

# **Economic and Institutional Structural Analysis of Semi-Nomadic Pastoralists in the Extreme Northwest of China**

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## **Abstract**

The objective of the research reported on in this article was to develop and utilize a computer program to determine production cost of livestock in China's pastoral area. The program utilized is quite complex, including about 315 variables and 800 parameters. This diagnostic tool was utilized to analyze semi-nomadic pastoralist's livestock production in the extreme northwest of China. The program was found to be quite versatile and served its purpose well. It was determined that women may work more than men, as their total livestock related hours alone are 81 percent of men. It was found that net family income amounted to 5.0 Yuan per hour if only direct (cash) costs are taken into account. The net income drops to 3.9 Yuan per hour if family labor cost (using an opportunity cost method) is included. In contrast, comparable laborers in a Xinjiang city would earn 2-4 Yuan per hour. An analysis of land use revealed that pastures are about 30 percent overgrazed, a finding that is consistent with reports for the grasslands as a whole in China. Suggestions about alleviating the land degradation problem based on a participatory rural appraisal method utilized in as part of the research in herder settled areas are also provided.

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## **Problem and Objectives**

China's economy has traditionally been divided into three zones or geo-geographic regions: East, Central and West. There are considerable differences between them in terms of labor productivity, income and other social and economic indicators. The west is the poorest region and has become a focus of current regional development policy. Much of this region, and also the northern part of the Central region—including Inner Mongolia which has recently been designated part of the Western Region by the central government due to its socio-economic features—is grassland. Roughly half of China is designated as pastoral and grassland. The grasslands *per se* are immense, accounting for about 30 percent of the nation's total area. About 2.4 million km<sup>2</sup>, or 85 percent of China's grassland and pastures, are in the temperate climatic zone. The prevalence of grassland in the region, low agricultural productivity of it, and general lack of water and other natural resources, are reasons for economic disparity between the three regions. One problem facing planners and development strategists is what to do about the grasslands, and that problem is the focus of the research reported on in this article.

Historically, the major production system in the grasslands has been nomadic animal management, with a small proportion of the population being semi-nomadic. There has been a major emphasis on settlement of herders into houses, i.e. an ever-increasing semi-nomadic or sedentary lifestyle. Herders have realized the negative impact of sedentarization on their grassland resources, but rapid population growth, strong desire to maintain cultural heritage, lack of opportunities for migration to urban areas, and lack of knowledge about technical and economic aspects of management alternatives have been a stumbling block to them. On the macro side, there is very little information available in a manner that is useful to international agencies and Chinese government officials for project and policy making on the grasslands.

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 the so-called "pastoral problem" of overgrazing, land degradation and relatively low animal offtake rates. However, there are a number of viable, logical interventions that could result in considerable improvement in productivity, income, and range rejuvenation. The problem, and the subject of this article, is to (1) provide information on a diagnostic tool developed to evaluate rangeland use from a holistic perspective of technical ecological factors, economics, and sociological factors on affected groups, and (2) results from using it in Xinjiang province, China.

An explanation of the computer program as the diagnostic tool used and results, particularly as they relate to ecology, production costs, income and labor use are included. Much of this information is useful in relation to settlement of pastoralists. Due to time limitations and funding constraints, only one size and type pastoral was analyzed.

Overall, the combination of fieldwork level research reported on in this article provides the basis for developing an economic and social profile of livestock households in the western grasslands. It can be linked to regional and national level analyses, and the quantitative as well as qualitative input data and results provide information that can be used to recommend interventions and policy-making alternatives.

### **Project Area**

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

Despite the large size of Xinjiang province, only about 3 percent of China's 124 million cattle is found in it. However, the province has 11 percent of China's horses and 13

percent of its donkeys, attesting to their importance in this primarily rural society. The province is known as the land of sheep, and indeed it is for 23 percent of all of the nations total are in the province. However, just 3 percent of goats are found there. There are about 130 million sheep in China, and there are about 140 million goats. Only four-tenths of all pigs are in Xinjiang.

The pastoralists where fieldwork was concentrated are semi-nomadic and located northwest of Altay (also spelled Altai) in the extreme northwestern area of the country and of Xinjiang province. Altay is 922m above sea level and is quite cold. It is even quite chilly in summer. The pastoralists live at an even higher elevation. Altay is small with a mere 170,000 residents of which about 60 percent are Han Chinese. The rest are mainly Kazakhs and this minority group was the dominant one where the field work among the pastoralists took place almost on the border of Kazakhstan, Russia and Mongolia (Figure 1). The fieldwork site was absolutely stunning, mountainous with heavy stands of evergreen trees, and rushing rivers.

### **Computer Program**

The computer program, “Grassland Cow-calf, Goat and Sheep Program Version 8,” prepared by Simpson, is designed to evaluate production and management alternatives. It is a fully integrated model that includes technical production analysis, economics of production, ecological impacts of animal stocking rates, and gender oriented labor use. It was developed in 2001 prior to visiting the research site in Xinjiang Province, and was modeled on a production systems study by the authors in Hurqige Gacha, Xilinguole League, Inner Mongolia in the summer of 2000, and on prior modeling done by Simpson in China and other countries. A unique aspect of the model is that it incorporates multiple species. To the author’s knowledge, this is the first program that incorporates all features described.

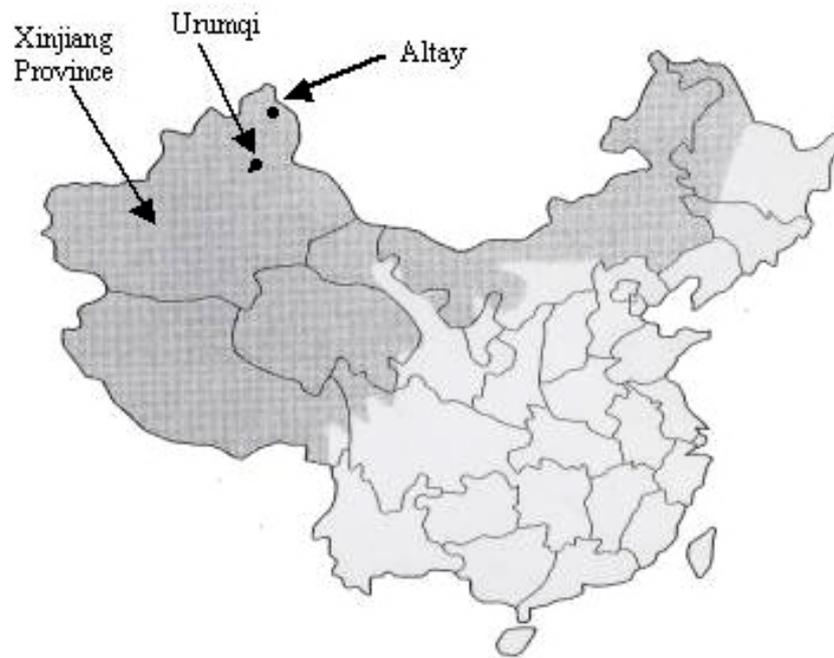


Figure 1. Pastoral area of China and project areas, 2001.

The model is very detailed and, in addition to knowledge about peculiarities of Chinese production systems, requires in-depth understanding of animal and grassland science. It was designed for use on China's grasslands, but is sufficiently flexible that it can be utilized in any range management situation in the world with little or no modification. The spreadsheet program, written as a Microsoft Windows Excel application, is quite large, including 1,700 lines. It has about 315 variables and 800 parameters.

The program was designed as an interactive diagnostic tool with data gathered through in-depth interviews with producers and/or other knowledgeable individuals. It is stressed that the program is a diagnostic tool, and not a survey instrument (in the general sense that the term is used). Rather, the objective is to use it as a vehicle to gather information on what is happening in the area, why it is taking place, what can be done to change management systems for the good of the individual and society, and analysis of alternative management strategies by individual producers or groups of them.

Four to six hours are required for one household interview in a new area or management system depending on language capabilities, sophistication level of interviewees, record-keeping, interviewers skill and experience, etc. The study reported on in this article was particularly difficult as none of the authors spoke Kazak, the local language. The main interpreter was a native Kazak speaker in addition to Chinese, but Simpson could only speak English and thus had to rely on the other team members who are native Chinese.

Experience in using the model reveals it is useful to have several producers or officials familiar with the area present at the interview that stimulates discussion and acts as a good check on accuracy of responses. Interview time has been found to decrease dramatically in a new area after the first few interviews especially if several producers and/or officials, all of whom will be interviewed, are together. In addition, there are numerous parameters such as input costs and sale prices common to one area. Once the validity of them is ascertained, they can be used for all interviews simply by checking to see if they are correct. A substantial portion of the parameters in one area are the same and thus once they are collected the interview process is speeded up. This is particularly true among a group such as semi-nomads. The use of a quantitative tool such as this program has been shown to be a very efficient method of gathering qualitative information along with quantitative data, and sufficient time should be allowed so that producer's opinions can be solicited and discussion utilized. It has also been found much more beneficial to assure that accurate data be collected on a small number of producers, rather than attempting to obtain numerous interviews.

### **Herder Profile and Interview Results**

The interviews were carried out in August 2001. The target livestock producers were mid-size pastoralists residing northeast of Altar, Xinjiang Province, China on the triangular border with Kazakhstan, Russia and Mongolia. They change pasture types with the seasons but have a base camp and are bound together in a "village" of 74 households. Groups of

households will generally move together, often traveling 50-100 km between seasonal pastures. They move several times inside a seasonal pasture as the forage in the immediate area is used up. The pastoralists surveyed live in yurts all year, a typical practice in the area.

The area covered is extensive and difficult to travel in. Consequently, because of time limitations, and because livestock and grassland specialists with substantial experience were readily available in Altai, most data for an initial, basic model was gathered from officials in the provincial ministry of agriculture. These individuals were found to be very knowledgeable, and were determined to have collected data on different size operations in different parts of the area. They also had difficult-to-obtain census results. The data gathered from these individuals was then checked by a site visit and interviews with individual producers. The local field livestock officer responsible for the area acted as the guide a livestock officer from Altai was the translator. The base for the “village” is quite remote, and it took about 5 hours to drive there from Altai. Another day was needed to reach the herders, many of who were engaged in moving from the summer pasture to the fall pasture. A total of five days was spent in the Altai area. Naturally, a much longer time would be necessary to really understand intricacies and peculiarities of different groups, and especially to develop models for small and large size producers, but it was not possible due to funding limitations.

Selected production data for the typical mid-size semi-nomadic herder modeled is given in Table 1. The “typical” pastoralist modeled in the area owns 14 mature cattle, 23 mature goats and 150 mature sheep. The cattle are weaned from their mothers at eight months of age and then sold or, if needed as replacements for cull cows, enter the herd at 19 months of age. Goats are weaned at two months of age and sold at six months. Sheep are weaned at two months of age and are either sold or enter the herd at six months of age. Some of the animals are slaughtered for personal use during the year and some are given to contract workers in the hay producing areas or for helping with lambing and kidding. The typical household sells one head of mature cattle annually, three mature goats and mature 22 sheep.

In addition they sell 10 calves, 18 young goats and 116 young sheep. All of the cows are intended primarily to produce milk for household use although cash revenue is derived from sale of calves.

Table 1. Production data input for middle size semi-nomadic herders, Altai area of Xinjiang Province, China, 2001.

Item	Units	Camels and horses	Cattle	Goats	Sheep
Inventory, beginning					
Mature females	Head		14	22	145
Breeding males	Head		0	1	5
Total matures	Head		14	23	150
Age at:					
Weaning	Months		8.0	2.0	2.0
End of growing season	Months		13.5	5.0	5.0
End of fattening phase	Months		19.0	6.0	6.0
Progeny per year					
Number born	Head		12	25	145
Number weaned	Head		12	25	143
Number end of growing phase	Head		12	25	143
Number end of fattening or sale	Head		12	25	143
Sales					
Growing (phase 2)	Head		0	0	0
Fattening (phase 3)	Head		10	18	116
Total progeny	Head		10	18	116
Cull females	Head		1	3	21
Cull males	Head		0	0	1
Total matures	Head		1	3	22
Cows for milk	Head		14		
Cows for beef calves	Head		0		
Camels	Head	7			
Horses	Head	11			
Total annual mohair & fine wool production					
Mature females	KG			9	15
Breeding males	KG			1	1
Growing phase	KG			0	0
Fattening phase	KG			0	11
Total production	KG			9	26
Total annual coarse wool production					
Mature females	KG			0	276
Breeding males	KG			0	12
Growing phase	KG			0	0
Fattening phase	KG			0	204
Total production	KG			0	491

A typical household has seven camels. This number is determined by the need to transport their household effects and yurt (which is dismantled for the move) during the many intra and inter seasonal moves. The typical mid-size household also has 11 horses, most of which are used in their herder activities or in moving.

Mohair and wool production are the primary source of income. The 23 mature goats produce nine kilograms of mohair annually. The 150 mature sheep provide 26 kilograms of fine wool and 491 kg of coarse wool.

Pasture use is found in Table 2. The first step in the interview process it is to develop a seasonal pasture use calendar. For example, it was found there are four main pastures; spring, summer, fall and winter. Spring pastures in the Altar area are used for 2.5 months, from April 1 to June 15, and summer pasture for 3 months, from June 15 to September 15. Fall pastures are divided into early and late ones for a total of 2 months from September 15 to November 15. Winter pasture is the longest, from November 15 to March 31.

Table 2. Pasture use by middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Season	Seasonal pasture use calendar		
	Days	Months	Approximate dates
Spring	76	2.5	APRIL 1 TO JUNE 15
Calving, kidding and lambing	45		APRIL 1 TO MAY 15
Other	31		MAY 15 TO JUNE 15
Summer	92	3.0	JUNE 15 TO SEPTEMBER 15
Fall	61	2.0	SEPTEMBER 15 TO NOVEMBER 15
Early	31		SEPTEMBER 16 TO OCTOBER 15
Late	30		OCTOBER 15 TO NOVEMBER 15
Winter	136	4.5	NOVEMBER 15 TO MARCH 31
Total	365	12.0	

Item	Optimal and actual amount of land used per sheep unit by season				
	Spring	Summer	Fall	Winter	Total
Optimal Mu per one sheep unit	11.64	2.16	11.64	11.76	
Optimal sheep unit months (sum)	1,073	1,400	861	1,901	5,236
Actual sheep unit months (sum)	1,416	1,714	1,136	2,533	6,799
Actual over optimal sheep unit months	343	314	275	633	1,564
Percent overgrazing	32	22	32	33	30

Table 2 also includes an analysis of the optimal and actual amount of land used per sheep unit. Animals are of various sizes and their grazing has varying effects on ecology and environment of the land. Consequently, a series of conversion factors have been developed and are used worldwide for the relationships. A common denominator used in North-west China is the sheep unit in which 7 sheep are equivalent to one camel, 6 equal one horse, 5 equal one cow, and one goat equals 0.8 sheep.

The optimal amount of land required for one sheep was gathered through interviews with officials and producers. Computer calculations based on production data were used to obtain actual use. It was found that there was significant overuse of the pastures. The typical producer, for example, uses pastures an equivalent of 6,799 sheep unit months, while the optimal amount was 5,236 sheep unit months. This means that, on the whole for all pastures, they were overgrazed by 30 percent. 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 the area indicate the range is at least 30 percent overgrazed. That is consistent with the rangelands in most of China. Moreover, if the optimal were considered from the viewpoint of many years ago, which is a measure of pasture potential for both China as a whole and the study site, the pastures are at least 40 to 60 percent overgrazed, and the land is seriously degraded.

Analysis of family labor use by gender and season by these mid-size semi-nomadic herders in the Altar area reveal that females play a very important role in the production process (Table 3). For example, the total amount of time spent per household by females in one year was 3,647 hours. In contrast, males spent 4,502 hours, only 23 percent more than the females. Males carry out most of the herding work during the day. Females assist during the production periods such as calving, lambing and kidding, but most of their time is spent on night guard duty. Sheep and goats are brought near the yurt each evening and someone has to periodically watch over them at night because there is no corral or fenced area to contain them. Apart from concern about animals straying away, there is the ever-present danger of attack by wild animals. Night watch is a very important part of the production process.

Table 3. Family labor use by gender and season by middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Cattle	Goats	Sheep	Total
Time spent by gender					
Females					
Spring	Hours	456	380	1,672	2,508
Summer	Hours	276	92	276	644
Fall	Hours	183	61	183	427
Winter	Hours	0	14	54	68
Total	Hours	915	547	2,185	3,647
Males					
Spring	Hours	76	228	1,444	1,748
Summer	Hours	92	92	736	920
Fall	Hours	61	61	488	610
Winter	Hours	136	136	952	1,224
Total	Hours	365	517	3,620	4,502
Whole year total	Hours	1,280	1,064	5,805	8,149
Females as a percent of males					
Spring	Percent	600	167	116	143
Summer	Percent	300	100	38	70
Fall	Percent	300	100	38	70
Winter	Percent	0	10	6	6
Total	Percent	251	106	60	81
Time use by type of animal species					
Females					
Spring	Percent	18	15	67	100
Summer	Percent	43	14	43	100
Fall	Percent	43	14	43	100
Winter	Percent	0	20	80	100
Total	Percent	25	15	60	100
Males					
Spring	Percent	4	13	83	100
Summer	Percent	10	10	80	100
Fall	Percent	10	10	80	100
Winter	Percent	11	11	78	100
Total	Percent	8	11	80	100
Whole year total	Percent	16	13	71	100

Most of the female work, 60 percent for the whole year, is carried out for sheep, which stands to reason since sheep are the largest number of animals. Most of their work takes place during the winter, as they must have extensive hours of guard duty, and in the spring, when they're working on peak production activities.

The value of family labor was determined using the opportunity cost method (Table 4). Officials and herders were asked to provide estimates of income they could make in an alternative enterprise or job. In some cases, the individuals based their estimates on work that they could do if they were in the city or an urban area, and in other cases, females in particular, on alternative work such as sewing or preparing clothing for other individuals, preparing handicrafts, working for other herders etc. It was found that on a monthly basis, females estimated their opportunity cost to be 200 Yuan. Males estimated it at 300 Yuan per month. An hourly rate was determined by asking producers about the time worked per day,

which turned out to be 10 hours. Twenty-four days per month were used to finally determine that hourly rate. The calculated hourly rate to determine family labor cost per year was 0.83 Yuan per female and 1.25 Yuan for males. From that it annual family labor cost for males and females was calculated.

Table 4. Opportunity cost of family labor use by middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Cost				
<u>Estimated opportunity cost of family labor</u>						
Monthly basis						
Females	Yuan	200				
Males	Yuan	300				
Annual basis						
Females	Yuan	2,400				
Males	Yuan	3,600				
Hours per day to get hourly rate						
Females	Yuan	10				
Males	Yuan	10				
Days per month to get hourly rate						
Females	Yuan	24				
Males	Yuan	24				
Calculated hourly rate used to determine family labor cost per year						
Females	Yuan	0.83				
Males	Yuan	1.25				
			<u>Cattle</u>	<u>Goats</u>	<u>Sheep</u>	<u>Total</u>
Calculated family labor cost per year						
Females	Yuan		3,039	763	456	1,821
Males	Yuan		5,628	456	646	4,525
Total	Yuan		8,667	1,219	1,102	6,346

Detailed interviews were carried out to determine the direct cost by herders for items like purchased concentrate feed, medicines and salt or minerals. The computer program is designed for all types of rangeland and grassland situations including high-income developed country situations. Consequently, because these nomadic herders use very few purchased inputs, very few of the categories actually applied to them. It was found that 72 percent of direct cost (essentially meaning cash costs) was for animal medicines (Table 5). The next significant categories were purchased forage at 6 percent, and concentrate feed, hay harvesting cost and miscellaneous each at 4 percent.

There are 4 categories of annual cost provided by the computer program as shown in Table 6. The first and most basic is direct production cost, in effect out-of-pocket or cash costs. The second includes family labor in addition to direct costs. The third has ownership

cost such as depreciation on buildings and machinery added on to the first two. The fourth category adds in capital costs, which are the opportunity cost producers incur by investing their money in their own production unit rather than putting it into an alternative use such as a bank or some other investment.

Table 5. Direct (cash) annual cost by for middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Total	Cattle	Goats	Sheep
Animals given to employees	Percent	Not shown as a cost, rather as a reduction in income			
Concentrate feed	Percent	4.2	10.7	10.1	1.9
Forage	Percent	6.5	16.4	15.6	3.0
Pasture expenses (hay land)	Percent	0.0	0.0	0.0	0.0
Hay harvesting cost	Percent	4.3	10.2	2.5	3.6
Salt	Percent	4.3	10.2	2.5	3.6
Minerals	Percent	0.0	0.0	0.0	0.0
Protein Supplement	Percent	0.0	0.0	0.0	0.0
Repairs, maintenance	Percent	0.0	0.0	0.0	0.0
Buildings	Percent	0.0	0.0	0.0	0.0
Fence	Percent	2.2	5.1	1.2	1.8
Vehicle repair (only part for business)	Percent	0.0	0.0	0.0	0.0
Veterinarian	Percent	0.0	0.0	0.0	0.0
Animal medicines	Percent	71.9	32.2	64.4	80.5
Gas, water, electric (only business)	Percent	0.0	0.0	0.0	0.0
Telephone (only business)	Percent	0.0	0.0	0.0	0.0
Vehicle fuel (only business)	Percent	0.0	0.0	0.0	0.0
Other fuel (only business)	Percent	0.0	0.0	0.0	0.0
Taxes, government management fee	Percent	2.2	5.1	1.2	1.8
Marketing costs	Percent	0.0	0.0	0.0	0.0
Transportation	Percent	0.0	0.0	0.0	0.0
Brokerage, other	Percent	0.0	0.0	0.0	0.0
Insurance	Percent	0.0	0.0	0.0	0.0
Miscellaneous, other	Percent	4.3	10.2	2.5	3.6
Total	Percent	100.0	100.0	100.0	100.0

Table 6. Annual costs based on cost type by middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Total	Cattle	Goats	Sheep
Direct production cost	Yuan	4,605	609	643	3,353
Direct and family labor	Yuan	13,272	1,828	1,745	9,699
Direct, family labor and ownership costs	Yuan	14,386	2,173	1,834	10,379
Direct, family labor, ownership, and capital costs	Yuan	24,191	4,816	2,644	16,732

The direct annual production cost is 4,605 Yuan (Table 6). Family labor is a significant cost, raising the total to 13,272 Yuan, which is 2.9 times the direct cost (Table 7). When ownership costs are included, the total rises to 3.1 times direct cost, and adding in capital costs makes the total 5.3 times direct cost. Capital costs are quite high because herdsman have a large investment in camels and horses as well as cattle, goats and sheep.

The cost of production for each of the four categories is given in Table 8. The direct cost per kg is 0.2 Yuan for young cattle sold, 0.6 Yuan for goat progeny and 0.9 Yuan for

sheep progeny. In contrast, the sale prices (shown at the bottom of the table) are 3.1, 5.4 and 7.5 Yuan per kg. Allocating costs between species as well as between commodities derived cost per kg. Three options are available for allocation between species, with the one chosen being sheep units. Two options are available for allocating costs between progeny and commodities produced (milk, mohair and wool). The one chosen was that the producers decide the allocation. Prices in all cases were significantly above costs even when family labor and capital costs are included. For example, except for milk, the cost of mohair production was calculated to be 171 Yuan while the sale price was 300 Yuan per kg.

Table 7. Ratio, other to direct production cost for middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Total	Cattle	Goats	Sheep
Direct and family labor	Ratio	2.9	3.0	2.7	2.9
Direct, family labor and ownership costs	Ratio	3.1	3.6	2.9	3.1
Direct, family labor, ownership, and capital costs	Ratio	5.3	7.9	4.1	5.0

Table 8. Cost per kg by commodities and cost type for middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Cattle	Goats	Sheep
<b>Animal produced</b>				
Direct production cost	Yuan	0.2	0.6	0.9
Direct and family labor	Yuan	0.7	1.7	2.7
Direct, family labor and ownership costs	Yuan	0.9	1.8	2.9
Direct, family labor, ownership, and capital costs	Yuan	1.9	2.6	4.7
<b>Milk, mohair and wool</b>				
Direct production cost	Yuan	0.002	41.5	0.1
Direct and family labor	Yuan	0.005	112.6	0.4
Direct, family labor and ownership costs	Yuan	0.006	118.3	0.4
Direct, family labor, ownership, and capital costs	Yuan	0.014	170.6	0.6
<b>Prices used in the analysis, per kg</b>				
Progeny (average)	Yuan	3.1	5.4	7.5
Milk	Yuan	0.8		
Mohair/fine wool	Yuan		300.0	6.0
Coarse wool	Yuan			2.0

Income is divided into two parts, cash income and income in kind (the value of the commodities which are consumed by the family rather than being sold). Sixty eight percent of both sources are from sales of animals, and 4 percent is value in kind from consumption of them (Table 9). Seven percent is derived from sale of mohair and wool. Three quarters of

total income from both sources is cash income. Milk accounts for 22 percent of all income, and that is value in kind.

Table 9. Annual income based on commodities for middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Total	Cattle	Goats	Sheep
<b>Cash income</b>					
Animal sales	Percent	67.9	36.9	44.4	94.2
Milk	Percent	0.0	0.0	0.0	0.0
Mohair or wool	Percent	6.5	0.0	47.2	3.5
Other	Percent	0.0	0.0	0.0	0.0
Total cash income	Percent	74.4	36.9	91.5	97.7
<b>Personal use value (value in kind)</b>					
Animal sales	Percent	3.5	4.0	8.5	2.3
Milk	Percent	22.1	59.1	0.0	0.0
Other	Percent	0.0	0.0	0.0	0.0
Total value in kind	Percent	25.6	63.1	8.5	2.3
Cash and value in kind	Percent	100.0	100.0	100.0	100.0

There is considerable difference in the source of income between species. For example, cash income accounts for 37 percent of cattle income, 92 percent for goats and 98 percent for sheep (Table 9). Mohair is the main income source for goats (47 percent) while animal sales are the main source for sheep (94 percent). There is an enormous difference between the price of Mohair and wool. Mohair sold for 300 Yuan per kg while sheep fine wool was 6 Yuan and coarse wool 2 Yuan.

Annual net income is provided in Table 10. Sheep account for about 2/3 of net income, because they are the largest number of animals. Net income falls as the number of cost categories is added. For example, with direct cost set at 100 percent, adding in family labor drops net income to 79 percent of direct cost (Table 11). It falls to 76 percent with the addition of ownership costs and to 52 percent when capital costs are added in.

Table 10. Annual net income based on cost type for middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Total	Cattle	Goats	Sheep
Direct production cost	Yuan	40,603	7,791	4,772	28,040
Direct and family labor	Yuan	31,936	6,572	3,670	21,694
Direct, family labor and ownership costs	Yuan	30,822	6,227	3,581	21,014
Direct, family labor, ownership, and capital costs	Yuan	21,017	3,584	2,771	14,661

Table 11. Annual net income for middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Total	Cattle	Goats	Sheep
Direct production cost	Percent	100.0	100.0	100.0	100.0
Direct and family labor	Percent	78.7	84.4	76.9	77.4
Direct, family labor and ownership costs	Percent	75.9	79.9	75.0	74.9
Direct, family labor, ownership, and capital costs	Percent	51.8	46.0	58.1	52.3

Net income per hour of family labor is one of the most interesting, if not the most interesting item in this analysis (Table 12). It turns out that net income per hour is 5.0 Yuan if only basic production cost is taken into account. If family labor is also included it is 3.9 Yuan, and 3.8 when ownership costs are included. It is 2.6 Yuan with capital costs taken into account. It is estimated that an unskilled male working in a Xinjiang city or mid-size town would earn no more than 2-4 Yuan per hour.

Table 12. Net income per hour of family labor by middle size semi-nomadic herders, Altar area of Xinjiang Province, China, 2001.

Item	Units	Total	Cattle	Goats	Sheep
Direct production cost	Yuan	5.0	6.1	4.5	4.8
Direct and family labor	Yuan	3.9	5.1	3.5	3.7
Direct, family labor and ownership costs	Yuan	3.8	4.9	3.4	3.6
Direct, family labor, ownership, and capital costs	Yuan	2.6	2.8	2.6	2.5

### **Perspective on the Overgrazing Problem, Conclusions and Recommendations**

The overgrazing problem and associated land degradation is a very serious problem in the pastoralist's site visited. Two settlement sites were also visited and extensive interviews conducted from which it was learned that all livestock owners as well as officials recognize the problem and are very concerned about it. The difficulty is that it is a "commonality" problem, like over-fishing is in oceans and lakes. No one owns the land and thus there is a tendency to "mine" it without concern for the long term. In addition, due to heavy population growth, the area allocated to a family has diminished in size as they have been divided among children. As a consequence, the average net income in the region has decreased. Naturally,

herders are reluctant to reduce animal numbers further to improve rangeland quality even though they would benefit in the longer run.

It was determined that herders who are settled have 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. Thus there is no incentive to reduce numbers, especially since they have little contact with daily operations. In many cases, the settlements are located hundreds of km away from the allotment.

Settled pastoralists were very happy to have left the old life which all described as boring, difficult and a low quality lifestyle in which it is difficult to educate their children. It was concluded that a substantial portion would give up their grazing allotment in return for a house and farmland. It was concluded enough would participate so that a province-wide program would likely be feasible. Given the lack of funding by government for settlement programs, even though many herders would opt to not participate if they had to give up their allotment, enough would so that the program could be a success. It would then be possible to reallocate the allotment among those who remain as pastoralists, or to retire the permits and close the area to grazing until the rangeland is rejuvenated.

There was only time to visit one site and much more time is needed formulate definite conclusions. Nevertheless, the computer program was found to be very useful and it is recommended that extensive use be made of it not only in Xinjiang province, but also throughout China's pastoral areas.