The Mongolian Livestock Sector: Vital for the Economy and People, but Vulnerable to Natural Phenomena

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I Introduction

The agriculture sector is of great importance to the economy of Mongolia, and its share of the gross national product of the country exceeds 30%. In particular, the livestock sector produces more than 80% of gross agricultural product and is the only source of income for more than 34% of all households in Mongolia. However, the pastoral character of animal husbandry makes it extremely vulnerable to such natural phenomena as severe winters preceded or followed by droughts, known as *"dzud"*.

Livestock in Mongolia is considered to be part of the nation's wealth and is subject to state protection under the country's constitution. "Animal husbandry continues to be the dominant economic sector in Mongolia with daily impacts on virtually all persons in the country" (Batjargal, 2000, p.5). As a result of the large-scale privatization process that began in the early 1990s, almost all state-owned livestock has been transferred to herders, encouraging a rapid increase in the number of herds. In 1999, the number of livestock reached 33.6 million – the highest level for the past 80 years – 96.2% of which was privately owned. In 1990, privately-owned livestock accounted for only 31.9% of all livestock throughout the country (see Figure 3.1).

The initial development of the industrial sector in Mongolia began in 1934 with the establishment of processing industries, the main raw materials of which, such as meat, milk, hides and skin, wool and cashmere, originate from the livestock sector. In addition, the sector is one of the country's major sources of export earnings, in the form of raw materials, preliminary and semi-processed products, and finished goods.

The purpose of this paper is to provide the reader with information illustrating these specifics and characteristics of Mongolian animal husbandry and animal raw material-based industry.

II Livestock as the Source of the Livelihood of the Mongolian People

With an area of 1.5641 million km^2, and a population of 2.4 million, Mongolia is the most sparsely populated country in the world, having an average population density of 1.54 persons per km^2. In terms of land area, Mongolia is the 18^{th} largest country in the world and the 5^{th} largest in Asia. The climate of Mongolia is a harsh continental one with four clearly differentiated seasons.

The population of Mongolia has increased almost fourfold during the past eight decades and is now mostly young and economically active. The urban and rural populations account for 56.6% and 43.4% of the total respectively, with 55.4% of the population living in Ulaanbaatar in 2000 (NSO, 2001b). Data indicate that the share of urban population decreased by 0.5% in 2000 compared with 1989. This shift in the urban and rural population shares during this period was associated with the structural change of the country's economy from industry-dominated to being focused on agriculture, specifically livestock.

The population census of 2000 revealed that more than half of all families in Mongolia live in traditional housing in the form of *gers*. Although the number of households living in conventional housing increased by 9.5% in 2000 compared with 1989, *gers* are still a popular type of housing for rural households, 76.8% of which still live in them (Table 2.1).

Table 2.1 Selected Population Characteristics of Mongolia

	1989	2000
Population, million	2.04	2.37
Average life expectancy at birth, years	62.6	65.1
Households living in conventional housing, % of total	39.6	49.1
Households living in *gers*, % of total	60.4	50.9

Source: NSO, 2001b.

Currently, herder households account for almost 35% of all Mongolian households for which livestock is the main source of income, which is a twofold increase on 1990 levels. This trend is related to the massive privatization of state-owned livestock (by distributing them among herders free of charge using a voucher system) and a sharp decline in industrial activity during that period, thus ending the domination of industry in the Mongolian economic structure and making agriculture more prominent.

In 2000, there were 421,400 herders, constituting almost half of the country's economically active population. This is defined as all employed and some unemployed persons of working age (women: 16-55, men: 16-60) who are registered at the Employment Regulation Office, but does not include the armed forces, prisoners, pupils and students of working age. Moreover, herders account for between 70-90% of the economically active population in almost all regions except a few industrialized regions.

Along with the privatization of livestock, the government adopted a policy aimed at avoiding placing an excessive tax burden on herders, which has encouraged herders to increase the number of livestock they farm. Accordingly, while in 1990 most herder households had only up to 30 head of privately owned livestock, by 1995 this figure had doubled or tripled in most cases, and the number of herders with more than 100 head of livestock increased substantially during the 1990s. For example, the number of herder households that have more than 100 and fewer than 200 head of livestock increased from 10,700 to 59,000 in 1990 and 2000 respectively. Although there was a national average of 177 livestock per herder household in 1999, this decreased to 141 and 89 in 2000 and 2001 respectively, due to losses of livestock in consecutive *dzuds* in those years. Thus, most herder households (85.5% of the total, as of 2000) had fewer than 200 head of livestock, with the biggest share (45.7% of the total) held by households that have more than 50 but fewer than 200 head (Figure 2.1).

Based on the average productivity of a head of livestock in Mongolian conditions, a herder household with fewer than 200 head of livestock is considered poor, as this number only assures self-sufficiency. Therefore, 85.5% of Mongolian herder households are still trapped in poverty.

The main characteristics of herder households in Mongolia are presented in Table 2.2. Data indicate that only 13.4% of herder households had electricity sources (mainly in the form of low-capacity mobile generators

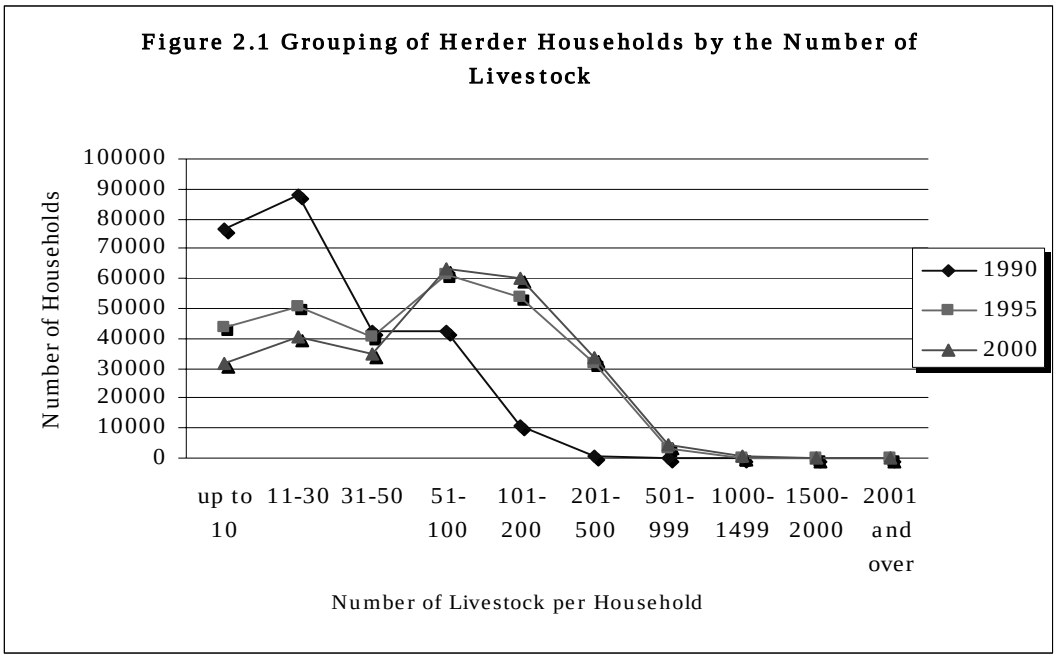
and renewable energy sources, such as solar or wind power); and 15.7% had TV sets in 2001. In addition, 9.5% and 1.5% had automobiles and tractors respectively. Motorcycles are the most popular type of motorized transport among herders in Mongolia, with 18.3% of herders possessing such transport in 2001 (Table 2.2). A survey conducted in more than 58% of all rural areas in Mongolia in the early 1990s (after the privatization of livestock), revealed that more than 60% of households had the ability and willingness to purchase modern information technology and electrical appliances. It is believed that the infrastructure of herders in the 21st century will be compatible with that of American and Australian herders today. Using modern information and communications technology, as well as the internet, Mongolian herders will be able to make direct contact with customers, cooperatives and organizations via satellite systems. By expanding the use of new energy resources (renewable sources, biogas, etc.), herder households will have sufficient electricity to engage in small-scale production at their sites (Chadraa, 2000).

Therefore, in order to respond to the emerging need for the improvement of herders' living standards on the one hand, and to facilitate more proactive production practices at herder settlements on the other, the proper development of infrastructure in Mongolia's rural areas is required. In particular, a reliable supply of energy is indispensable. Given the pastoral character of animal husbandry in Mongolia, and its vast and scarcely populated areas, small-scale renewable energy sources are considered to be the most practical.

Table 2.2 Selected Indicators of Herder Households in Mongolia

Indicators	1990	1995	1999	2000	2001
Number of herders, thousand	147.5	390.5	417.7	421.4	407.0
Number of herder households, thousand	74.7	169.3	189.9	191.5	185.5
Share of herder households with electricity, %	15.0	11.3	13.5	10.6	13.4
Share of herder households with a TV set, %	NA	9.9	16.3	12.8	15.7
Share of herder households with an automobile, %	NA	2.9	6.7	8.7	9.5
Share of herder households with a motorcycle, %	NA	15.8	15.7	16.6	18.3
Share of herder households with a tractor, %	NA	NA	1.6	1.5	1.5

Sources: NSO, 2001a; NSO, 2002a.



Source: NSO, 2001a.

III Livestock as the National Wealth of Mongolia

3.1. A Brief History of Animal Husbandry Development in Mongolia

The natural environmental conditions of Mongolia, which are suitable for rearing domestic livestock, were the major reason for the development of the livestock sector as the country's first productive sector, although, as in other countries across the globe, the first economic activity undertaken by early humans was hunting. The initial process of domesticating wild animals began in Mongolia between the 8th and 3rd centuries B.C. and they came to be the focus of productive activity after the latter half of the 2nd century B.C. Traditionally, five types of domestic livestock were commonly raised in Mongolia: sheep, goats, cattle, horses and camels, while pigs, hens and other birds were seldom reared. Horses were the first animal in Mongolia to be domesticated (Baasanjav et.al., 1999).

The harsh continental climate of Mongolia, which is characterized by significant changes in the weather during the four seasons, as well as differences in the grassland available in different areas, cause the Mongolian people to lead a nomadic lifestyle based on pastoral animal husbandry. Research suggests that this was economically more effective than conventional agriculture (i.e. planting). Therefore, the classic Mongolian type of animal husbandry is considered an efficient production activity in terms of labor, economic payoffs and ecological considerations. The term "classic" denotes the original pastoral animal husbandry methods that have developed over time during the course of the nomadic lifestyle, and which have been transferred from generation to generation.

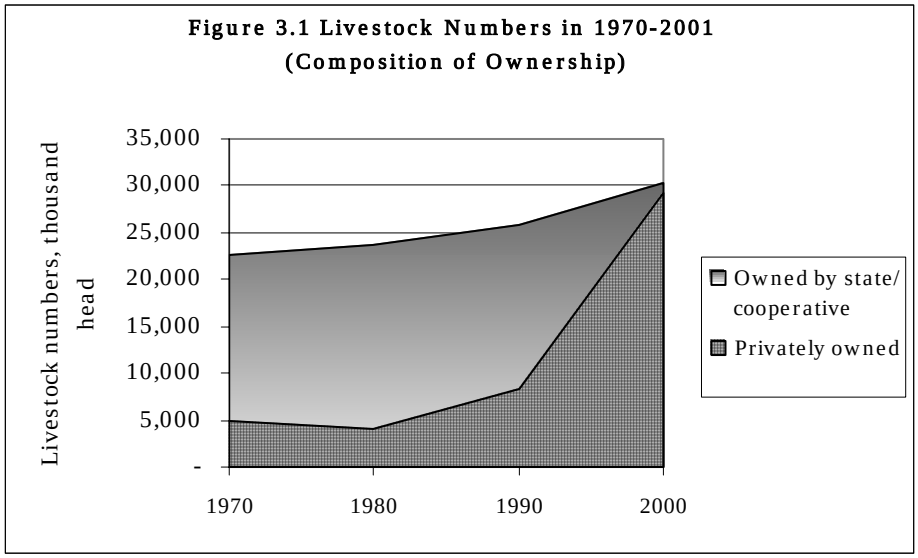
Between the 13th and 14th centuries, herder-settlements – groups of herder households forming small nomadic settlements – became the first major labor division of herders. Typically, every herder household

raised a variety of livestock as the different species provided different services and products, such as food, clothing, transportation, housing and production devices. One herder-settlement typically consisted of 7-12 households. During the summers – the busiest season for herders – they settled in one place to engage in various collective animal husbandry activities; when the weather became harsher, they would move to their winter shelters.

However, after 1950, when the nationwide campaign for the establishment of cooperatives started, the herder-settlement system of labor division, which had been practiced for more than 700 years in Mongolia, was abandoned in favor of cooperatives. Thus, the majority of private livestock was transferred to the collective ownership of cooperatives. The management of the cooperatives was responsible for providing various services to herders, such as preparing livestock enclosures, constructing wells, and making hay to feed herds during the winter and early spring, etc. Furthermore, more advanced methods of animal husbandry were established, including livestock farms, sites for rearing young animals, and livestock complexes. However, herders who belonged to the cooperatives had to follow a strict plan for livestock production levels. In the 1970s and 1980s, interventions from the state became more intense, interfering with the cooperatives' property and controlling product prices, thus changing the function of cooperatives from that which was originally intended (Baasanjav et al, 1999).

Nevertheless, in 1991, with the beginning of the transition from a centrally-planned command economy to a market-oriented one, a massive privatization process got underway and livestock was transferred back to private ownership free of charge, mainly to the cooperatives' own members; all the cooperatives were thus dissolved. Consequently, the herder-settlement method of labor division has recently been regaining popularity among herders.

Before the formation of cooperatives, almost all livestock (e.g. 99.8% in 1940) was in private hands. During the collectivization period (1960-1990), the share of private livestock decreased to 17-30% of the total number of livestock, but due to the privatization process that began in the early 1990s, the share of privately-owned livestock increased again, with 96.7% of total livestock in private hands in 2000. It is evident that livestock numbers tend to increase by a greater degree when they are in private hands. From the 1950s to the beginning of the 1990s, when livestock was under cooperative/state ownership, the numbers remained steady or increased only slightly despite various efforts made under the centrally-planned command regime (Figure 3.1).



Source: NSO, various issues.

3.2. Types of Livestock and Their Regional Distribution

Five types of livestock are raised in Mongolia: sheep, goats, cattle, horses, and camels. Conforming to the traditional pattern, sheep and goats comprise the majority of livestock and respectively accounted for 45.9% and 34.0% of the total number of livestock in 2000. Camels account for only 1.1% of total livestock and are mainly raised in the southern part of the country. In Asia, Mongolia ranks 2nd and 4th in terms of horses and camels, 6th and 7th in terms of sheep and goats respectively, and 15th in terms of cattle. Worldwide, Mongolia has the most horses and goats per capita and is 3rd in terms of camel and sheep per capita (NSO, 2002b).

The livestock numbers by type are shown in Table 3.1. As the data show, the fluctuation in the number of sheep in 1970-2000 was relatively steady, ranging between 12.0 and 16.0 million head, while the number of goats increased sharply (almost by twofold) during the last decade. This was associated with an increase in the market price of cashmere due to high demand for it in markets and strong competition for its procurement, both among domestic producers and foreign competitors.

Livestock products are supplied to processing industries for producing a variety of semi-finished and finished goods and products, as well as being exported. Since the various types of livestock were first domesticated in Mongolia, they have become adapted to Mongolia's climate by means of careful selection, breeding and cross-breeding, making them a uniquely reliable source of renewable resources for food and other products. For example, a special goat variety that produces the finest cashmere in the world is found only in Mongolia. The quality of cashmere – known as the "fiber of kings" – produced by Mongolian goats is superior to the cashmere produced in other countries and localities, as it is longer and finer than any other (Khishigjargal & Sedvanchig, 2000).

Table 3.1 Mongolian Livestock by Type, thousand head

Year	Total	of which, %				
		Camels	Horses	Cattle	Sheep	Goats
1970	22,574.9	2.8	10.3	9.3	59.0	18.6
1980	23,771.4	2.5	8.4	10.1	59.9	19.2
1990	25,856.9	2.1	8.7	11.0	58.3	19.8
2000	30,227.4	1.1	8.8	10.2	45.9	34.0
2001	26,075.2	1.1	8.4	7.9	45.8	36.8

Source: NSO, various issues.

Although livestock is relatively uniformly distributed in comparison with the population size of each region, the forests and mountainous areas of northern and eastern Mongolia are most populous in terms of livestock. According to the livestock census of 2001, there was an average 61 sheep-equivalent head of livestock per 100 ha of pastureland in those regions, whereas it ranged from 30 to 34 in other regions. (For accounting purposes, livestock numbers are usually converted into sheep-equivalent or cattle-equivalent head using the relevant conversion coefficients)[1]. The national average was estimated to be 39 sheep-equivalent head per 100 ha of pastureland in 2001, falling from 48 sheep-equivalent head in 2000 due to a decrease in the number of livestock. Overgrazing is becoming problematic in areas close to major markets. For example, livestock density measured in sheep-equivalent head per 100ha of pastureland in Orhon and Darhan-Uul provinces and Ulaanbaatar rose to 190-881 in 2001, which is 5 to 10 times higher than the figure in other regions (NSO, 2002b). Nevertheless, the appropriate number of livestock for Mongolia – taking into account the country's economic, social and environmental conditions – has yet to be clarified. Some researchers argue that it should be no more than 60 million sheep-head equivalent, i.e. the number of livestock in Mongolia at present.

IV Livestock Production and Livestock Raw Material Processing Industries in Mongolia

4.1 Livestock Output

As of 2000, livestock production accounted for 87.6% of Mongolia's gross agricultural product, whereas the agriculture sector accounted for 30% of the country's GDP. At the same time, the livestock sector directly employed almost half of the country's economically active population.

The usual livestock rearing method used in Mongolia involves the extensive grazing of various types of livestock at one herder household site (livestock farming). Although intensive livestock farming (i.e. housed dairy cattle, pigs and poultry) was practiced during the 1980s under state and cooperative ownership, such farms ceased to be appropriate after the livestock was transferred to private hands. Extensive livestock farming is

[1] The coefficients used by the NSO (National Statistical Office of Mongolia) are as follows:
The sheep-equivalent head coefficients for camels, horses, cattle, sheep and goats are 5.0, 7.0, 6.0, 1.0, and 0.9 respectively. The cattle-equivalent head coefficients for camels, horses, cattle, sheep and goats are 1.5, 1.0, 1.0, 6.0 and 8.0 respectively. The coefficients are not necessarily identical as they have been developed for tax purposes in different years.

important not only for providing different types of products, such as meat, milk and wool, but also for ensuring that fodder plant species are grazed in a balanced fashion (Batjargal, 2000).

Livestock production is entirely seasonal, taking place in harmony with the Mongolian climate. For example, wool and hair is collected in late spring and early summer, while most livestock is slaughtered in late autumn and early winter, at either meat factories, temporary slaughterhouses in rural areas, or herder household sites. Milk and dairy products are mainly produced during summer. Accordingly, industries that use raw materials of livestock origin have to cope with such specifics and usually have to maintain inefficiently high inventories of raw materials. The limited range of short-term, high interest rate loans available from commercial banks operating in Mongolia at present is not appropriate for financing such activities, as these loans do not take such operational realities into account. In fact, this was a major cause of the sharp decline in production and failure experienced by many such industries in Mongolia during the transition from a centrally-planned economy to a market-oriented one that started in the early 1990s. As a result, the majority of raw materials of livestock origin is exported without being processed, exports of finished and value-added products have decreased substantially and many finished products have actually disappeared from the export list. Despite this problem, proper schemes to deal with the situation do not seem likely to be devised in the near future.

As mentioned earlier, the Mongolian economy largely depends on livestock production. The country's gross agricultural output, evaluated at constant 1993 and 1995 prices, is shown in Table 4.1. The livestock sector has historically been the predominant sector in the Mongolian economy and accounted for more than 70% of gross agricultural output during the past 30 years. As shown in Table 4.1, the ratio of livestock and crop output in total agricultural output in 1990 was 73:27, becoming 85:15 in 2000. Despite a decline in crop production after 1995, increases in gross agricultural output have occurred owing to increases in livestock output arising from an increase in livestock numbers. Mechanized farming of croplands, which was no longer sustainable without massive subsidies from the state, declined by about 50% during the 1990s.

Table 4.1 Gross Agricultural Output of Mongolia, 1970-2000

	1970	1980	1990	1995	1999	2000
	At constant 1993 prices, billion MNT			At constant 1995 prices, billion MNT		
Total	69.5	74.8	109.3	102.8	321.2	256.3
Livestock	58.4	61.1	79.3	87.8	282.5	218.9
Crop	11.1	13.7	30.0	15.0	38.7	37.4
	Share (%)					
Livestock	84.0	81.7	72.9	85.2	89.8	85.4
Crop	16.0	18.3	27.1	14.8	10.2	14.6

Source: Mongolian Statistical Yearbook, various issues.

4.2 Major Livestock Products and Industries Processing Raw Materials of Livestock Origin

Mongolia's major livestock products are meat, meat by-products, and milk and dairy products, which provide staple foods for the population, as well as being inputs in many food industries. In addition, wool, hair, cashmere, hides and skins are key inputs for animal raw material processing industries within Mongolia. Due to

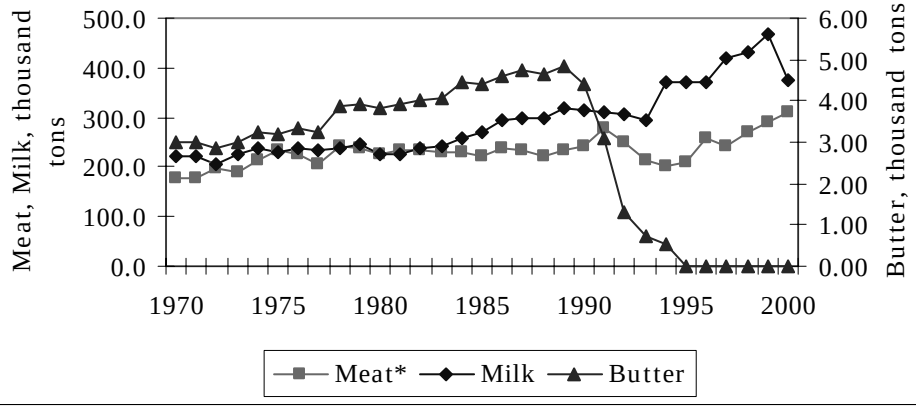
a decline in production in these industries during the last decade, the majority of such raw materials are presently exported without being processed.

The initial development of this industry began with the establishment of industries processing the abundant raw materials produced by the livestock sector, including meat, milk, wool, cashmere, hides and skin. The development of this industry dates back to December 1933, when the first wool-washing factory in Hatgal town, Huvsgul province began operating, while an industrial complex consisting of a wool-washing factory, leather tannery, and shoe and felt factories, as well as a second electric power station, became operational in 1934 in Ulaanbaatar. Further expansion has taken place with the establishment of many other new enterprises, such as meat and dairy factories, textile industries, cashmere-processing plants, carpet and blanket factories, spinning and knitting enterprises, and fur-processing, leather garment and haberdashery factories; in addition, existing enterprises have undergone modernization and expansion. Due to a decline in production in these industries during the last decade, the majority of such raw materials is presently exported without being processed.

A. Meat and Milk

On average, 7.5 million head of livestock are slaughtered for consumption annually, accounting for about 25% of the total livestock herd counted at the beginning of each year. This equals 250,000-300,000 tons of meat (Table 4.2). Mutton and beef comprise the main share of total meat prepared, accounting for around 45% and 35% of the total quantity of meat respectively. Horse and camel meat is not so popular in Mongolia and these types of meat are usually consumed mostly during the winter. Because the air temperature in Mongolia drops to between -15 and -30^{O}C during winter, all herder households and most urban households put aside enough different types of meat to see them through the winter.

Figure 4.3 Meat and Milk Production Dynamics of Livestock in Mongolia, 1970-2000



Note: *of slaughtered weight

A special method of meat procurement for meat-processing factories and slaughterhouses was developed in Mongolia as an alternative to the conventional delivery modes for goods, which is still used today. The country's vast land area and the lack of a proper nationwide transportation network make the extensive use of

different transportation modes in meat procurement for major meat-processing factories unfeasible. Therefore, factories usually buy livestock based on the live-weight rate in spring, when the price of livestock is lowest due to the livestock having lost weight during the winter, and herders bring them to the factory by autumn. This takes about 3-4 months, depending on the distance they must travel, and the livestock regain weight along the way during the summer. Each herd is accompanied by 3-5 herders depending on the type and size of the animals. The herders draw up contracts with the purchasing factories regarding the total weight that will be gained during the course of delivery and rates for excess weight gained. Depending on the type of livestock and the location of their usual meadows, slaughter weight as a percentage of live weight ranges from 42% to 50% (NSO, 2000). At present, 12 major meat-processing factories operate in Mongolia, with an annual supply capacity of 50,300 tons of live weight of various types of meat (TCI, 2001).

Table 4.2 Meat Production in Mongolia by Type (thousand tons of slaughtered weight)

Years	Total	Of which				
		Camel meat	Horse Meat	Beef	Mutton	Goat Meat
1970	179.4	5.8	26.1	51.7	79.1	16.7
1980	225.6	9.7	29.5	70.6	94.3	21.5
1990	240.8	11.6	30.7	66.2	107.6	24.7
2000	310.6	NA	NA	113.4	120.0*	

Source: NSO, various issues. Note: * total for mutton and goat meat.

Obviously, Mongolia has never imported any type of fresh meat for consumption. Instead, it is a potential exporter of organic meat and dairy produce. Table 4.3 shows exports of Mongolian meat and meat by-products between 1970-2000. During the 1970s and 1980s, Mongolia exported up to 46,000 tons of meat in addition to exports of living livestock; all of this was exported to the former Soviet Union. Until 1992, 20,000-50,000 tons of live weight of livestock was exported, including 20,000-76,000 head of horses, but exports of livestock later ceased due to strong pressure from domestic meat producers and reimbursement difficulties.

In 1995, only 2,200 tons of meat was exported, twenty times lower than the peak reached in 1980. However, after 1995, meat exports began to recover, reaching 16,700 tons in 2000, mostly to Russia and Kazakhstan. Meanwhile, exports of intestines experienced less dramatic declines (Table 4.3).

Table 4.3. Exports of Meat and Meat By-Products from Mongolia, 1970-2000

Main Items	1970	1975	1980	1985	1990	1995	2000
Meat, thousand tons	20.9	35.7	45.9	36.8	24.3	2.2	16.7
Intestines, thousand rolls	1,800.9	2,797.2	3,228.9	2,858.6	2,163.8	1,288.3	869.6
Bone dust, thousand tons	-	-	-	-	0.8	1.5	2.4
Livestock, thousand tons of live weight	51.0	50.2	36.1	24.7	20.8	0.0	0.0
Horses, thousand head	67.5	61.8	76.3	63.1	42.3	0.0	0.0

Sourse: NSO, Statistical Yearbook, various issues

Currently, Mongolian meat-processing plants have an annual export capacity of 60,000 tons of meat (TCI, 2001). However, despite the hormone-free organic qualities of Mongolian meat, which is in high demand in

international markets, the lack of domestic “infrastructure” to meet international standards and requirements for trade in such products still prevents the expansion of export markets. These obstacles include the lack of internationally accredited laboratories for the quality control and certification of products; insufficiently developed nationwide animal health services; the lack of refrigerated container transportation facilities; and the lack of bilateral and multilateral negotiations and agreements on animal health and food hygiene certification with major importing countries. Currently, Mongolia has agreements on the mutual acceptance of animal health and food hygiene certification with Russia and China.

As stated above, Mongolia needs to develop its proper “infrastructure” further in order to increase the quantity and variety of meat and dairy product exports, thus fully utilizing its competitive advantage in organic agricultural/livestock products. Since Mongolia joined the WTO in 1997, scant progress has been made in terms of capacity building, increasing the country’s negotiating power with its trading partners, and building an adequate trade infrastructure. The WTO Sanitary and Phytosanitary (SPS) Committee’s decision on equivalence in October 2001 was an important step forward in overcoming major trade barriers that face developing countries. The decision made it possible to implement the provisions of Article 4 of the SPS Agreement on the Application of Sanitary and Phytosanitary Measures and affirms that equivalence can be applied between all members irrespective of their level of development. Moreover, appropriate technical assistance to facilitate the implementation of this article shall be provided, especially to a developing country if it requests it, thus enhancing its market access opportunities (WTO, 2001). Therefore, Mongolia needs to develop its trading infrastructure by extensively utilizing such opportunities, as well as other resources.

Another major livestock product is milk. Annually 250,000-350,000 tons of milk is produced in Mongolia. The majority of this is cow’s milk, which accounts for more than 80% of the total quantity of milk produced, with sheep & goat milk and horse milk accounting for approximately 10% and 8% respectively. With regard to cow’s milk, the yield and period of milking each year also differs depending on the breed and region. More than 90% of all cows is accounted for by native Mongolian cows, which have an average milk yield of 1.9 liters per day in the steppe region, and 1.3 liters in the Gobi region. Cows are milked for 8.4 months of each year in steppe and forest regions, and 5.3 months in the Gobi region. Because of the higher milk yield of cows in steppe regions, small livestock (i.e. sheep and goats) are not usually milked in those regions (NSO, 2000).

Milk is consumed by herder households and used to produce various dairy products for domestic consumption, as well as being supplied to manufacturers of dairy products, such as yogurt, butter, dried curds, cheese etc. These industries have established large manufacturing facilities in major cities. For example, the four factories in Ulaanbaatar, Darhan and Selenge process 573.1 million liters of milk per annum. However, some of them currently only utilize about 2-4% of installed capacity due to an insufficient supply of milk; this is as a result of the demolition of intensive cattle farms. As shown in Figure 4.3, butter production has been declining since the early 1990s and has almost ceased since 1995 due to a decline in production by these factories, with butter for the domestic market being almost entirely imported.

On the other hand, the previous centralized procurement and distribution system for the state-run industry became obsolete as a result of the country's transition from a centrally planned economy to a market-oriented one. Therefore, the capacities of such enterprises became too large and were inconsistent with market demand, given that they supplied only domestic markets. However, their share of the market has been taken over to some extent by a number of small companies, which produce a greater variety of milk and dairy products, as well as by direct supplies by herder households. Much of the space at large factories has been rented out to these small units. Milk and dairy products are sold entirely on the domestic market, but some companies are also seeking out export opportunities.

Most horse milk is used to produce a popular drink known as *airag*, a low-alcohol content drink that is similar to beer in, but is white in color, as it is milk. The Mongolian tradition of making *airag* dates back about 2300 years. Rich contents of amino acids, vitamins and sugar found in horse milk makes *airag* a nutritious and healthy drink, which is also low in fat. Therefore, it is used to treat many illnesses, including tuberculosis, diseases of digestive organs, pharmaceutical toxicity, and fatigue. Mongolia has several special sanatoria that use *airag* as the main form of treatment. Currently, *airag* is only consumed in Mongolia.

Milk from other livestock is used to produce a variety of milk and dairy products such as dried curd, yogurt, cheese, and butter in factories and also by herder households for their own consumption as well as for sale. During the summer, milk and dairy products provide the major sources of food for rural and herder households. It is said that because of their high intake of dairy products, especially dried curd, rural Mongolians have very strong white teeth and are rarely affected by dental diseases.

B. **Wool, Hair and Cashmere**

Wool, hair, and cashmere are other valuable resources originating from livestock. These are renewable resources with an annual cycle. The warm coats (hair, wool and down) of livestock in Mongolia developed naturally as a way to survive the country's harsh winters. When the air temperature starts to rise, the down on the animals' undercoats loosens naturally, making its collection and removal easier. Goat, cattle, and camel down and cashmere are gathered by combing, while sheep wool and hair is removed by shearing.

About 25,000 tons of wool, hair and cashmere is produced in Mongolia annually, more than 70% of which is accounted for by sheep wool. Mongolia is the second largest producer of raw cashmere in the world (after China); currently, 3300 tons of cashmere is produced annually, accounting for about 20% of the total global supply. Cashmere is one of Mongolia's main export commodities.

Processing industries based on these raw materials have developed significant capacity in Mongolia since the mid-1930s. They include wool-washing factories, felt and felt boot plants, carpet manufacturers, spinning and knitting factories, cashmere-processing plants and factories producing non-woven fabrics. However, other than in the cashmere industry, only a small proportion of installed capacity is being utilized currently.

Production of this industry's principal goods for the period 1970-2000 is shown in Table 4.4. Similarly to the meat and dairy industry, it experienced peak production levels during the 1970s and 1980s, but these declined sharply in the early 1990s. For example, the production of spun thread and woolen fabrics dropped almost 22-fold and 244-fold respectively in 1997 from their peak levels in 1989. Although a slight recovery was experienced in the production of scoured wool and woolen fabrics, real recovery is still far away.

Table 4.4 Production of Major Items in the Mongolian Wool and Cashmere Industry, 1970-2000

Main Items	1970	1980	1985	1990	1995	2000
Spun thread, tons	NA	NA	2,722.5	2,285.4	344.9	40.8
De-haired cashmere, tons	NA	NA	198.5	240.1	420.8	450.9
Camel wool blankets, thousand m	NA	NA	84.9	91.2	19.4	28.5
Scoured wool, thousand tons	9.8	11.8	11.3	9.7	1.2	1.4
Carpet, thousand sq.m	6.6	464.4	1,585.6	1,971.2	595.7	704.8
Knitted goods, thousand pcs	157.4	1,134.0	2,824.7	4,248.6	522.7	1,233.5
Felt, thousand m	550.2	614.6	623.9	745.1	76.5	113.9
Felt boots, thousand pairs	394.2	465.8	452.2	588.5	79.0	34.0
Woolen fabrics, thousand running m	623.7	963.5	1,432.5	1,111.3	71.1	21.0

Source: NSO, Statistical Yearbook, various issues.

Nevertheless, the cashmere sector was the only sector in this industry that was able to survive transitional difficulties, due to the increased demand for and high value of cashmere and cashmere products on the international market. The first experimental factory for cashmere processing was built using technical assistance provided by UNIDO in 1975 and a production complex covering all stages of production, from the processing of raw cashmere and camel wool to the manufacturing of various finished products, went into operation in 1981 using technical and financial aid from Japan. During the 1990s this sector attracted foreign and domestic investors and, as of 2001, five domestic and 77 joint-venture entities were operating in this field, in which more than 50% of excess capacity (compared with the domestically available quantity of raw cashmere) has been installed for use in the scouring and de-hairing processes (MIT, 2002).

In order to facilitate closer interaction between herders, cashmere traders and manufacturers, cashmere exchanges and auctions were organized in two southern provinces last year as part of a USAID-funded collaborative project, with another four scheduled for this year. This initiative will serve as a good start in rebuilding the raw material collection system and transforming it into one appropriate to the new market economy. Moreover, price premiums and quality discounts in the negotiating process ensure herders have a true sense of and concern for the quality of their raw materials and act appropriately. Therefore, the current single-pricing practices with regard to bulk cashmere will eventually move to quality-based price quotations, which is essential to the industry's sustainability.

Exports of the major commodities of the Mongolian wool and cashmere industry for 1970-2000 are shown in Table 4.5. The values for cashmere and sheep wool include both raw and semi-processed items. Cashmere represents the main export commodity not only in this sector but also for the whole country, and Mongolia is

the world's second largest supplier. A substantial part of the cashmere produced in Mongolia is supplied for export in its raw and semi-processed forms. Since the price fluctuation of such commodities on the world market is high compared with the prices of finished products using cashmere fibers, export earnings are highly vulnerable. In 2000, 1500 tons of cashmere was exported, valued at US$77 million. This accounted for 16.5% of the country's total exports. The main countries that import such products are Italy, the United Kingdom, China and Japan. Cashmere exports to Japan were worth about US$9 million in 2001, an increase of 2.3 times on the previous year (NSO, 2002a).

Table 4.5 Exports of Major Mongolian Wool and Cashmere Industry Commodities, 1970-2000

Main Items	1970	1980	1985	1990	1995	2000
Camel wool, thousand t	3.2	3.0	2.6	1.9	0.9	0.8
Cashmere, thousand t	0.9	1.2	0.6	0.4	0.6	1.5
Sheep wool, thousand t	10.1	10.8	7.7	3.3	14.9	5.2
Horse mane, thousand t	0.9	0.7	0.6	0.5	0.4	0.2
Knitted goods, thousand pcs	0.0	45.1	252.6	298.9	570.3	3,393.5
Carpets, million. sq.m	0.0	0.4	1.5	1.7	0.0	0.1
Woolen fabrics, thousand m	230.3	31.9	34.6	0.0	0.0	0.0
Woolen blankets, thousand pcs	37.6	330.8	313.9	336.4	20.5	4.5

Source: NSO, Statistical Yearbook, various issues.

Other items included in this sector's exports were sheep wool, horse manes, knitted goods, woolen fabrics, woolen blankets and carpets. However, since the early 1990s, exports of most of these commodities have almost vanished as production declined due to the various reasons mentioned earlier. Moreover, as neighboring countries impose high import tariffs (more than 50%) on woolen products, exports of such commodities remain unchanged (GOM, 2000b). Only exports of sheep wool have displayed a relatively stable pattern over the period, with 5,200 tons of wool (both greasy and scoured) being exported in 2000 (Table 4.5).

C. Hides and Skin

Livestock hides and skin are also a valuable resource for producing luxury consumer goods, and are a by-product of livestock slaughtered for consumption.

About 6.5-8.5 million individual hides and skins are produced in Mongolia annually if counted on the basis of the number of livestock slaughtered for consumption. More than 80% of these are sheep- and goat-skins. Most of them are supplied to processing industries or exported, as well as being used by herder households. Traditionally, sheepskin was used for making warm winter coats and floor coverings, while various accessories for handling horses were made from cattle hides.

Sufficient capacity to process hide and skin resources completely has been installed in the country over the course of the development of Mongolia's leather industry since the 1930s. The technical level of the leather industry is more-or-less comparable with the global average, owing to modernization and restructuring in recent years. Similarly to the wool and cashmere sector, the development of this sector is characterized by the

horizontal integration of technology. An industrial complex comprising a preliminary processing plant for hides and skin, tanneries for shoe uppers, linings and soles, leather garment and leather haberdashery manufacturers, a shoe-making plant, and a fur and skin processing plant have been established in Ulaanbaatar. In addition, several auxiliary plants were established in order to utilize the waste materials and scraps generated during the production process, such as a sewing plant that uses leather scraps, a glue manufacturer, and a synthetic leather plant. A sheepskin goods manufacturing complex was opened in Darkhan city with the cooperation of Bulgaria, while another shoe-making plant was established in Dzavhan province.

The initial development of the leather production complex in Ulaanbaatar was carried out with technical assistance from the former Czechoslovakia. In 1988, a new plant for producing leather garments and leather haberdashery was put into operation in cooperation with the former Yugoslavia, with investment of more than US$11 million. As all the machinery and equipment installed at this plant was purchased from Western manufacturers and used the best technology available at the time, Mongolia was able to export more than 90% of the factory's products to a diverse range of markets, including the most sensitive western markets. Major markets included France, Germany, Switzerland and the former Yugoslavia, in addition to the ex-CMEA countries. Japan also accounted for some sales.

A production line using Italian technology was installed in a shoe factory, while major renovation work was carried out at a cow-hide tannery in Ulaanbaatar under a project developed in cooperation with Italy during the mid-1990s. Though all work was completed, the project was not as successful as originally intended. It cost the equivalent of US$17 million, 15% of which was directly invested by the Mongolian government, with the remaining balance provided by an Italian commercial bank supported by the government of Italy. However, the plant failed to repay its debts due to unstable production. The reasons for this failure are similar to those behind the failures of other industries described in this paper.

The production pattern of selected items in the Mongolian leather industry is illustrated in Table 4.6. Overall, the leather industry was the hardest hit by the transitional shocks of the 1990s and is still awaiting recovery. 4.2 million pairs of leather shoes and 300,200 leather garments were produced in 1990, but this figure dropped to 5,600 and 200 respectively in 2000. Accordingly, the production of tanned sheepskin and goatskin declined to 4,600 sq. m and 800 sq. m respectively in 2000 from record levels of 1.51 million sq. m and 418,400 sq. m respectively in 1990.

Similarly to other industrial sectors in Mongolia, the various transitional difficulties mentioned earlier conspired to bring about the failure of the country's leather industry. Moreover, apart from a few items subject to excise duties, such as alcohol, tobacco and passenger cars, Mongolia unilaterally reduced its general import tariffs to zero on May 1st, 1997. A uniform rate of 15% was imposed on all imported goods until this date. This measure was another major blow to domestic industries, because cheap – though not necessarily high-quality – imported goods swamped domestic markets. Consequently, exports of finished leather products have entirely been replaced by exports of raw hides and skins (Table 4.7). However, import duties were reintroduced in 1999

at lower rates than before (The rates are: 5% effective from July 1st, 1999; 7% effective from January 1st, 2001 and 5% effective from January 1st, 2002).

Table 4.6. Production of Selected Items in the Mongolian Leather Industry, 1970-2000

Main Items	1970	1980	1985	1990	1995	2000
Sole leather, tons	1,300.0	1,400.0	800.0	1,000.0	0.0	0.0
Tanned sheepskin, thousand sq. m	NA	1,209.5	1,491.6	1,510.5	193.5	4.6
Tanned goatskin, thousand sq. m	NA	178.0	331.1	418.4	35.9	0.8
Leather shoes, thousand pairs	1,621.5	2,104.9	2,883.4	4,222.5	245.5	5.6
Leather garments, thousand pcs	47.9	269.9	357.2	300.2	31.6	0.2
Sheepskin coats, thousand pcs	NA	83.0	135.2	138.1	16.8	1.0

Source: NSO, Statistical Yearbook, various issues.

Table 4.7. Exports of Raw Hides and Skin and Selected Items from the Mongolian Leather Industry

Main Items	1970	1980	1985	1990	1995	2000
Cattle hide, thousand pcs	NA	NA	NA	47.7	309.6	1,058.5
Horse hide, thousand pcs	12.1	65.0	58.0	105.2	70.0	276.3
Sheepskin, thousand pcs	5.1	261.0	280.2	130.0	2,004.3	2,640.0
Goatskin, thousand pcs	4.2	315.1	526.2	113.2	361.4	110.5
Tanned goatskin, thousand pcs	224.6	175.0	236.6	172.0	0.0	0.0
Tanned sheepskin, thousand pcs	394.6	123.1	411.0	24.1	0.0	0.0
Leather garments, thousand pcs	14.2	54.7	321.5	87.0	0.8	0.0

Source: NSO, Statistical Yearbook, various issues.

V Livestock and the Environment

5.1. Pastureland and Livestock

The vast, diverse pastureland of Mongolia is highly suitable for livestock production, with more than 600 of the 2,600 natural plant species found in pastureland palatable to livestock and providing its major source of feed (GOM, 2001). Pastureland in Mongolia occupied 129.4 million ha in 2000, an increase of 4.9% on 1980 levels, but a decrease of 8% in comparison with the level in 1950. A nationwide crop cultivation program started in Mongolia in 1959 and about 1.2 million ha of agricultural land was made available for this. However, with the beginning of economic transition, state subsidies were no longer allocated to this sector, and crop cultivation began to drop sharply. Currently only 20-30% of land is utilized for annual crop cultivation, a level four times lower than in the 1980s.

The total number of livestock was 30.2 million in 2000, an increase of 7.6 million head or 33.9% on the 1970 level. Levels reached a record high of 33.6 million head in 1999. As a result of a decrease in pastureland area and an increase in the number of livestock, it was estimated that pastureland available per head of livestock decreased from 6.2 ha in 1930 to 4.3 ha in 2000. However, due to huge losses of adult animals during the severe winters of 2000-2001, livestock numbers decreased further to 26.1 million head in 2001.

Mongolia's harsh continental climate and seasonal patterns, as well as the pastoral character of its extensive livestock farming mean that a wide area of pastureland is necessary for each herd. Sheep and goats are put out

to pasture together, usually in the area closest to the herder settlement, while cattle, horse and camel herds are put out to pasture separately in areas further away. Areas surrounding the herder settlement are used for young livestock. In order to feed the livestock with a variety of natural plants, herder households have to move several times each year, depending on grass and water availability. Moreover, the same pastureland is shared or rotated daily between neighboring herder households. Academics describe this as follows: "The methodology of seasonal use and segmentation of pasture is the choice of the Mongols, arising from their traditions and experience shaped over centuries" (Adyasuren, 2000, p.4). Moreover, in an area such as Mongolia, where there are extreme fluctuations in air temperature both annually and diurnally, and which has a relatively short effective vegetation growth period (80 to 130 days, depending on altitude and location), the rotation system of land management is the only way to maximize outcomes while not exceeding the ecological capacity threshold of a given landscape (Batjargal, 2000).

Accordingly, each herder household usually has several sites that are used during winter, spring, and autumn, which are equipped with specific herd shelters, herd enclosures, hay and other facilities. Wood is the material most commonly used in building such facilities. Because they are usually used for several years, herders avoid using pastures surrounding these facilities during summer, thus facilitating the natural restoration of pastureland and ensuring that it will be available for use the following year. Although herder households change locations several times during the summer, no pre-prepared enclosures are needed. As a rule, areas used for herder settlements are supposed to be cleaned completely before moving to other places. Enclosures for summer use are far simpler in construction than those used in other seasons. As mentioned earlier, herders usually use the herder-settlements model of labor division during the summer.

Pastureland management is usually based on mutual understanding and agreements among the herders of a particular area within a region; however trans-regional movements are not an exception. There are warnings that areas close to major markets are tending to be over-exploited because of large concentrations of livestock, causing land degradation in those areas. However, the idea of privatizing pastureland areas for individual use by herders, as advised by some local and outside experts, seems a rather odd solution. The country's total area of pastureland would simply not be sufficient to meet the minimum required level of pastureland per herd if the current pastoral character of livestock rearing continues and the pasturelands are not shared. Others suggest shifting to a settled model of intensive livestock farming. Although such a transformation would be optimal for the more populated areas (i.e. near the largest cities), the complete shift of all livestock farming towards such methods would be impractical and unprofitable in Mongolia. Firstly, the infrastructure needed for intensive livestock farming, along with the initial investments and operating costs, may cost much more than that required for extensive pastoral livestock farming. Without certain subsidies, it would lead to an increase in the prices of all livestock products. Secondly, years of breeding and crossbreeding would be required in order to accustom Mongolia's existing livestock to a settled pattern of farming. In addition, animal psychology has to be dealt with adequately. This branch of animal sciences is still underdeveloped to a great extent in Mongolia, although

experienced herders have acquired this knowledge through their own experiences and those of their ancestors. Thirdly, the most important aspect is that the ecological superiority of Mongolian livestock products would vanish, causing the industry to lose its competitive advantage. It is uncontested that Mongolia is the only country in the world where extensive pastoral livestock farming can be developed and sustained. Infrastructure development and the introduction of the latest small-scale production methods and technology in order to mechanize production activities at herder settlements, not to mention a proper policy on the balanced development of the regions, would offer much better solutions for most of these problems.

The pastoral character of Mongolian animal husbandry makes it extremely vulnerable to such natural phenomena as severe winters and droughts, especially severe winters preceded by droughts, which are known as "*dzud*". This is recognized as the prime disadvantage of pastoral animal husbandry. In this sense, the consequences of global warming and climate change have a strong direct impact on Mongolian animal husbandry.

The pastures that support livestock are strongly affected by weather conditions. The coldest period is January, when the air temperature drops to between -31.1^{O}C and -52^{O}C, rising to between +28.5^{O}C and 44 ^{O}C in July. Precipitation is low, averaging 200-220 mm per annum. Droughts occur once every 2-3 years in the Gobi region and every 10 years in other regions (GOM & UNDP, 2000). Nationwide droughts occurred in 1944 and 1972 (MFA, 2001).

Livestock gain weight through taking in nutrients during the summer, reaching their maximum weight in autumn. From winter to early spring, they lose weight due to cold air temperatures, the unavailability of fresh grass, snow cover, snow and dust storms and strong winds, so their survival depends greatly on the weight and energy gained during summer and autumn. Mongolian livestock has become adapted to such conditions over the years through natural selection and selective breeding.

Data show that an average loss of 0.8-1.0 million adult livestock – 4% of the total number of livestock – occurs in Mongolia annually in normal years. A substantial part of this loss results from adverse weather conditions. Data show that the percentage of losses of different types of livestock exhibit very similar trends, although in extreme weather conditions, i.e. during *dzuds*, losses of cattle and horses in terms of the percentage of the total number of each tend to be higher than those of other livestock. In addition to losses of adult livestock, young animals also suffer greatly from the adverse effects of natural phenomena.

5.2. The Consequences of Recent *Dzuds*

As a result of climate change, such natural phenomena as *dzud*, droughts, strong winds and flooding have begun to occur frequently in Mongolia recently. Two consecutive *dzuds* occurred in 2000-2001; during the *dzud* of 2000, Mongolia lost 3.5 million adult animals, while in 2001, a further 4.8 million were lost. This means that the scale of losses in 2000 and 2001 was equal to 11.5 % and 18.2 % of the country's total livestock

respectively. As a percentage of total livestock at the beginning of the respective years, the figures were 10.4% and 15.7% respectively (NSO, 2002b).

In autumn 2000, snow fell earlier than usual and more than 90% of Mongolia was covered with snow well before the usual period for this extent of snow cover. More than 70% of 158 *soums* in 13 provinces suffered *dzud*. About 2400 herder households lost all of their livestock and more than 10,000 herder households ended up with fewer than 100 head of surviving animals. The total value of lost livestock was 91.7 billion togrogs (MFA, 2001).

The *dzud* of 2001 was more severe than the previous one in terms of the area covered and the drop in air temperature. During this *dzud* 7400 herder households lost all of their livestock and another 13,300 households lost more than 50% of their total livestock. A survey revealed that 74.3% of these losses was attributed to a shortage of fodder. In terms of losses as a percentage of total herds, cattle and horses were the hardest hit, with 49.2% of adult cattle and 20.5% of adult horses lost in 2001, compared with 20.3% and 14.8% respectively in 2000 (MFA, 2001).

In addition to direct losses of adult and young animals, other adverse consequences, such as an increase in the number of barren female animals and miscarriages, also resulted in the reduction of total livestock numbers in 2000-2001. For example, there were 1.5 million and 1.4 million barren female animals in 2000 and 2001 respectively, as well as 1.2 million and 1 million miscarriages in those respective years (NSO, 2002b). All this contributed to an increase in rural poverty across the nation. Moreover, estimates show that, due to the reduction of agricultural, and thus livestock, production, the country's GDP grew only at 1.1% in 2001; had this drop in production not taken place, GDP growth could have attained 10.0% (BOM, 2002).

The abovementioned situation requires that the government of Mongolia actively undertake measures to prevent and minimize the consequences of *dzud*. Indeed, it is paying close attention to this problem, developing and implementing complex measures aimed at the protection of herds and the prevention of livestock losses due to such natural phenomena as *dzud*. Attention is also being focused on the rehabilitation of industries processing raw materials of livestock origin.

Accordingly, the government of Mongolia is undertaking a number of programs to support the country's livestock sector by diverting funds from state budgets, as well as actively mobilizing the financial and other resources allocated to the country by international organizations and donor-countries, including Japan. However, in view of the country's limited financial capacity, it is obviously not possible for Mongolia completely to solve this problem on its own. The situation is aggravated by economic stagnation arising from various internal and external factors, which relate to the period of transition from the planned economy to the market-oriented one.

Therefore, collaboration with international organizations, donor-countries and other concerned parties is needed in organizing joint initiatives aimed at developing and implementing complex measures to protect herds and prevent livestock losses as a result of such natural phenomena as *dzud*. Other goals of these initiatives could

include supporting herder households and improving the nation's capacity to take preventive measures against problems caused by severe climate conditions, as well tackling those problems when they do arise.

VI Conclusion

Livestock plays a significant role in the Mongolian economy, providing renewable sources of food and consumer goods. It directly supports the livelihood of more than half of the country's population. Processing raw materials of livestock origin constitutes Mongolia's main manufacturing industry and is one of the country's major sources of export earnings. However, the pastoral character of animal husbandry makes it extremely vulnerable to natural phenomena.

In view of the importance of livestock, the government of Mongolia is paying close attention to this problem and taking every possible measure by developing and implementing complex measures aimed at the protection of herds and the prevention of livestock losses as a result of such natural phenomena as *dzud*. In order to facilitate the prevention of livestock losses arising from *dzud* and other natural phenomena, the following measures could be developed and undertaken: (i) the improvement of forecasting and analysis, and the expansion of the information network in isolated areas; (ii) strengthening the capacity to respond to and take urgent measures to tackle naturally-occurring climatic phenomena; (iii) the revitalization and improvement of the work of forage production units; (iv) the supply of cattle-breeding farms in isolated areas with power from renewable energy sources; and (v) the improvement of pastureland management and veterinary assistance in preventing various animal parasites etc.

Fundamental reforms in livestock sector development in the 21st century constitute the main challenge for the country. However, simply favoring a more settled style of animal husbandry over the traditional pastoral one does not seem to be the best solution. Thanks to global economic development and technological advancement, especially in the field of information and communications technology, remote areas are no longer being left behind. Therefore, a proper policy and the active introduction of such technology, aimed at bringing new insights to pastoral animal husbandry, offer much better prospects.

The economic, environmental, and social changes and challenges of the next 50 years are likely to be fundamentally different from those of the past half-century. Therefore, there should be no doubt that Mongolia's economic development strategy must deal with these tendencies and be based upon a vision for sustainable development.

A development strategy must be aimed at facilitating the transformation of the Mongolian economy from its current "deadlocked" position towards a more advanced sustainable path, while identifying the barriers to, as well as potential catalysts for such change. A blueprint for the sustainable development of Mongolia in the 21st century, known as MAP-21 (Mongolian Action Program for the 21st Century), was released in 1999. Although it laid good foundations for the evolution of a development strategy in coming years, it needs to be revised and

redefined, setting concrete goals for sustainable economic development in the present dynamic global environment.

References

Adyasuren, Ts. (2000). Development of Animal Husbandry Suited to the Carrying Capacity of the Environment. Report presented at an international symposium on "Nomads and the Use of Pastures Today" held in Ulaanbaatar, 13-15 December 1999. *Nomadic IISNC (*International Institute for the Study of Nomadic Civilizations in Ulaanbaatar) *Newsletter*, No. 4, 5, 2000.

Baasanjav, Z., Batbayar, D., Boldbaatar, J. and others. (1999). *History of Mongolia*. (in Mongolian) Ulaanbaatar: Admon.

Batjargal, Z. (2000). Climate and Pastoralism. Report presented at an international symposium on "Nomads and the Use of Pastures Today" held in Ulaanbaatar, 13-15 December 1999. *Nomadic IISNC Newsletter*, No. 4, 5, 2000.

BOM (2002). *Bank of Mongolia Annual Report 2001*. Ulaanbaatar.

Chadraa, B. (2000). Lifestyle Model for a Mongolian Herder in the 21st Century. Report presented at an international symposium on "Nomads and the Use of Pastures Today" held in Ulaanbaatar, 13-15 December 1999. *Nomadic IISNC Newsletter*, No. 4, 5, 2000.

GOM (2000a). Sub-Program "Cashmere". Attachment to Government Resolution No.114, 2000. Ulaanbaatar: The Government of Mongolia.

GOM (2000b). Sub-Program "Wool". Attachment to Government Resolution No.114, 2000. Ulaanbaatar: The Government of Mongolia.

GOM (2001). *National Program to Assist the Protection of Livestock from Drought and Zud*. Attachment to Government Resolution No.47, 2001. Ulaanbaatar: The Government of Mongolia.

GOM and UNDP (2000). *Lessons Learned in the 1999-2000 Dzud*, Research report compiled under the MON/00/302 Project funded by the Government of Mongolia and the UNDP. Ulaanbaatar: JEMR Publisher.

Khishigjargal, Ts. & Sedvanchig Ts. (2000). *Magnificent Cashmere: A Look into the Luxurious Clothing Fiber of Mongolia*. Dodge City, Kansas: High Plains Publishers, Inc.

MFA (2001). *Livestock in the Winter of 2000-2001: Conclusions-Lessons Learned-Challenges*. Report compiled by the Ministry of Food and Agriculture of Mongolia. Ulaanbaatar: JEMR Publisher.

MIT (2002). The Present Situation of Mongolian Industry, information placed on the website of the Ministry of Industry and Trade of Mongolia, Available on-line: http://202.179.7.52/ (May 29, 2002).

NSO (National Statistical Office) (2000). *Agricultural Sample Survey and Economic Accounts*. Ulaanbaatar: Admon.

NSO (2001a). *Mongolian Statistical Yearbook 2000*. Ulaanbaatar-NSO.

NSO (2001b). *Population and Housing Census 2000. Statistical Booklet: Housing*. Ulaanbaatar: NSO.

NSO (2002a). *Monthly Bulletin of Statistics, December 2001*, Ulaanbaatar: NSO.

NSO (2002b). Report of Livestock Census 2001 (in Mongolian), 68 pages. Available online: http://nso.mn/ls_census2001.htm (April 26, 2002).

TCI (2001). *Mongolian Meat Exporters Association.* CD-ROM created by The Competitiveness Initiative Project Unit in Mongolia sponsored by USAID.

WTO (2001). SPS Committee's Decision on Equivalence, G/SPS/19, 4 pages, Available online: http://www.wto.org/english/tratop_e/sps_e/equivalence2001_e.htm (October 26, 2001).

Small-Scale Energy Development in Northeast Asia: Experience, Prospects and Social Implications of Solar PV in Mongolia

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The priority for small-energy development in many cases is economic growth and the alleviation of poverty. As of today, one-third of the world's population has no access to commercial energy. Many live in low-income developing countries, including some in Northeast Asia.

Small-scale energy development may play a key role in the eradication of disparities in standards of living, per capita electricity consumption, access to information and modern communications, and medical and educational services. On the other hand, it is necessary to develop renewable energy resources. The development of small-scale energy systems may play a part in increasing social stability. Government subsidies, incentives encouraging the utilization of renewable energy sources and the inclusion of these in the national energy policy portfolio are needed.

This paper looks at the utilization of solar PV (photovoltaics) in Mongolia as an example of small-scale clean energy.

1. Introduction

The priorities for small-scale energy development in many cases are the support of economic growth and alleviation of poverty. At present, such as the 40% or so of the Mongolian population that currently has no access to electricity.

Small-scale energy development may play a key role in the eradication of disparities in standards of living, per capita electricity consumption, access to information and modern communications, and medical and educational services. On the other hand, it is necessary to develop and use renewable energy resources, including solar energy.

2. Renewable energy sources

Wind energy: In Mongolia, the wind blows anywhere and at any time. The potential reserve of wind energy is 836.8 billion kilowatt hours (kWh), with an average possible utilization period of 3,500-4,600 hours each year. An average wind velocity of 4-5 m/s prevails in the southeastern part of the country, covering 60% of the territory with a wind energy reserve of over 100 Watts per square meter (W/sq. M).

There are 52 *soums*[1] in this part of the country, where 100-150 kW wind turbine generators could be installed. Some projects for evaluating wind generators operating in tandem with existing diesel generators or the grid network are under consideration.

Smaller 50W windmills manufactured by the domestic company Monmar Co., Ltd. are available for 167,000 togrog (MNT)[2], for use in pastoral livestock farming, but not in sufficient quantity. 3-5 kW windmills have been approved for use in activities involving greater consumption, such as water pumping and powering some facilities at summer settlements. Winter settlements are usually established on windless, sunny sites. The publication of the Wind Energy Atlas of Mongolia by the National Renewable Energy Laboratory (2001) of the U.S. Department of Energy will be very useful for designing wind power generators.

Solar energy: Mongolia, the "Land of Blue Sky", enjoys more than 260 sunny days a year, typically between 2,250 and 3,300 hours each year. There are no more than two consecutive days without sun. Its average altitude of about 1,600 meters above sea level provides comparatively favorable conditions for the utilization of solar energy (Tsegmid 1969). It is estimated that the southern part of the country receives on average between 4.3-4.7 kWh/sq. m of solar energy per day. Solar PV research work, which started at the beginning of the 1970s, showed that, compared with diesel/gasoline generators, PV modules are just as feasible for the purposes of powering radios, portable TV sets, lighting *ger*[3], meeting *soum* hospitals' needs, pumping water, and for radio relay transmission trunk lines. Currently about 3% of herder families use solar PV modules for lighting purposes.

Hydro-energy: In Mongolia, about 20 hydro sites have been identified, with installed capacities ranging from 5 Megawatts (MW) to 110MW. However, these are mainly situated in the mountainous western part of Mongolia, far from the central grid. Therefore, these resources would probably be expensive to develop. A couple of projects have been devised, which involve constructing hydroelectric power stations to be connected to the existing network in order to decrease the peak hour load and reduce imports of electricity from abroad. Some micro hydroelectric generators are in use at summer settlements.

Conventional ovens for cooking in and heating *ger*: For cooking purposes, the utilization of gas stoves with an appropriate scheme of gas provision could also be considered. Fuel (wood, coal, animal dust, etc.) fuller burning and smokeless ovens are chosen for local production and distribution to those

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[1] Rural district in Mongolian prefectures
[2] Mongolian currency unit: MNT 1124 = US$1, as of late 2002
[3] Tent made from felt forming the traditional residence of herders

living in *ger*. (Khuldorj 1999). On the other hand, recent proposals[4] for cooperation with Russia in the field of natural gas allow its practical use in households (cooking and heating).

Other sources of energy: Bioelectricity has been proven to be a feasible option for meeting the current and projected electricity needs of rural areas in many developing countries. There are about 50 remote villages in the northern part of Mongolia where biogasifiers could be feasible.

3. Solar PV cells and their utilization

PV systems can be installed in remote villages or homes. Solar PV cells are proven to be capable of converting 15% of incident solar energy into electricity. Their modularity enables them to deal with loads ranging from a few milliwatts to several megawatts. Solar PV could be the energy technology of choice for many households, hospitals, schools, farmers, and telecommunications companies. Home PV systems are most economical in remote locations and can be used to power lights or small appliances such as radios/TV sets. A 50W solar PV system provides approximately 10 to 15 kWh/month to a household.

PV systems can be used to power vaccine refrigerators, sterilization equipment, emergency radios and other critical loads, lighting and computers. The cost of PV modules per watt of generating capacity has decreased from $15 in the mid-1980s to around $4 today. There has been a rapid expansion in sales of household PV systems, with nearly a half a million installed in developing countries (World Bank 2002).

The use of PV systems results in improved quality of life through access to such services as education, medical care, and information to support small business development. The provision of lighting is the biggest incentive for rural households to introduce PV systems. A typical 50W solar PV system for household use offsets about 400 kg of CO_2 emissions annually (World Bank 2002).

Larger PV systems are used in remote areas to supply power for telecommunications and decentralized drinking water supply systems. Water supply ranges from as little as 0.3 liters per day for drip irrigation to over one thousand liters per day for a village water supply. Both residential and community use of PV can be promoted by such mechanisms as government subsidies. One example of this is the special program implemented in Japan, which subsidized the installation of grid-connected 3.5 kW PV systems in homes. (NEF 2002)

4. Pastoral livestock farming in Mongolia

Animal husbandry based on natural pastureland plays an important role in the Mongolian economy. The problem of electricity supply is the main obstacle to operating wells and increasing water supply. The

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[4] *Joint communiqué on the official visit of Prime Minister Mikhail Kasyanov of the Russian Federation to Mongolia, April, 2002*, Ulaanbaatar, Mongolia, www.extmin.mn/kasianovCV.htm (30 May 2002).

country's 26 million livestock are farmed in the traditional pastoral way. About a third of pastures (total 129 million hectares) are not being used because of a shortage of water, putting a pressure on the pastureland that is utilized. Of the 24,600 wells built in the period up to 1991, only 8,200 were in operation in 2001 (Table 1). In the husbandry sector, about 185,500 families (Table 1) were engaged in producing primary livestock products, of which, only about 13% had access to electricity in 2001.

Table 1. Some Social Indicators of Herders in Mongolia

	1991	2001
Number of herders	245,000	407,000
Number of herder households	114,900	185,500
Number of herder households with electricity	12,300	24,800
Number of wells	24,600	8,200

Source: National Statistical Office of Mongolia (2002) *Mongolian Statistical Yearbook 2001*. Ulaanbaatar: NSO.

As a result of the loss of herds during "zhud"[5], the number of these families decreased by 6,000 in 2001 on the previous year. The pasture around urbanized settlements such as district and province centers is practically exhausted, because herders try to keep their herds as close as possible to markets and public services. As a consequence, a large portion of the nation's livestock has been lost. Such a situation should be corrected by all possible means, including better energy provision.

Urban and rural household inequalities are also growing wider. Increased exports of livestock products and the high share of the labor force engaged in the agricultural sector (49%) mean that greater attention should be paid to the problem of supplying electricity to such families. Tables 2 and 3 demonstrate that electricity consumption in Mongolia is at about the same level as in some countries of Central Asia.

Table 2. Electricity Production and Consumption in Mongolia

	1990	2001
Total resources, million kWh	3,576	3,213
Consumption, million kWh	2,719	1,948
-Agriculture, million kWh	116	17
-Communal housing, million kWh	349	476
Total population, million	2.0977	2.4425
-Urban population, million	1.1957	1.3971

[5] If the "zhud" natural disaster in 2000 resulted in a 10% loss from 33 million herds, then the one in 2001 will mean a 15% loss from 30 million herds. However, the reasons for these losses differ from one case to another. Herds die because of a shortage of feed or no access to dry grass, due to heavy snow fall on pastures covering large areas, or a lack of snow, which is a source of water (black zhud), and/or an extremely low temperature. Losses will also be incurred if there was a drought the previous summer.

-Rural population, million	0.902	1.0454
Electricity produced per capita, kWh	1,664.0	1,235.0
*Electricity consumed per capita, kWh	948.7	797.5
*Household electricity consumption per capita in urban areas, kWh	291.9	340.7
*Household electricity consumption per capita in rural areas, kWh	128.6	16.3

Source: National Statistical Office of Mongolia (2001), (2002) *Mongolian Statistical Yearbook 2000* and *2001*. Ulaanbaatar: NSO
* - derivative data

Table 3. Electricity Consumption in Some Countries (1999 data)

Country	Population, million	GDP, billion US dollars (1995)	Electricity consumption, kWh/capita
China	1,260.32	1,112.84	936
Mongolia	2.40	0.90	1,253
Kyrgyz	4.87	4.14	1,585
Turkmenistan	4.78	4.63	1,319

Source: International Energy Agency (2001). *Key World Energy Statistics from the IEA 2001*, Paris: OECD.

However, electrical power consumption by households in rural areas is very low and they could be considered to suffer from "energy poverty". The lack of a reliable electricity supply to herder families causes problems. Many families are completely without information about weather forecasts, markets and news due to the lack of power supply. Access to clean water sources is also limited, while the health and education services in remote areas are inadequate.

1) *Use of solar PV for pastoral livestock farming*

Mongolia's geographical and meteorological characteristics ensure that PV is the first choice in terms of renewable energy sources for use in pastoral livestock farming. Tests of PV modules designed to ascertain herding families' minimum demand for electricity showed that a system of around 50W PV is economically feasible compared with gasoline generators. Feasibility analyses have also been carried out on other PV applications in pastoral livestock farming (Galbaatar and Nachin 1982).

The feasibility of PV use in *ger* has also been confirmed by research carried out by international organizations, including UNDP and NEDO (New Energy and Industrial Technology Development Organization), Japan. Based on the results of these tests, a project to construct a solar PV module assembly plant was drafted. This was later approved and 0.5MW PV modules can now be produced domestically. The products from this plant were primarily designed for installation on radio relay transmission trunk lines atop mountains. The government of Mongolia has announced the "*100,000 solar ger*" project (GOM 1999). Under the project's first stage, solar PV systems were installed in 826 herder homes, with 409 of those systems being capable of receiving TV broadcasts (GOM 2002).

2) *PV modules for lighting ger*

12W, 24W and 55W PV systems containing an automotive battery with a capacity of 30-70 Ampere hours (Ah), an electronic block to prevent overcharging /deep recharging, and a daylight tube have been designed for lighting *ger*. Installation costs range between 175,000-347,220 togrog or US$150-300. While 5,100 herder families are considered to have access to electricity, equipping the remaining 180,400 families would cost between US$27 million and US$54 million.

3) *PV modules for soums*

Currently there are about 200 *soums* that still have to use diesel generators because they are not yet connected to Mongolia's central electricity grid. Most of these diesel generators (each *soum* center has 2-3 diesel generator sets with a rating of 100-200 kW) run for a limited period of time, usually between 18:00-23:00, in order to save fuel. Annually, the central government provides about 5 billion togrog (US$5 million) of subsidies to run these generators. Since these diesel generators operate in the evenings, the installation of PV systems in high-priority public service facilities, including hospitals, schools, post and telecommunications offices, and water pumping units is needed.

4) *PV modules for hospitals and schools*

A 200W PV system, which is able to light 2-3 rooms and power a small refrigerator, is probably the smallest unit that could supply electricity to hospitals located in *soum* centers. For a school, a 250W PV system may be the smallest feasible size. However, installed capacity could be increased gradually according to the financial means and size of each hospital or school.

As mentioned earlier, because of interruptions to the electricity supply, the use of computers in schools and advanced medical equipment in hospitals is limited, so solar PV systems should be upgraded at least to 3 kW level (NEF 2002)[6]. At present, social services such as education and medical treatment are mainly under state control, so subsidies to purchase PV systems should be provided by the government.

5) *New options for rural electric supply*

The modularity of PV makes it ideal for use in remote locations, allowing upgrades or increases in installed capacity and circumventing the need for investment in extending the electricity grid.

A memorandum on building a solar power station in Mongolia has recently been signed between the Ministry of Infrastructure of Mongolia and NEDO of Japan. A group of Japanese and Mongolian experts

[6] 3.5 kW PV modules are in use in some Japanese homes

is due to leave for Noyon *soum*[7] in Omnogov *aimag*, in order to start construction of this 200 kW solar PV station. The cost of the station, which will provide remote *soums* and settlements with electricity, is around US$3 million (BBC 2002).

It is estimated that the additional installation of PV systems in 200 *soum* centers in order to reduce the amount of diesel fuel used by electricity generators would cost US$200-400 million. The total cost of introducing the combined diesel generator and solar PV system for households is estimated at roughly US$250-450 million.

According to JICA's Master Plan Study for Rural Power Supply by Renewable Energy in Mongolia, the second stage (2010), which is aimed at improving the power supply to every household in order to stabilize people's livelihoods in the 167 *soums* targeted, is expected to save about 5 million liters of fuel annually through the use of renewable energy sources (PV, wind and small hydropower) in combination with existing diesel stations and the realization of planned grid extension. The third stage (2015), which is aimed at achieving community development and a steady power supply to every household, would save 7 million liters of fuel, thereby reducing emissions (JICA, 2000b).

5. Economic and social implications

The alleviation of "energy poverty" in rural areas would have great social impact, such as improved access to information, medical treatment, schools, remote education, clean water, better management and use of pastures, and a decreased risk of mass loss of animals. In addition, for herder families, the introduction of PV would be at the lower end of investment risk, because it is modular and therefore can be installed and expanded step by step.

Animal husbandry accounts for one-third of Mongolia's GDP of US$1 billion and comprises three-quarters of its agricultural output. As of late 2001, the total size of the national herd was 26.1 million livestock, including 11.9 million sheep, 9.6 million goats, 2.1 million cattle, 2.2 million horses and 0.3 million camels. Mongolia produces around 25% of the worldwide output of cashmere, and also exports high-quality skins, hides, wool, meat and other products of animal origin. Cashmere, hides and meat products form the second largest source of hard currency revenue (around one-third of exports) after the export of copper concentrate.

Among herder families, ownership of 100-200 sheep is common. According to the 2001 census, 23.5% of herder families have 51-100 head, while 20% own 101-200 head. The average number of head per herder family is 99 (1 camel, 8 horses, 8 cattle, 45 sheep and 37 goats). Therefore, herd capitalization of 10-20% will give around US$200-800 per year per family. This data, the abovementioned importance of

[7] Rural district in the Gobi desert situated 240 km from Omnogobi *aimag* center (at a distance of about 600 km from Ulaanbaatar, the capital city)

PV utilization in the agricultural sector and the estimated cost of PV implementation efforts would require significant capital investment, including financing from ODA sources and other mechanisms, such as the Clean Development Mechanism (CDM).

As a whole, the introduction of PV will provide socio-economic benefits not only for the rural population, but also for the entire country, and may also earn the public approval that is the raison d'être of policy-makers.

Regional governments recognize the need to balance energy use, economic growth, and environmental limitations and are attempting to realize it both domestically and internationally with varying degrees of success. Under these circumstances, the utilization of renewable sources of energy, especially solar PV, presents a means of supplying electricity to the 40% or so of the Mongolian population that currently has no access to electricity.

6. Conclusions and recommendations

Specific demand is essential to the development of renewable energy sources, which may play a part in increasing social stability.

A strategy for reducing greenhouse gas emissions, which focuses simultaneously on the short- and long-term might be realized, focusing on the development of small-scale energy systems based on renewable energy sources. Inclusion of the utilization of renewable energy sources into the national energy policy portfolio with government subsidies and incentives will be a significant issue.

International cooperation (realization of CDM, as well as governments of industrialized countries encouraging national companies to produce and export advanced technologies involving the utilization of renewable energy sources/natural gas) is important to promote cleaner fuel options such as natural gas and renewable energy, where cost-effective.

References

BBC (2002). *Mongolia Signs Solar Power Station Deal with Japanese Agency*. BBC Monitoring Asia Pacific – Political (July 19, 2002)

Galbaatar T., Nachin D. (1982). *Feasibilty of the Utilization of Solar PV in Mongolia*. Economic Problems. Vol.2 (17-20). (in Mongolian) Ulaanbaatar: Press of the Academy of Sciences of Mongolia.

Government of Mongolia (GOM) (1999). The National Programme "*One Hundred Thousand Solar Ger*" on energy supply to rural residents from renewable energy sources. Attachment to Government Resolution #158, 1999. Ulaanbaatar: GOM.

GOM (2002). *Activity Report of the Government of Mongolia as of May 1st, 2002*. Ulaanbaatar: GOM. www.gate1.pmis.gov.mn/cabinet/news.htm (03 July 2002).

Japan International Cooperation Agency (JICA) (2000a) *Study on Support for Economic Transition and Development in Mongolia, Final Report of the Medium Term Economic Development Strategy*. Tokyo: JICA.

JICA (2000b) *Final Report on the Master Plan Study for Rural Power Supply by Renewable Energy in Mongolia*, Tokyo: JICA.

Khuldorj, B. (1999). *Mongolian Action Programme for the 21st Century*, Ulaanbaatar: ADMON

National Renewable Energy Laboratory (NREL) (2001). CD-ROM *Wind Energy Resource Atlas of Mongolia*, Colorado: NREL

New Energy Foundation (NEF) (2002). *New and Renewable Energy in Japan: Present State of New Energy Introduction in Japan and its Outlook.* Tokyo: NEF. www.nef.or.jp/english/new/present.html (22 July 2002).

Tsedmid, Sh. 1969. *Physical Geography of the MPR*. Ulaanbaatar: Press of the Mongolian Academy of Sciences

World Bank (2002). *Solar Electricity*. Washington, DC: World Bank.

www.worldbank.org/html/fpd/energy/subenergy/solar/solar_pv.htm (23 January, 2002)