoralism for alternative employment.

Two of the producers, Aorizhabu in Hurqige Gacha in North-central Inner Mongolia, and Bao Shan in Mang Lai in Northeast Inner Mongolia, were quite small with only about 145 sheep units each. The primary issue for them was size constraints as an impediment to their being able to develop economically and improve their lifestyle in concert with developments taking place in the areas where they lived. The other case, the typical nomadic herder in northwest Xinjiang Province was determined to be well-off economically, with the issue being sedentarization of herders as a national level long-term social goal.

First small producer

The small Northeast Inner Mongolia producer family, led by Bao Shan, had a very small size crop/livestock operation (2.7 ha of crop land, no owned grazing land, and rented grazing land) close to the Jilin Province border in a semi-arid area with limited and low quality irrigation water (Map 3). They did have the advantage of electricity from a nearby town, and being near a paved road. In

addition, while they spoke a local variant of Mongolian, they could speak, read and write Chinese. At the time of interview in 2004 they had 9 mature female cattle, 25 mature goats, but no sheep or horses for a total of 144 sheep units (Table 18). They fed their animals on crop residues, crop products (mainly maize and hay) and purchased forage and concentrates. Sale of milk products was their primary occupation apart from sales of cattle and goat progeny.

Based only on the opportunity cost income of $1,752 from migration, compared with net cash and in-kind income of $1,047 above direct cost, but just $338 above direct costs and family labor, it would appear that migration might be appealing. However, the number of hours worked by the family would increase 2.7 times resulting in a wage rate of $0.33 per hour compared to $0.54 above direct costs at the current residence. Conversely, they only earned $0.17 per hour when family labor was included.

So, what's the conclusion for Bao Shan and his wife? On the one hand they are locked into a small operation with little apparent opportunity to increase size as a means to avoid falling into a culture of poverty exacerbated by China's rapid development. On the other hand, continuing to live on the operation that they feel so comfortable with may be in their best interest considering they are middle aged and at least own their own home, which might not be the case if they were to move.

Second small producer

The second small herder operation, the Aorizhabu family, is an example of what can happen in the harsh unyielding windblown steppe on the Mongolian border. A few years prior to the interview in 2002 this family's operation was equivalent in size to the middle size operation in Hurquige Gacha (Map 2). Then, suddenly, they lost a large portion of their animals in a terrible winter storm. The wife and children moved to Xilinhot where she made a living in various jobs. At the time of interview they only had one cow, 36 goats, 35 sheep and 13 horses (145 sheep units) of their own (Table 18) although they still had the land allocated to them and associated use rights. They also had a share grazing arrangement with a livestock owner to care for that herder's animals and provide forage from their allotment for the animals. In return, they received half the progeny born. The family's objective was to slowly rebuild to the previous herd size, and that was the obligation of the husband and teenage daughter. Given the low base it would take a long time to reach their previous level.

The economic analysis, which only covered their own livestock, shows that their opportunity cost income of $1,500 would be marginally more than the $1,446 above direct costs on their current

operation. But, it was deemed dramatically greater than the $402 when family labor was considered. The average $0.27 the man and daughter might earn per hour in a new location was somewhat less than the $0.32 they earned above direct costs, but substantially higher than the $0.09 calculated that they actually earn taking family labor into account in their current operation. Those numbers make it appear as though migration would be the favored alternative. But, the number of hours worked by the male and his daughter would increase 22 percent, although she would have much more access to educational opportunities and social life (Table 16).

A problem is they had only very rudimentary Chinese, and a low education level thus making the transition difficult. A serious consideration was that the whole family really liked the herder lifestyle. Through migration, the opportunity to eventually rebuild their herd back to a medium size would be lost. That option would, of course, have to be tempered by the risk of adverse climatic conditions always lurking in the background during the long rebuilding period. A logical approach given these considerations would be to develop a business plan including realistic projections of cash flows and scenarios of what might happen if things go wrong. But, the sad reality is they were determined to be lacking in the necessary analytical skills, and assistance from government was found to be unsatisfactory.

Xinjiang Medium Size family

The case study from the northwest area of Xinjiang, above the city of Altar (Map 2, Part I), was based on a typical nomadic producer in the area which, in terms of other case studies, was medium size with 483 sheep units (14 head of cattle, 22 goats, 145 sheep and 11 horses). They also had 7 camels that were primarily required for periodic movement of their entire household effects. The typical household modeled had two females and one male. Winter pasture was their home base, consisting of the small groups that traveled together during the other seasons. Most households sent their children to board during the school year in the town of Altay, which for them would mean anywhere from 1 to 3 days trip from their remote area. Medical services were rudimentary for the nomads. For example, pregnant women would frequently move to an area with a midwife or doctor for delivery.

It is easy to conceptualize the tough, primitive, frugal life for nomads in which moving to a new location would seemingly benefit all. Opportunity cost was one approach employed to determine the attractiveness of migration out of herding. The Xinjiang males, for example, could work in the village's hay and forage production operation or as contract labor for another family at

their current location. Herders in more settled areas could work for other herders. Xinjiang females were found to have opportunities for sewing or preparing clothing for other individuals, making handicrafts, making felt for yurts out of sheep wool, working for other herders etc.

Results from an economic analysis of the current operation brought to light net cash and in-kind income of $8,169 above direct costs, and 6,893 above direct costs and family labor (Table 18). The opportunity cost analysis showed that they could only earn an alternative $1,085 at their current operation and $1,500 for a move to a new location. Results on a per hour basis were also quite revealing. The budgeting analysis on a per hour basis demonstrated that family income was much higher than might be expected, $1.00 above direct costs only, and $0.85 above direct plus family labor, compared with an opportunity cost per hour of $0.27 for a move to a new location.

It is easily concluded that, from an economics standpoint, there would be no reason to consider moving. Importantly, the hourly wage in a new location would be gross, meaning that the family would have to locate a place to stay, probably pay rent, and pay for food and other living expenses. An overall research methodology conclusion is that the vast difference between their opportunity costs and the actual net cash income highlights the drawback of using opportunity cost (even based on actual hours of work as one in the research) at the current location as the sole proxy for determining whether a family should move based on economic analysis.

There are also many other considerations. For example, the typical family modeled earned enough income to pay for their children to live in town and to attend a school the parents selected. Perhaps it is sufficient for their contentment to know that their children, through their schooling, are receiving the tools necessary to forge a new life. On the other hand, having children living at home through migration rather than boarding in town does have a positive reward. Our preliminary research (not documented) in a resettlement area exclusively for nomadic peoples indicated that educational opportunities were far greater in Altay.

On the negative side, nomadic life is hard and in many respects boring, particularly for women. On the other hand, they have their own home and lifestyle that they grew up with, and the transition to a new location does not guarantee they would be happier, particularly if they are older and especially considering that very few nomads speak, read or write Chinese. It can be seen that the migration issue is a social one as well as from the stakeholder's viewpoint.

Conclusions on Migration from Grassland Areas

The three cases discussed in this section reveal the ambiguity involved in policy making about migration. Policy makers are continually being badgered to "do something" about the increasing income gap between the Coastal and Western areas. In reality, there is considerable development taking place in various parts of the Western areas and some rural people are at least improving their livelihoods. The herders profiled, and likely virtually all that would be considered in any migration program have a home, albeit primitive, and one would have to be rented or provided in a new location that probably would still be fairly rustic. A profound implication is that a subsidy, and probably for an extended period, would be required. The nine case studies, and especially the three herders profiled for migration, demonstrate the difficulty of attempting to develop policies about land tenure, range rejuvenation and migration.

Perspectives on Gender Use

The living and working conditions of herdsmen were found to have greatly improved as they shifted from a nomadic system to a semi-nomadic one, then to semi-sedentary life, and finally a completely settled lifestyle. A semi-nomadic lifestyle meant that since women still spent considerable time living in a yurt, the arduous task of continuously taking it down, moving it, setting it back up as movements to new forage sites necessitated. The transition to a settled lifestyle was dramatic, especially for women, as sheep were often enclosed in pens, which prevented access by wolves so that wives could sleep peacefully with their families rather than getting up during the night to check on their livestock.

The adoption of tractors was a great labor saver for women as men then drove them to fetch water and dung (animal droppings) used for cooking fires rather than this just being women's work. Mechanized transportation also meant a much more varied and healthful diet. Education opportunities for children, a continual preoccupation of mothers, were greatly augmented. And, having a permanent structure opened up the opportunity to gain many modern conveniences such as bottled gas for cooking and wind generators to provide electricity.

The amount of time spent on livestock by men and women was documented in the extensive interviews of the nine case study herder families. One major finding, as expected by agricultural families, was that the percent of time spent by women was quite significant even as herd size and net incomes increased. In the case of the typical nomadic herder family in Northwestern Xinjiang Province, women's labor contribution in hours annually was equivalent to 81 percent that of males (Table 19). In the case of two settled herder families, a medium size Yak specialized operation on the Qinghai Plateau, and a small size one in Northeast Inner Mongolia, women's labor contribution was about 50 percent more than that of males. The five case studies at Hurqige Gacha in North-central Inner Mongolia revealed that although women still contributed a significant amount of time to livestock, the proportion of their time (among "the four") compared to males decreased as size of operation increased. Most women's time was spent with cattle, primarily in milking and product preparation. Goats required the second amount of their time and sheep third. Overall, women in all the nine case studies continued to have a significant role in livestock production, even when the operations grew to become large and very large.

Summary and Conclusions, Parts I and II

New China, born in 1948 following protracted civil unrest and World War II, soon began to focus on national development. By the 1970s that resulted in a major emphasis on settlement of grassland herders into houses, initiating an ever-increasing semi-nomadic lifestyle, and more recently a sedentarized livestock system. That segment of, now relegated to a regulated lifestyle, soon realized the negative impact of sedentarization on their grassland resources particularly due to division of once extensive lands into increasingly small holdings among siblings. Compounding the problem has been lack of knowledge about technical and economic aspects of sedentarized livestock raising in a climatic environment affording very limited alternative range and management improvement strategies.

The case study integration method used in the research reported on in this article that binds together issues of production systems, seasonal grazing patterns, relationship of actual use to mandated maximum use (percent overgrazing if that was the case), cost of production by species and products produced (what might be termed profit centers), evaluation of gender use, and calculation of migration related opportunity costs linked to net income, was found to be a treasure-trove of quantitative results. It also provided a manageable way to really understand the feelings, frustrations, and desires for personal improvement and rejuvenation of the grasslands by herders that can lead to appropriate policies and legislation. The method, although time consuming, led to in-depth understanding that pastoral area and herder development is not one of a single plan; rather, a multitude of efforts are needed, just as there is no one solution to overgrazing.

A valuable finding was that reliance on the opportunity cost method as a major indicator for migration decisions has severe flaws as it can lead to incorrect recommendations about benefits of migrating from herding. The solution was found to be in combining it with detailed budgeting that does provide reliable quantitative information about actual economic benefits. It was also determined that the method of combining a computer based program to register data from participatory rural appraisal interviews on-site was indispensable for determining accurate responses, data and stimulating responses and ideas. It was concluded that the case study integration method employed should be considered for use at the global level in addition to China.

Herders in all systems were found to know the problems, but that it was difficult for them to really understand the impact of their short-term actions emanating from their daily issues of simply surviving in a hostile climate. What they were found to really want was an opportunity to participate in the hard, arduous task of decision-making in policy formulation. They clearly understood that the

grasslands are a finite resource that has been terribly abused, for many have lived through the degradation of their areas.

The herders realized that tough, yet fair, national and regional level policies, laws, monitoring, strict enforcement and heavy penalties for non-compliance on reduction of grazing pressure are vital to provide the best results for their children and coming generations. Paradoxically, in the big picture, all herders face a commonality problem to some extent because all land in China belongs to all the people. Semi-nomadic and settled herders are users with land tenure rights, and thus in particular are stewards charged with being responsible for maintaining and improving the land they manage. Likewise, fair treatment for advancement of the grasslands is a responsibility and priority for every one; urbanites and others that will never even set foot on the grasslands, as well as herder families that trace their roots back generations.

The broadest conclusion from the case studies is there needs to be a national vision about what the grasslands should represent a few decades hence. Associated strategic planning would include objectives and quantifiable goals about such diverse issues as national parks, control over runaway mindless land grabbing of the most scenic areas, and conservation of the grasslands—which cover 40 percent of China's land mass. In conclusion, the pastoral areas represent a unique opportunity for preservation of an exceptional, irreplaceable part of China.

Tables Part II

Table 1. Production data for Huriqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

Item	Units	Cattle	Goats	Sheep	Horses
Breeding females and work use inventory					
Medium Da Genpule	Head	14	62	370	14
Large Enkebayila	Head	12	75	501	9
Large Tumuriqulo	Head	14	74	420	19
Very large Eridengbilge	Head	37	183	925	39
Small Aorizhabu	Head	1	36	35	13
Progeny potentially available for replacements and sale after subtraction of death loss, and use for personal and contract purposes					
Total number born					
Medium Da Genpule	Head	8	55	300	
Large Enkebayila	Head	6	55	453	
Large Tumuriqulo	Head	9	46	400	
Very large Eridengbilge	Head	30	190	855	
Small Aorizhabu	Head	1	25	31	
Total number weaned					
Medium Da Genpule	Head	8	45	244	
Large Enkebayila	Head	6	44	372	
Large Tumuriqulo	Head	9	46	356	
Very large Eridengbilge	Head	30	178	761	
Small Aorizhabu	Head	1	23	29	
Sales, all progeny					
Medium Da Genpule	Head	5	37	190	
Large Enkebayila	Head	4	34	299	
Large Tumuriqulo	Head	6	36	291	
Very large Eridengbilge	Head	24	147	629	
Small Aorizhabu	Head	1	16	24	
Total annual mohair/wool production					
Medium Da Genpule	Kg		20	381	
Large Enkebayila	Kg		24	541	
Large Tumuriqulo	Kg		23	462	
Very large Eridengbilge	Kg		131	938	
Small Aorizhabu	Kg		11	38	

Table 2. Optimal and actual amount of land used per sheep unit by season Huriqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

Item	Total	Spring	Summer	Fall	Winter
Grazing land available to use (Hectares)					
Medium Da Genpule	677.6	177.6	166.7	166.7	166.7
Large Enkebayila	1,016.4	336.4	266.7	266.7	146.7
Large Tumuriqulo	899.1	153.3	163.5	194.1	388.3
Very large Eridengbilge	1,185.8	204.9	311.3	242.9	426.7
Small Aorizhabu	1,016.3	254.1	254.1	254.1	254.1
Optimal Mu per one sheep unit					
Medium Da Genpule		20	22	18	18
Large Enkebayila		23	23	23	18
Large Tumuriqulo		23	23	23	18
Very large Eridengbilge		23	23	23	18
Small Aorizhabu		23	23	23	18
Optimal Ha per one sheep unit					
Medium Da Genpule		1.3	1.5	1.2	1.2
Large Enkebayila		1.5	1.5	1.5	1.2
Large Tumuriqulo		1.5	1.5	1.5	1.2
Very large Eridengbilge		1.5	1.5	1.5	1.2
Small Aorizhabu		1.5	1.5	1.5	1.2
Optimal sheep unit months (sum)					
Medium Da Genpule	6,295	1,598	1,363	1,666	1,666
Large Enkebayila	9,342	3,027	2,182	2,666	1,467
Large Tumuriqulo	7,880	1,199	1,279	1,519	3,882
Very large Eridengbilge	10,207	1,604	2,436	1,901	4,266
Small Aorizhabu	8,505	1,988	1,988	1,988	2,540
Actual sheep unit months (sum) (1)					
Medium Da Genpule	7,250	1,607	1,545	1,768	1,330
Large Enkebayila	8,641	1,918	1,869	1,764	3,089
Large Tumuriqulo	8,670	1,806	1,880	1,766	3,218
Very large Eridengbilge	18,590	3,254	4,908	3,613	6,815
Small Aorizhabu	NA	NA	NA	NA	NA
Actual over optimal sheep unit months					
Medium Da Genpule	955	8	181	102	663
Large Enkebayila	-701	-1,109	-313	-902	1,623
Large Tumuriqulo	790	606	601	247	-664
Very large Eridengbilge	8,384	1,651	2,472	1,712	2,549
Small Aorizhabu	NA	NA	NA	NA	NA
Percent overgrazing (minus sign means under-used)					
Medium Da Genpule	15	1	13	6	40
Large Enkebayila	-8	-37	-14	-34	111
Large Tumuriqulo	10	51	47	16	-17
Very large Eridengbilge	82	103	101	90	60
Small Aorizhabu	NA	NA	NA	NA	NA

(1) Da Genpule had 631 sheep units, Enkebayila 754, Tumuriqulo 757, Eridengbilge 1,628, Aorizhabu 145.

Table 3. Family labor use by gender, Hurique Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

	Living in household	Living outside household	Fulltime equivalent in house	Fulltime equivalent outside house	Total fulltime equivalent
Family members					
Females					
Medium Da Genpule	2	0	2	0	2
Large Enkebayila	2	0	2	0	2
Large Tumuriqulo	2	0	2	0	2
Very large Eridengbilge	2	0	2	0	2
Small Aorizhabu	0	1	0	0.5	0.5
Males					
Medium Da Genpule	2	0	2	0	2
Large Enkebayila	2	0	2	0	2
Large Tumuriqulo	2	0	2	0	2
Very large Eridengbilge	2	0	2	0	2
Small Aorizhabu	1	0	1	0	1
Contract labor (not included in following table)					
Medium Da Genpule		1		1	1
Large Enkebayila		1		1	1
Large Tumuriqulo		1		1	1
Very large Eridengbilge		1		1	1
Small Aorizhabu		0		0	0

Item	Units	Total	Cattle	Goats	Sheep
Annual time spent					
Females					
Medium Da Genpule	Hours	1,195	490	234	471
Large Enkebayila	Hours	1,350	616	234	500
Large Tumuriqulo	Hours	1,137	991	146	0
Very large Eridengbilge	Hours	1,360	1,055	244	61
Small Aorizhabu	Hours	444	225	219	0
Males					
Medium Da Genpule	Hours	2,894	443	387	2,064
Large Enkebayila	Hours	3,142	520	388	2,234
Large Tumuriqulo	Hours	4,160	793	376	2,991
Very large Eridengbilge	Hours	6,017	1,069	482	4,466
Small Aorizhabu	Hours	4,038	458	1,908	1,672
Females and males					
Medium Da Genpule	Hours	4,089	933	621	2,535
Large Enkebayila	Hours	4,492	1,136	622	2,734
Large Tumuriqulo	Hours	5,297	1,784	522	2,991
Very large Eridengbilge	Hours	7,377	2,124	726	4,527
Small Aorizhabu	Hours	4,482	683	2,127	1,672
Females as a percent of males					
Medium Da Genpule	Percent	41	111	60	23
Large Enkebayila	Percent	43	118	60	22
Large Tumuriqulo	Percent	27	125	39	0
Very large Eridengbilge	Percent	23	99	51	1
Small Aorizhabu	Percent	11	49	11	0
Time use by type of animal species					
Females					
Medium Da Genpule	Percent	100	41	20	39
Large Enkebayila	Percent	100	46	17	37
Large Tumuriqulo	Percent	100	87	13	0
Very large Eridengbilge	Percent	100	78	18	4
Small Aorizhabu	Percent	100	51	49	0

Table 4. Total annual costs and ratios, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002 (1)

Producer	Direct production cost	Direct and family labor	Direct, family labor and ownership costs	Direct, family family labor ownership and capital costs
	----------US dollars----------			
Medium Da Genpule	5,647	6,620	10,623	16,831
Large Enkebayila	5,488	6,556	10,458	17,666
Large Tumuriqulo	8,706	9,976	14,004	20,968
Very large Eridengbilge	14,233	16,008	23,487	37,146
Small Aorizhabu	865	1,910	3,926	6,066
	----------Ratio to direct costs----------			
Medium Da Genpule	1.0	1.2	1.9	3.0
Large Enkebayila	1.0	1.5	1.5	2.3
Large Tumuriqulo	1.0	1.1	1.6	2.4
Very large Eridengbilge	1.0	1.1	1.7	2.6
Small Aorizhabu	1.0	2.2	4.5	7.0

(1) 6.8 Yuan per dollar

Table 5. Production cost per Kg, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

Item	Sales prices US Dollars	Direct production cost US Dollars	Direct and family labor US Dollars	Direct, family labor and ownership costs US Dollars	Direct, family family labor ownership and capital costs US Dollars
Per cattle calf raised					
Medium Da Genpule	0.82	1.14	1.29	1.82	2.51
Large Enkebayila	0.82	1.20	1.09	1.74	2.30
Large Tumuriqulo	0.82	0.40	0.79	1.24	1.92
Very large Eridengbilge	0.82	1.64	1.78	2.09	2.63
Small Aorizhabu	0.82	0.24	0.65	1.84	2.52
Per goat kid raised					
Medium Da Genpule	0.91	0.57	0.64	0.86	1.20
Large Enkebayila	0.91	0.56	0.63	0.85	1.23
Large Tumuriqulo	0.91	0.39	0.49	0.93	1.59
Very large Eridengbilge	0.91	0.24	0.27	0.48	0.78
Small Aorizhabu	0.91	0.20	0.87	1.42	2.09
Per sheep lamb raised					
Medium Da Genpule	0.88	0.37	0.45	0.82	1.41
Large Enkebayila	0.88	0.25	0.31	0.59	1.09
Large Tumuriqulo	0.88	0.73	0.80	1.08	1.58
Very large Eridengbilge	0.88	0.28	0.33	0.55	0.97
Small Aorizhabu	0.88	0.74	1.19	2.84	4.43
Goat mohair					
Medium Da Genpule	32.35	37.71	42.20	56.90	79.25
Large Enkebayila	32.35	30.90	34.64	46.60	67.34
Large Tumuriqulo	32.35	7.98	10.13	19.16	32.83
Very large Eridengbilge	32.35	8.15	8.93	16.11	26.20
Small Aorizhabu	32.35	5.19	22.69	36.97	54.35
Sheep wool					
Medium Da Genpule	0.44	0.14	0.17	0.32	0.55
Large Enkebayila	0.44	0.11	0.13	0.25	0.47
Large Tumuriqulo	0.44	0.34	0.37	0.50	0.73
Very large Eridengbilge	0.44	0.13	0.16	0.26	0.45
Small Aorizhabu	0.44	0.36	0.57	1.37	2.14
Raw milk					
Medium Da Genpule	0.44	0.27	0.31	0.43	0.60
Large Enkebayila	0.44	0.27	0.31	0.39	0.51
Large Tumuriqulo	0.44	0.04	0.08	0.12	0.19
Very large Eridengbilge	0.44	0.10	0.11	0.13	0.16
Small Aorizhabu (2)					

(1) 6.8 Yuan per dollar

(2) No production.

Table 6. Sale prices of milk products per Kg, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

Item	Medium Da Genpule USDollars	Large Enkebayila USDollars	Large Tumuriqulo USDollars	Very large Eridengbilge USDollars	Small Aorizhabu USDollars
Year data collected	2002	2002	2002	2002	2002
Cow milk products					
Butter	2.79	2.79	2.79	2.79	2.79
Cheese	1.25	1.25	1.25	1.25	1.25
Raw milk	0.44	0.44	0.44	0.44	0.44

(1) 6.8 Yuan per dollar

Table 7. Percent breakdown of direct (cash) expenses, Hurique Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

	Medium Da Genpule	Large Enkebayila	Large Tumuriqulo	Very large Eridengbilge	Small Aorizhabu
Animals given to employees (1)	(1)	(1)	(1)	(1)	(1)
Concentrate feed, maize, grains	1.1	1.5	0.0	0.6	0.0
Animal feedstuffs from other own activities (2)	0.0	0.0	0.0	0.0	0.0
Forage	52.1	53.6	59.1	51.7	17.0
Pasture expenses (hay land)	0.0	0.0	0.0	0.0	0.0
Hay harvesting cost	0.0	0.0	0.0	0.0	0.0
Salt	0.0	0.0	0.0	0.0	0.0
Minerals	0.0	0.0	0.0	0.0	0.0
Protein Supplement	0.0	0.0	0.0	0.0	0.0
Repairs, maintaince					
Buildings (only part for business)	0.0	0.0	0.0	0.0	0.0
Fence	0.5	1.6	3.4	3.1	10.2
Vehicle repair (only part for business)	9.9	1.6	3.4	4.1	0.0
Veterinarian other medical products	1.2	1.7	3.4	4.1	0.0
Animal medicines	1.4	2.8	0.9	1.6	1.4
Gas, water, electric(only business)	0.0	0.0	0.7	0.0	0.0
Telephone (only business)	0.8	1.1	0.4	0.5	0.0
Vehicle fuel (only business)	5.5	5.6	5.1	6.2	15.3
Other fuel (only business)	0.5	0.0	1.0	0.6	15.3
Taxes, government management fee	19.2	22.0	13.5	16.5	37.4
Marketing costs					
Transportation	0.0	0.0	0.0	0.0	0.0
Brokerage, other	0.0	0.0	0.0	0.0	0.0
Insurance	0.0	0.0	3.7	6.8	0.0
Contract labor	6.2	6.4	4.1	2.5	0.0
Grazing land rental	0.0	0.0	0.0	0.0	0.0
Miscellaneous, other	1.6	2.1	1.4	1.7	3.4
Total direct costs	100.0	100.0	100.0	100.0	100.0

(1)Not shown as a cost, rather as a reduction in income because fewer animals are sold.

(2) Transfer payment to other own enterprise activities such as farming.

Table 8. Sources of income from sale and personal use, percent, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

	Medium Da Genpule Percent	Large Enkebayila Percent	Large Tumuriqulo Percent	Very large Eridengbilge Percent	Small Aorizhabu Percent
Cash income (sales)					
Animals sold	77.9	79.7	83.6	81.5	70.7
Milk products	5.3	0.0	0.0	11.7	0.0
Mohair (sold)	0.0	4.7	4.8	0.0	15.8
Wool (sold)	1.4	1.4	1.3	1.1	0.7
Total cash income	84.6	85.8	89.7	94.3	87.2
Personal use value (value in kind)					
Animals	11.1	11.2	8.8	4.4	12.8
Milk products	4.2	3.0	1.6	1.3	0.0
Mohair	0.0	0.0	0.0	0.0	0.0
Wool	0.0	0.0	0.0	0.0	0.0
Total value in kind	15.4	14.2	10.3	5.7	12.8
Combined cash income and value in kind					
Animals	89.1	90.9	92.3	85.9	83.4
Milk products	9.5	3.0	1.6	13.0	0.0
Mohair	0.0	4.7	4.8	0.0	15.8
Wool	1.4	1.4	1.3	1.1	0.7
Total combined cash and value in kind	100.0	100.0	100.0	100.0	100.0

Table 9. Annual net cash income by livestock category, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002 (1)

	Direct production cost USDollars	Direct and family labor USDollars	Direct, family labor and ownership costs USDollars	Direct, family family labor ownership and capital costs USDollars
Cattle				
Medium Da Genpule	-738	-954	-1,755	-2,786
Large Enkebayila	-653	-916	-1,306	-1,978
Large Tumuriqulo	678	265	-218	2,565
Very large Eridengbilge	-1,906	-2,401	-3,597	-5,624
Small Aorizhabu	88	-52	-153	-254
Goats				
Medium Da Genpule	381	234	-246	-976
Large Enkebayila	536	389	-79	-892
Large Tumuriqulo	1,336	1,212	688	-456
Very large Eridengbilge	5,863	5,691	4,120	1,909
Small Aorizhabu	819	324	-79	-570
Sheep				
Medium Da Genpule	4,801	4,192	1,469	-2,895
Large Enkebayila	8,453	7,796	4,752	-868
Large Tumuriqulo	3,298	2,565	-456	-5,829
Very large Eridengbilge	16,068	14,960	10,248	1,032
Small Aorizhabu	244	-166	-1,678	-3,142
Total				
Medium Da Genpule	4,444	3,472	-532	-6,657
Large Enkebayila	8,336	7,269	3,367	-3,738
Large Tumuriqulo	5,312	4,042	14	-3,720
Very large Eridengbilge	20,025	18,250	10,771	-2,683
Small Aorizhabu	1,151	106	-1,910	-3,966

(1) 6.8 Yuan per dollar. The categories include co-products other than animal sales such as milk products and cashmere.

Table 10. Annual combined net cash and in-kind income by livestock category, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002 (1)

	Direct production cost USDollars	Direct and family labor USDollars	Direct, family labor and ownership costs USDollars	Direct, family family labor ownership and capital costs USDollars
Cattle				
Medium Da Genpule	-29	-246	-1,046	-2,077
Large Enkebayila	29	-235	-625	-1,297
Large Tumuriqulo	1,126	713	230	-468
Very large Eridengbilge	-1,184	-1,679	-2,875	-4,902
Small Aorizhabu	294	154	53	-48
Goats				
Medium Da Genpule	417	271	-209	-939
Large Enkebayila	590	444	-25	-837
Large Tumuriqulo	1,336	1,212	688	-105
Very large Eridengbilge	5,863	5,691	4,120	1,909
Small Aorizhabu	855	361	-43	-534
Sheep				
Medium Da Genpule	5,877	5,277	2,555	-1,810
Large Enkebayila	9,989	9,331	6,287	668
Large Tumuriqulo	4,463	3,729	709	-4,664
Very large Eridengbilge	17,418	16,310	11,598	2,382
Small Aorizhabu	297	-113	-1,625	-3,090
Total				
Medium Da Genpule	6,265	5,302	1,300	-4,826
Large Enkebayila	10,608	9,540	5,637	-1,466
Large Tumuriqulo	6,925	5,654	1,627	-5,237
Very large Eridengbilge	22,097	20,322	12,843	-611
Small Aorizhabu	1,446	402	-1,615	-3,672

(1) 6.8 Yuan per dollar

Table 11. Production cost and net income per sheep unit, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002 (1)

Item	Medium Da Genpule	Large Enkebayila	Large Tumuriqulo	Very large Eridengbilge	Small Aorizhabu
Total sheep units	631	754	757	1,628	145
	----------USDollars----------				
Direct production cost	5,647	5,488	8,706	14,233	865
Cost per sheep unit	8.95	7.28	11.50	8.74	5.97
Net cash income	4,444	8,336	5,312	20,025	1,151
Income per sheep unit	7.04	11.06	7.02	12.30	7.94
Net cash & in-kind income	6,265	10,608	6,925	22,097	1,446
Income per sheep unit	9.93	14.07	9.15	13.57	9.97

(1) 6.8 Yuan per dollar

Table 12. Calculations of opportunity cost per hour for one female and one male, and average of both, based on *estimated* alternative income, and *estimated* time spent in current operation,Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002 (1)

	Estimated monthly opportunity cost (2) US dollars	Annual opportunity cost basis (3) US dollars	Estimated hours per day per person at current operation	Estimated days per month at current operation	Estimated annual per person labor (4) hours	Calculated opportunity cost per person per hour (5) US dollars
			Herder *Estimates* at Current Residence			
Estimated opportunity value of family labor						
Females						
Medium Da Genpule	66	794	10	30	3,600	0.22
Large Enkebayila	66	794	10	30	3,600	0.22
Large Tumuriqulo	66	794	10	30	3,600	0.22
Very large Eridengbilge	66	794	10	30	3,600	0.22
Small Aorizhabu	37	441	10	30	3,600	0.12
Males						
Medium Da Genpule	66	794	9	30	3,240	0.25
Large Enkebayila	66	794	9	30	3,240	0.25
Large Tumuriqulo	66	794	9	30	3,240	0.25
Very large Eridengbilge	66	794	9	30	3,240	0.25
Small Aorizhabu	66	794	9	30	3,240	0.25
Total						
Medium Da Genpule		1,588			6,840	0.23
Large Enkebayila		1,588			6,840	0.23
Large Tumuriqulo		1,588			6,840	0.23
Very large Eridengbilge		1,588			6,840	0.23
Small Aorizhabu		1,235			6,840	0.18
			Herder *Estimates* Move to New Location			
Estimated opportunity value of family labor						
Females						
Medium Da Genpule	88	1,059	10	24	2,880	0.37
Large Enkebayila	88	1,059	10	24	2,880	0.37
Large Tumuriqulo	88	1,059	10	24	2,880	0.37
Very large Eridengbilge	88	1,059	10	24	2,880	0.37
Small Aorizhabu	37	441	10	24	2,880	0.12
Males						
Medium Da Genpule	88	1,059	9	24	2,592	0.41
Large Enkebayila	88	1,059	9	24	2,592	0.41
Large Tumuriqulo	88	1,059	9	24	2,592	0.41
Very large Eridengbilge	88	1,059	9	24	2,592	0.41
Small Aorizhabu	88	1,059	9	24	2,592	0.41
Total						
Medium Da Genpule		2,118			5,472	0.39
Large Enkebayila		2,118			5,472	0.39
Large Tumuriqulo		2,118			5,472	0.39
Very large Eridengbilge		2,118			5,472	0.39
Small Aorizhabu		1,500			5,472	0.27

(1) 6.8 Yuan per dollar.
(2) The interviewees estimated the monthly income they earn from alternative work at home or in a nearby location. in place of working at the current operation.
(3) Monthly opportunity cost times 12 months.
(4) Hours per day times days time 12 months.
(5) Annual opportunity cost divided by annual hours of work.

Table 13. Calculations of opportunity cost per hour based on *estimated* alternative income and *actual* time spent in current operation, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002 (1)

Item	Number of persons in family	Calculated opportunity cost per hour (2) US dollars	Actual annual family labor (3) hours	Annual opportunity cost income (4) US dollars
	Actual hours at current Residence			
Opportunity cost based on actual time spent				
Females				
Medium Da Genpule	2	0.66	1,195	794
Large Enkebayila	2	0.59	1,350	794
Large Tumuriqulo	2	0.70	1,137	794
Very large Eridengbilge	3	0.58	1,360	794
Small Aorizhabu	1	0.99	444	441
Males				
Medium Da Genpule	2	0.27	2,894	794
Large Enkebayila	2	0.25	3,142	794
Large Tumuriqulo	2	0.19	4,160	794
Very large Eridengbilge	3	0.13	6,017	794
Small Aorizhabu	1	0.20	4,038	794
Total family				
Medium Da Genpule	4	0.39	4,089	1,588
Large Enkebayila	4	0.35	4,492	1,588
Large Tumuriqulo	4	0.30	5,297	1,588
Very large Eridengbilge	6	0.22	7,377	1,588
Small Aorizhabu	2	0.28	4,482	1,235

(1) 6.8 Yuan per dollar.
(2) Annual income divided by hours.
(3) From Table 3.
(4) From Table 12.

Table 14. Net cash income per hour of family labor by livestock category, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

Item	Direct production cost USDollars	Direct and family labor USDollars	Direct, family labor and ownership costs USDollars	Direct, family family labor ownership and capital costs USDollars
Cattle				
Medium Da Genpule	-0.79	-1.02	-1.88	-2.99
Large Enkebayila	-0.57	-0.81	-1.15	-1.74
Large Tumuriqulo	0.38	0.15	-0.12	-0.52
Very large Eridengbilge	-0.90	-1.13	-1.69	-2.65
Small Aorizhabu	0.13	-0.08	-0.22	-0.37
Goats				
Medium Da Genpule	0.61	0.38	-0.40	-1.57
Large Enkebayila	0.86	0.63	-0.13	-1.43
Large Tumuriqulo	2.56	2.32	1.32	-0.20
Very large Eridengbilge	8.08	7.84	5.68	2.63
Small Aorizhabu	0.38	0.15	-0.04	-0.27
Sheep				
Medium Da Genpule	1.89	1.65	0.58	-1.14
Large Enkebayila	3.09	2.85	1.74	-0.32
Large Tumuriqulo	1.10	0.86	-0.15	-1.95
Very large Eridengbilge	3.55	3.30	2.26	0.23
Small Aorizhabu	0.15	-0.10	-1.00	-1.88
Total				
Medium Da Genpule	1.09	0.85	-0.13	-1.65
Large Enkebayila	1.86	1.62	0.75	-0.86
Large Tumuriqulo	1.00	0.76	0.00	-1.31
Very large Eridengbilge	2.71	2.47	1.46	-0.39
Small Aorizhabu	0.26	0.02	-0.43	-0.90

(1) 6.8 Yuan per dollar

Table 15. Net cash and in-kind income per hour of family labor by livestock category, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002

	Direct production cost USDollars	Direct and family labor USDollars	Direct, family labor and ownership costs USDollars	Direct, family family labor ownership and capital costs USDollars
Cattle				
Medium Da Genpule	-0.03	-0.26	-1.12	-2.23
Large Enkebayila	0.03	-0.21	-0.55	-1.14
Large Tumuriqulo	0.63	0.40	0.13	-0.27
Very large Eridengbilge	-0.56	-0.79	-1.35	-2.31
Small Aorizhabu	0.43	0.23	0.08	-0.07
Goats				
Medium Da Genpule	0.67	0.44	-0.34	-1.51
Large Enkebayila	0.95	0.71	-0.04	-1.35
Large Tumuriqulo	2.56	2.32	1.32	-0.20
Very large Eridengbilge	8.08	7.84	5.68	2.63
Small Aorizhabu	0.40	0.17	-0.02	-0.25
Sheep				
Medium Da Genpule	2.32	2.08	1.01	-0.71
Large Enkebayila	3.65	3.41	2.30	0.24
Large Tumuriqulo	1.49	1.25	0.24	-1.56
Very large Eridengbilge	3.85	3.60	2.56	0.53
Small Aorizhabu	0.18	-0.07	-0.97	-1.85
Total				
Medium Da Genpule	1.53	1.30	0.32	-1.20
Large Enkebayila	2.36	2.12	1.25	-0.35
Large Tumuriqulo	1.31	1.07	0.31	-1.01
Very large Eridengbilge	2.99	2.75	1.74	-0.11
Small Aorizhabu	0.32	0.09	-0.36	-0.84

(1) 6.8 Yuan per dollar

Table 16. Summary, family opportunity cost and net income, Hurqige Gacha, Dongwuzhumuqi Banner, Inner Mongolia, China, 2002 (1)

Item	Medium Da Genpule US Dollars	Large Enkebayila US Dollars	Large Tumuriqulo US Dollars	Very large Eridengbilge US Dollars	Small Aorizhabu US Dollars
		Opportunity cost calculations (2)			
Current location based on actual hours worked (2)					
Total income	1,588	1,588	1,588	1,588	1,235
Total hours worked	4,089	4,492	5,297	7,377	4,482
Hourly income	0.39	0.35	0.30	0.22	0.28
Move to new location (3)					
Total income	2,118	2,118	2,118	2,118	1,500
Total hours worked	5,472	5,472	5,472	5,472	5,472
Hourly income	0.39	0.39	0.39	0.39	0.27
		Economic Analysis of Current Operation			
Net cash income above (4)					
Direct costs	4,444	8,336	5,312	20,025	1,151
Direct plus family labor	3,472	7,269	4,042	18,250	106
Net cash and in-kind income above (5)					
Direct costs	6,265	10,608	6,925	22,097	1,446
Direct plus family labor	5,302	9,540	5,654	20,322	402
Net cash income per hour above (6)					
Direct costs	1.09	1.86	1.00	2.71	0.26
Direct plus family labor	0.85	1.62	0.76	2.47	0.02
Net cash and in-kind income per hour above (7)					
Direct costs	1.53	2.36	1.31	2.99	0.32
Direct plus family labor	1.30	2.12	1.07	2.75	0.09

(1) 6.8 Yuan per dollar.
(2) Table 13.
(3) Table 12.
(4) Table 9.
(5) Table 10.
(6) Table 14.
(7) Table 15.

Table 17. Production cost and net income per sheep unit in US dollars, nine grassland case studies, China, 2001-2005 (1)

	Small Northeast Inner Mongolia (2)	Small Aorizhabu Inner Mongolia (3)	Northwest Xinjiang (4)	Medium Da Genpule Inner Mongolia	Large Northeast Inner Mongolia	Large Enkebayila Inner Mongolia	Large Tumuriqulo Inner Mongolia	Qinghai Plateau	Very large Eridengbilge Inner Mongolia	Correla-tion with sheep units
Sheep units	144	145	483	631	745	754	757	1301	1,628	
Direct production cost	1,471	865	677	5,647	8,271	5,488	8,706	949	14,233	0.64
Per sheep unit	10.22	5.97	1.40	8.95	11.10	7.28	11.50	0.73	8.74	-0.12
Net cash income income above										
Direct costs	913	1,151	5,878	4,444	11,843	8,336	5,312	11,225	20,025	0.92
Direct & family labor	203	1,446	4,602	6,265	10,164	10,608	6,925	10,694	22,097	0.94
Per sheep unit above										
Direct costs	6.34	7.94	12.17	7.04	15.90	11.06	7.02	8.63	12.30	0.35
Direct & family labor	1.41	9.97	9.53	9.93	13.64	14.07	9.15	8.22	13.57	0.50
Net cash and in-kind income above										
Direct costs	1,047	1,446	8,169	6,265	12,936	10,608	6,925	12,937	22,097	0.93
Direct & family labor	338	402	6,893	5,302	11,257	9,540	5,654	12,406	20,322	0.95
Net cash income per hour for family above										
Direct costs	0.47	0.26	0.72	1.09	1.98	1.86	1.00	1.18	2.71	0.80
Direct & family labor	0.10	0.02	0.56	0.85	1.70	1.62	0.76	1.13	2.47	0.85
Net cash and in-kind income per hour for family above										
Direct costs	0.54	0.32	1.00	1.53	2.17	2.36	1.31	1.36	2.99	0.79
Direct & family labor	0.17	0.09	0.85	1.30	1.88	2.12	1.07	1.31	2.75	0.83
Opportunity cost, family										
Total income (5)										
Current operation	708	1,063	1,085	986	1,684	1,083	1,290	512	1,083	
Move to new location	1,752	1,500	1,500	2,118	1,944	2,118	2,118	504	2,118	
Income per hour										
Current operation	0.36	0.24	0.13	0.24	0.28	0.24	0.24	0.05	0.24	
Move to new location	0.33	0.27	0.27	0.39	0.46	0.39	0.39	0.09	0.39	

(1) 6.8 Yuan per dollar.
(2) 9 cattle, 25 goats.
(3) 1 cattle, 36 goats, 35 sheep, 13 horses.
(4) 14 cattle, 22 goats, 145 sheep, 11 horses.
(5) Income only is calculated because the family only works as labor for another enterprise.

Table 18. Economic analysis of three grassland case study herder families considered for migration, China, 2001-2005 (1)

	Small Northeast Inner Mongolia (2)	Small Aorizhabu Inner Mongolia (3)	Northwest Xinjiang (4)
Sheep units	144	145	483
	----------$US----------		
Economic analysis of net cash and in-kind income per family above			
Direct costs	1,047	1,446	8,169
Direct & family labor	338	402	6,893
Opportunity cost, family			
Total income (5)			
Current operation	708	1,063	1,085
Move to new location	1,752	1,500	1,500
	----------$US per hour----------		
Economic analysis of net cash and in-kind income per family above			
Direct costs	0.54	0.32	1.00
Direct & family labor	0.17	0.09	0.85
Opportunity cost income per family, above (5)			
Current operation	0.36	0.24	0.13
Move to new location	0.33	0.27	0.27

(1) 6.8 Yuan per dollar.
(2) 9 cattle, 25 goats.
(3) 1 cattle, 36 goats, 35 sheep, 13 horses.
(4) 14 cattle, 22 goats, 145 sheep, 11 horses.
(5) Income only is calculated because the family only works as labor for another enterprise.

Table 19. Family labor use by gender, nine case studies, China, 2001-2005

Item	Units	Total	Cattle	Goats	Sheep	Yaks
Annual time spent						
Females as a percent of males						
Northwest, Xinjiang (1)	Percent	81	251	106	60	
Qinghai Plateau (2)	Percent	154	481			132
Central North Inner Mongolia (3)	Percent	41	111	60	23	
Central North Inner Mongolia (4)	Percent	43	118	60	22	
Central North Inner Mongolia (5)	Percent	27	125	39	0	
Central North Inner Mongolia (6)	Percent	23	99	51	1	
Central North Inner Mongolia (7)	Percent	11	49	11	0	
Northeast Inner Mongolia (8)	Percent	29	71	36	13	
Northeast Inner Mongolia (9)	Percent	167	176	159		
Time use by type of animal species						
Females as a percent of males						
Northwest, Xinjiang (1)	Percent	100	25	15	60	
Qinghai Plateau (2)	Percent	100	20			80
Central North Inner Mongolia (3)	Percent	100	41	20	39	
Central North Inner Mongolia (4)	Percent	100	46	17	37	
Central North Inner Mongolia (5)	Percent	100	87	13	0	
Central North Inner Mongolia (6)	Percent	100	78	18	4	
Central North Inner Mongolia (7)	Percent	100	51	49	0	
Northeast Inner Mongolia (8)	Percent	100	49	24	27	
Northeast Inner Mongolia (9)	Percent	100	52	48		

(1) Nomadic, Medium size, Altar area, Xinjiang Province.
(2) Do Bo, Settled, Medium size, Hongyuan, Sichuan Province
(3) Da Genpule, Semi-nomadic Medium size, Xilinguole League, Hurqige Gacha, inner Mongolia.
(4) Enkebayila, Semi-nomadic, Large size, Xilinguole League, Hurqige Gacha, inner Mongolia.
(5)Tumuriqulo, Semi-nomadic Large size, Xilinguole League, Hurqige Gacha, inner Mongolia.
(6) Eridengbilge, Semi-nomadic Very Large size, Xilinguole League, Hurqige Gacha, inner Mongolia.
(7) Aorizhabu, Semi-nomadic,Small size, Xilinguole League, Hurqige Gacha, inner Mongolia.
(8) Dao Bu Chen, Semi-nomadic, Medium size, Wu Bu Lin Sumu, Inner Mongolia.
(9) Bao Shan, Settled, Small Size, Mang Lai Gacha, Inner Mongolia.

Endnotes

[i] Li Ou and Ma Rong are particularly well prepared to chronicle the events as Li Ou spent 10 years in the case study site during the Cultural Revolution (1966-1976) and Ma Rong was there for 8 years.

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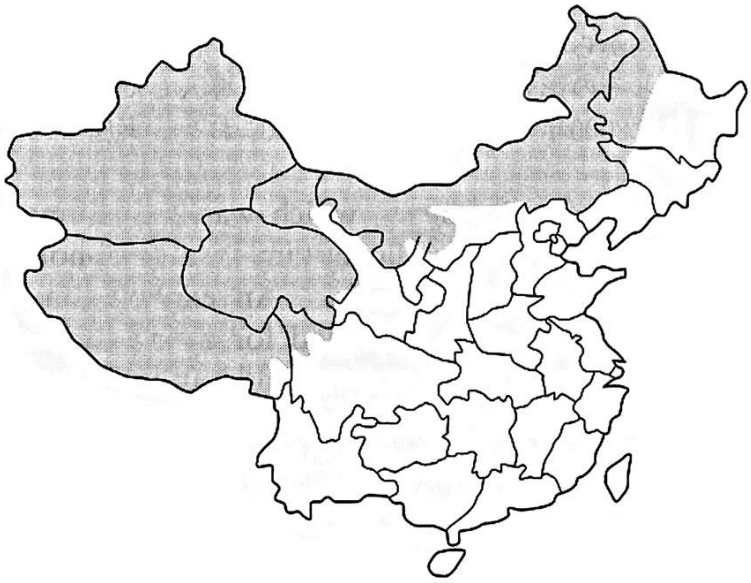
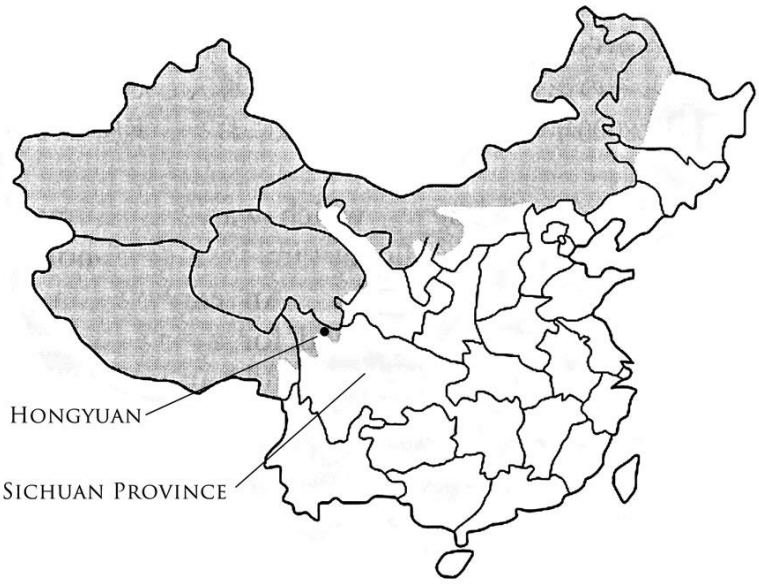
Maps

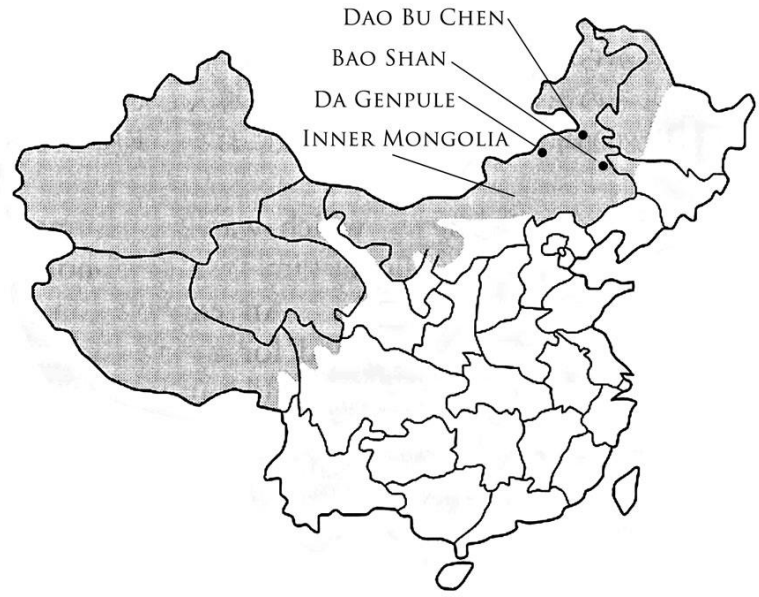


MAP 1. PASTORAL AREA OF CHINA

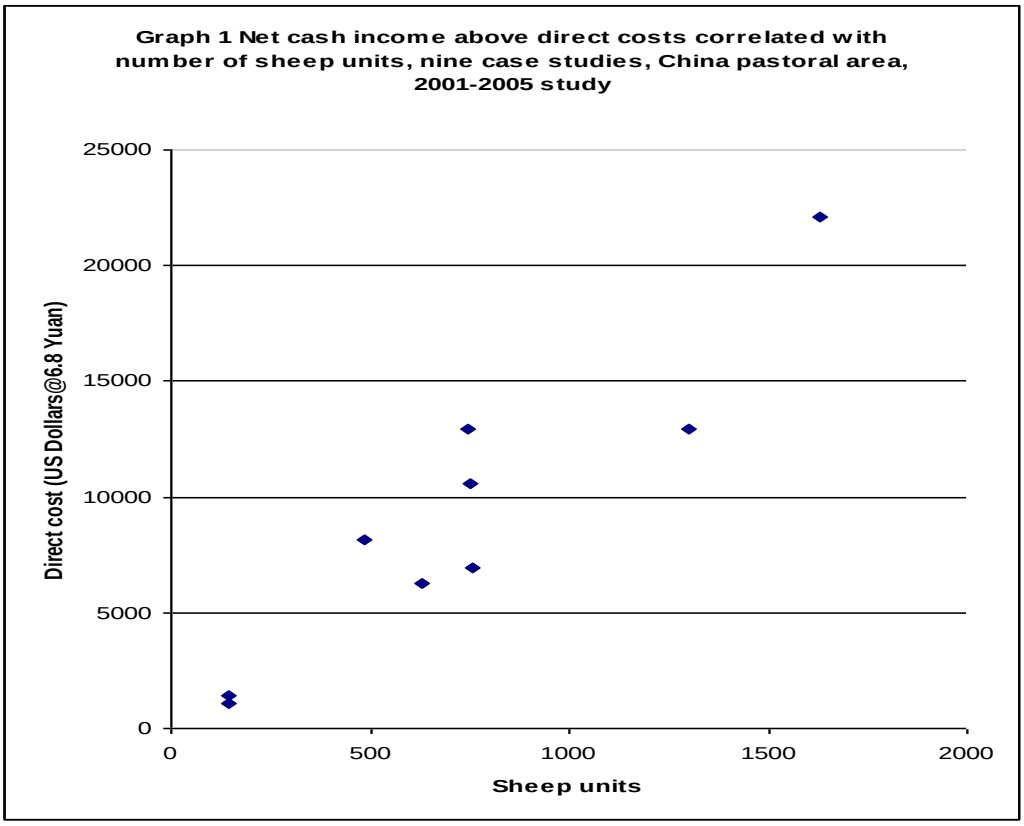
MAP 2. PROJECT AREA, NOMADIC PASTORALISTS IN THE EXTREME NORTH-WEST OF CHINA



MAP 3. PROJECT AREA, QINGHAI PLATEAU, SICHUAN PROVINCE, CHINA



MAP 4. THREE INNER MONGOLIA, CHINA CASE STUDIES


Graph 1 Net cash income above direct costs correlated with number of sheep units, nine case studies, China pastoral area, 2001-2005 study
Direct cost (US Dollars@6.8 Yuan)
25000
20000
15000
10000
5000
0
0
500
1000
1500
2000
Sheep units

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Ou Li holds a PhD in Agricultural Economics from Nanjing Agricultural University. He is Professor Emeritus, China Agricultural University (former Beijing Agricultural University), in P.R. China. Dr. Li Ou is a competent and prominent professional in the research, training/teaching, project development and consulting on sustainable development of rural and pastoral areas. He has consulted widely to an extensive number of international development organizations such as the World Bank. Well known as a prominent leader in development of the Participatory Rural Development (PRA) method, he has worked abroad in countries such as Indonesia, Japan, Mongolia, the Netherlands, USA, and UK, in addition to almost all the provinces of China.

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