APN Final Activity Report

Change and Sustainability of Pastoral Land Use Systems in East and Central Asia (APN 2001-03)

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Summary of entire project

A total of 40 foreign and about 60 Mongolian people attended the Symposium (See Appendix 1). Participants from China, Korea, Japan, Russia, U.S.A. and Australia were directly funded from the APN/START. Participants from Kasakhstan, Uzbekistan and France were sponsored from MEDIAS-France in order to allow scientists from Central Asia to set up a regional network and have contacts with their colleagues from the LUTEA project. START supported TEACOM Members. Some participants from UK, Kenya, Germany, U.S.A., Australia, Russia, France and Kazakhstan came on their own.

Abstracts of the Open Symposium on "Change and Sustainability of Pastoral Land Use Systems in Temperate and Central Asia" were published (4 copies enclosed in the mail). The book contains an agenda of the Symposium as well. As an output - the Symposium Proceedings on "FUNDAMENTAL ISSUES AFFECTING SUSTAINABILITY OF THE MONGOLIAN STEPPE" is going to be published this spring (See an Appendix 2). In addition, we are planning to produce a regional synthesis paper on vulnerability of rangelands and pastoral systems. The symposium was a great success according to evaluation of the participants.

Introduction/Background

The objectives of the Open Symposium were:

- Synthesis of existing knowledge on pastoral land use and cover changes (LUCC), identification of knowledge gaps and vulnerability of the regions to global changes;
- Review of integrated assessments of land use/cover change and climate change impacts on rangeland ecosystems and pastoral systems and potential adaptation strategies;
- Enhancing modalities for capacity building and networking among the scientists involved in research on pastoral LUCC studies in the region, and developing synergies for future collaboration.

In arid and semi-arid regions of east and central Asia, nomadic pastoralism has been the dominant agronomic activity for many centuries. Recent political, economic, social and cultural factors have caused changes in pastoral land use systems. The value of the Symposium was the gathering of the international and local multi-disciplinary experts who did long-term research primarily on pastoral land use systems. The Symposium provided a forum for regional and international scientists to share information and develop a stronger understanding of linkages between climate, ecosystem and human elements of the region. The Symposium facilitated the integration of the knowledge gained by different research groups of natural and social scientists, and identified policy products, knowledge gaps and vulnerable regions to global changes.

Detailed information of activities conducted

Participants dealt with issues related to the current trends of land productivity and land use in the region. Strategies of how to sustain the steppe regions of the area provided a lively topic for discussion from the interdisciplinary group present. Keynote presentations on integrated research outputs were made at general sessions of the Symposium.

The Symposium was organized along these parallel sessions:

- Vulnerability of pastoral systems to climate change and variability;
- Political and economic drivers affecting pastoral land use systems;
- Land use impact on rangeland ecosystem and biodiversity;
- Pastoral systems in regional and rural development;
- Integrated technologies (RS, GIS and modeling) for pastoral LUCC studies;
- Conservation and pastoral land use;
- Hydro-geomorphological impact of land use;
- Agro-pastoral and urban-rural interface: vulnerability to climate and land use change.

Each session was summarized by Chairs of the sessions - experts in the particular fields. These summaries will be included in the Symposium Proceedings (Appendix 2). A regional synthesis paper development on pastoral land use change is planned by PI-s in collaboration with key researchers.

A field trip to the Hustain Nuruu National Park was organized to study land use patterns and conservation planning. The field trip was hosted by the Mongolian Association for Conservation of Nature and the Environment (Programme of the field trip was included in mail). There were 35 foreign and 15 local scientists that participated in the field trip (Appendix 3). Takhi – a wild horse was re-introduced in the Hustain Nuruu National Park. The Symposium participants visited the National park and visited herders' families living nearby to the park. The main topics of discussion with herders were on traditional land use strategies and pastoral land use changes due to establishment of the park.

In addition, a joint research plan for the Mongolian, Chinese and Central Asian scientists was formulated during the field trip. A joint project on livestock dynamics (pastoral chronology) analysis was developed during the trip. The LUTEA and Central Asian scientists groups decided to submit separate

proposals, but combine their efforts afterwards. AIACC proposal development strategy was discussed. Three Mongolia AIACC pre-proposals united their efforts and submitted a single project from Mongolia.

The Symposium discussion on the sustainability of pastoral systems in the Mongolian Steppe region centered on the role which nomadic grazing systems have contributed to the degradation of the steppe ecosystems in the region. It was acknowledged that the overstocking of the steppe is occurring and action to reduce this situation needs to be taken, however, the solution to this problem can take various paths. The consensus was that strategies for reversing the degradation and development of sustainable strategies for the region should incorporate the benefits of traditional pastoral systems. Rotational grazing systems utilized by nomadic pastoralists are beneficial to mitigate the effects of droughts and other extreme weather events what are likely becoming more frequent and intense with climate change.

Outcomes/Products

The Symposium Abstracts have been published and the Symposium Proceedings on "FUNDAMENTAL ISSUES AFFECTING SUSTAINABILITY OF THE MONGOLIAN STEPPE" is going to be published this spring (see Appendix 2). All the papers on the list already have been collected. Now we are at the stage to review them and start finalizing the proceedings.

The development of grazing management systems needs to consider the advantages of traditional practices and incorporate appropriate new technologies which would provide the best path forward in attaining long-term sustainability of steppe resources. Appropriate strategies include:

- Strengthening traditional pastoral (resilient) networks and communities;
- Development of a disaster relief mechanism for dealing with natural disasters, such as *zud*, droughts, fires and animal disease outbreaks;
- Restoration of degraded pastures, especially near the water sources;
- Improvement of key ecosystems management, including riparian ecosystems;
- Restoring and adding water points;
- Enhancing hay production where it is possible;
- Increasing social and economic security of pastoral communities;
- Improving upon locally adapted and productive livestock breeding and distribution;
- Improvement of monitoring and forecasting technologies for environmental conditions;
- Improve accessibility and development of appropriate veterinarian practices for pastoral systems;
- Facilitate access to social and technological goods and services.

Future directions/follow-up work

A diversity of response to political and environmental shocks happened in different countries of this region. The understanding of multiple factors affecting livestock dynamics was proposed from the Symposium (See appendix 4).

Impact, vulnerability and adaptation assessment of global change on pastoral land use systems is critical for regional sustainability. Integration of natural and social sciences for this assessment is still an important issue in the region where tradition for such collaboration was undermined. A multi-disciplinary study of the human-environmental systems in arid and semi-arid lands of East and Central Asia in close collaboration with stakeholders and policymakers should be carried out. Conservation, rural and regional development issues would be more successful if they would be culturally acceptable and economically and socially viable. Sustainable community development approach might be the best approach where subsistence economy is still dominant.

The Mongolian AIACC 3-year project on climate change impact, vulnerability and adaptation assessment for rangelands and pastoral systems has been funded. T. Chuluun is one of Co-PI-s of the Mongolian AIACC project. Another Chinese AIACC project has been funded. The regional IGBP-II Terrestrial Human-Environment (THE) LAND project may be based on the LUTEA heritage. In other words, the LUTEA network's scientific strategy could adopt THE LAND project objectives.

The Symposium Proceedings will be ready for publication within a month. T. Chuluun is planning to work on it in Ulaanbaatar during next month. A meeting for the synthesis paper on vulnerability of pastoral land use systems of the region is under development. A small working meeting to work on it has planned, but we need of the APN approval.

Project website details (if available)

Website hasn't been produced.

CDs (if available)

CDs have not been produced.

If workshop(s)/conference(s) was/were held submit

- agenda/programme (Apendix 5)
- participant list (Apendix 1)

*Note: please submit by **28 February 2002** both an **electronic and hard copy** version of the APN final activity report – thirty bound copies, if possible. Thank you.*

Appendix 1. List of Participants for the Open Symposium on "Change and Sustainability of Pastoral Land Use Systems in East and Central Asia", June 28-July 1, 2001, Ulaanbaatar, Mongolia

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In addition, 6 American students and 2 French scientists participated in the Symposium.

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Appendix 3. List of Participants of the Field Trip to the Hustain Nuruu National Park, June 30-July 1, 2001

On APN funds

1. Yanfen WANG, China
2. Lindsey CHRISTENSEN, US
3. Mike COUGHENOUR, US
4. Jim ELLIS, US
5. Dennis OJIMA, US
6. Josep CANADELL [Pep], Australia
7. K.S. RAJAN, Japan
8. Peter GUNIN, Russia
9. Yinpeng LI, China
10. Gang WEN, China
11. Xingguo HAN, China
12. Zuozhong CHEN, China
13. Guangsheng ZHOU, China
14. Yuhui WANG, China
15. Liming YANG, China
16. Qinxue WANG, China
17. Teitaro KITAMURA, Japan

On MEDIAS FRANCE support and own expenses

1. Monique MAINGUET, France
2. Robin S. REID, US
3. Gerard BEGNI, France
4. Hassan VIRJI, US
5. Congbin Fu, China
6. Cho-Nam NG, China
7. Zhibin WAN
8. Roy H. BEHNKE, Jr., UK
9. Carol KERVEN, UK
10. Charles KRUSEKOPF, US (5 his students)
11. Svetlana NIKULINA, Uzbekistan
12. Sergey BAZHA, Russia
13. Temirbekov SAYAT, Kazakhstan

Total 35 foreign participants, including Charles' 5 students

Mongolian participants supported by the APN funds

1. Tsolmon
2. Batima
3. Erdenetuya
4. Chuluun
5. Dagvadorj
6. Battogtoh
7. Nyamaa
8. Danzan
9. Damdinsuren
10. Gerlee
11. Chimgee
12. Bilgee
13. Altanhuu
14. Sanjid
15. Bayasgalan

Appendix 4. Vulnerability of Livestock Populations to Climate Variability and Socio-Economic Factors in Predominantly Pastoral Temperate East Asia

Detailed Proposal

Overall Objective: Our objective is to investigate the vulnerability of livestock populations to climate variability and socio-economic factors. Livestock population data provide a graphic, concrete, long-term record of change, a kind of pastoral dendro-chronology, "tree rings" for the livestock sector (Behnke 2001). Population dynamics are the complex outcome of the interaction of multiple causes, so there are many variables that might drive increases, declines, temporary fluctuations or stability.

Climatic extreme events such as drought and *zud* (the Mongolian term used for severe winter conditions affecting livestock) limit livestock population increase. For example, 32 million of livestock were lost due to drought and *zud* over the last five decades in Mongolia (Z. Batjargal 2001). Some of these events are shown in Table 1. Previous summer condition is critical for livestock losses due to *zud*. The summer and fall drought of 1944 in the whole territory of Mongolia followed by the *zud* of 1944-1945 resulted in the highest loss of livestock, 7.5 million. However, 1.4 million animals were lost during 1976-1977 *zud*, despite having the highest snow level in the last 60 years because the previous summer was normal. Two consecutive droughts and *zud* of 1999-2001 resulted in loss of about 5 million livestock. Mongolia experienced a drought in over 60% of its territory last summer, so a *zud* condition is again expected in this coming winter. The well-being of herders is directly related to their number of livestock in Mongolia. The living standard of the rural people is plummeting rapidly after these recent climatic extreme events, contributing to an increase in unemployment and poverty in rural areas. For instance, 2,369 households have lost their entire livestock and over 10,000 households were left with less than 100 head of livestock due to the *zud* of 1999-2000.

Table 1. Livestock losses due to climate extreme conditions and livestock diseases in Mongolia (Z. Batjargal 2001)

Year	Livestock number, mln	Livestock loss, mln			Affected territory, %	Climate condition	
		climate	Diseases	Total		Temperature, colder from the average, ^{0}C	Snow depth, cm
1943	23.5	2.2	0.6	2.8	30	1.6 - 4.4	18 – 30
1945	20	7.5	0.5	8	80	5.9 - 11.4	15 – 28
1950	22.7	3.5	0.5	4	15	1.2 - 5.4	15 – 38
1955	23.1	1.3	0.6	1.9	44	1.2 – 9.1	20 – 26
1957	23.3	1	0.5	1.5	57	3.7 – 6,5	20 – 40
1961	20.4	0.5	0.7	1.2	25	0	15 - 30
1966	22.6	1.2	1	2.2	15	5.5 – 5.8	5 – 13
1968	20.7	2	0.7	2.7	62	2 –10	10 – 20
1977	22.9	1.4	0.6	2	81	1.2 – 8.5	40 – 60

Livestock production is a function of yield per animal and the number of animals from which the output was obtained. The traditional extensive pastoral system encouraged an increase in the number of livestock. This is still the main practice in Mongolia and China. However, an intensive pastoral system aimed at increasing yield per herd was introduced under collectivization, though more in China than in Mongolia. Livestock product price and forms of livestock ownership also greatly impact on livestock dynamics. Goat numbers have doubled in Mongolia during the 1990s during the transition to the market economy due to high prices for cashmere. A similar increase in goat numbers was observed in China since the early 1980s. Many other factors in addition to climate, livestock price, market demand and ownership can influence the amplitude of livestock fluctuations. For example, increased stocking rate, rangeland degradation, settlement, introduction of foreign breeds, poor veterinary services, lack of fodder and lack of herders' experience would contribute to greater vulnerability of pastoral systems, increasing loss of livestock during the extreme climate events.

Specific Research Objectives and Methods: Evaluate county/sum level changes of livestock numbers and densities for the past 50 years relative to:

- climate variability;
- livestock price and markets;
- livestock ownership patterns.

The approach involves creating a working group to collate the data and develop a summary paper for different areas of the region. We will obtain data on livestock population and grazing management practices from existing databases at the county level for pastoral regions of the Mongolian steppe in Mongolia and China.

Research Plan: Data collation for livestock numbers by major type, environmental information on extreme events and monthly weather, and economic data related to livestock prices will be conducted at the county-level. The time period for this analysis will cover the last 50 years. The analysis will compare livestock population changes across region and countries relative to environmental and economic data.

A) *Livestock data.* This data exists and is reliable enough in most cases. In Mongolia and China, livestock data is available at the national, provincial, and county level. This multi-tiered administrative structure will provide various levels of aggregation for the analysis. Thus, despite fundamental institutional changes, it is possible to compare livestock populations from the pre-reform period up to the present, at a variety of administrative and geographical scales.
B) *Comparative analysis of factors contributing to changes in stock numbers.* For methodological purposes, the factors fall into two categories. First are social factors that incorporate economic and policies changes that may have affected the livestock sector over the past several decades. These include:

- Removal of state support to livestock collective farms
- Institutional breakdown
- Land tenure laws which fragment large livestock farms
- Price of livestock products
- Cost of operations, including cost of fodder reserves, transportation, etc
- Availability of water resources

The main policy changes will be evaluated from primary sources (national legislation and policy decrees) and secondary sources (scholarly publications).
The second set of factors is more environmentally based and include:

- Climate extremes: droughts and *zud*
- Growing season precipitation: total amount and distribution
- Growing season degree days
- Forage availability

Timeline:

- Initial planning meeting of key people in spring 2002 (Beijing, PRC). This meeting will develop the specific data base structure and information content of the available data sets for the different study areas. We will define the specifics of the ancillary data related to socio-economic and climate information needed. We will provide funding for key participants from the region and associated experts. In addition, we will invite experts dealing with livestock systems in other semi-arid systems. The meeting will involve six to eight regional experts for a 3-day meeting in Beijing.
- Database development: Spring to September, 2001.
- Fall 2002: small workshop in Mongolia to report results and to work on publications (10-15 people for 5 days).

Relationship To Priority Topics in the APN Research Framework

Grasslands of the Asian steppe, including the Mongolian Plateau, have been a critical resource for meat, milk, leather, wool, and cereal grain production supporting millions of people in the region. Historically, low population densities of nomadic pastoralists have utilized the rich grassland region to graze their mixed herds of cattle, sheep, goats, horses and camels. Grazing patterns were dictated more by intra- and inter-annual climate variability than political or economic factors.
Dramatic changes in pastoral land use system have occurred with changes in governments and political controls on livestock demographic patterns. During the socialist period in China and Mongolia, many aspects of the traditional nomadic culture were replaced by socialistic practices. Herdsmen were commonly organized into collectives and were allowed to keep only

a small number of private animals. Risk avoidance mechanisms improved as more hay could be produced using machinery, more winter-shelters were built, and livestock had improved access to water from wells. It provided a buffer against climate extreme events.
In addition, human population levels rose dramatically during the first 40 years of the People's Republic of China, from 549 million in 1949 to 1,16 billion by July 1, 1990. This has led to increased grazing intensity and rates of cropland conversion. The most fertile land areas have been converted to croplands, and grazing has been shifted to less productive lands. This practice has intensified grazing on the remaining areas and has in many cases reduced ecosystem productivity and led to overgrazing. Whereas the growth of human population and the expansion of agriculture have impinged on and reduced the grasslands, the number of animals that depend on this shrinking resource has increased exponentially. The total number of grazing animals more than tripled, from slightly more than 100 million to nearly 340 million head between 1949-1989.

Over the past half century, many villages were created and overgrazing around these villages became widespread. Rangeland degradation has been associated with a greater occurrence of dust storms (Dagvadorj 1996). Since 1960, the number of dust storm days has increased twofold in Mongolia and nearly threefold in the Gobi (Natsagdorj and Namkhai 1993). This increase of dust storm days since 1960 can be also explained by this "spring drought" increasing trend in addition to land use intensity increase (Z. Batjargal 2000). A decrease in spring precipitation decrease by 17% and an increase in spring temperature by 1.4-1.5^{0}C is contributing to a drier spring environment (Mongolia National Action Program on Climate Change 2000).

The economic liberalization, in Mongolia and China, is affecting the livestock sector in a number of ways. For instance, Mongolia has been shifting from a socialistic centralized economy to a free market economy since 1990. During the 1990-1999 period, the total number of livestock increased from 25.8 million to over 33.57 million (the record number since 1918), 96% of which is privately owned (Mongolian Statistical Yearbook 2000).

The dissolution of the collective system and its associated top-down livestock and pasture management has led to the re-emergence of traditional informal institutions such as *hot ail* (a number of households pooling their labor resources together). However, their success is contingent upon other factors associated with liberalization such as migration, the terms of trade facing herders, the decreased availability of supplementary livestock feed and so forth. These changes have undermined coping mechanisms against climate variability/extremes and have resulted in a more vulnerable situation of pastoral systems.

Regional Collaboration

This research effort is a direct follow-on from the LUTEA Symposium held in June 2001 in Ulaanbaatar, Mongolia. The research proposed here will further the research collaboration among scientists working on grassland systems in the region, a major research theme for LUTEA research. The joint efforts of Chinese, Mongolian, Russian, Japanese, US and Australian scientists will be strengthened through analysis of livestock dynamics in this region of Asian grasslands. In addition to efforts described in this proposal, collaboration with ex-USSR Central Asian scientists is being developed. This will involve a parallel effort being proposed through European Union funding for obtaining similar data sets from Central Asian countries and Russia republics with large grassland areas. These countries have similar steppe ecosystems and have experienced comparable changes in social and economic conditions during the past century. The grassland ecosystems in these countries have been differentially impacted. Cross-country comparisons within the whole Eurasian grassland region would be useful in a wider assessment of the vulnerability of livestock populations to changes in climate and socio-economic policies.

Capacity Building

Research associates in China and Mongolia will collate the needed data and place them in a common database format. The data base will be made available to the LUTEA research community through an internet-accessible data interface. Work on data base development and

analysis will be carried out by national research associates and local students in Mongolia and China. Involving the students in the data compilation and research effort will provide additional training in scientific analysis related to global change in the region.

Links to Policy

Pastoral systems, which have lost traditional resilience mechanisms of coping with climate variability, will be the most vulnerable to climate change. For example, livestock mortality has been reduced in pastoral community *neg-golynhon* (herders from one river) which were self-organized into collectives compared to other *neg-golynhon* which were not organized into the collectives during the last *zud* winter of 2000-2001 (Enh-Amgalan 2001). This shows that strengthening of traditional pastoral networks with rural development policy will increase the adaptive capacity of pastoral systems against climate variability.

Production goals for the livestock industry must be based on limits imposed by ecologically-based stocking rates that ensure the pursuit of social and economic goals does not result in irreversible deterioration of the pastoral resources (Sheehy 1993). Land use intensity has increased in many parts of the Mongolian steppe. The carrying capacity for livestock might be exceeded in central and western parts of Mongolia. During the past decade, grazing pressure has intensified in central and western aimags such as Arhangai, Bayan-Olgii, Uvs and Hovd aimags by 44-99% and in Ulaanbaatar city area even 33 times (Tserendash 2000). The old herders from central regions of Mongolia have also complained that the plant productivity has decreased by one third to half during their life (Ellis and Chuluun 1993 & 2001). Identification of the regions vulnerable to climate change and land use intensity, where livestock density exceeds carrying capacity and also the regions showing high turbulence in livestock dynamics, has a direct link to policy.

Relationship to Global Change Research Programme

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Related Research Work

Pastoral systems, where humans depend on livestock, exist largely in arid or semi-arid ecosystems where climate is highly variable. Thus in many ways pastoral livestock systems are intimately adapted to climatic variability. In general, there is a direct relationship between climate variability and the spatial scale of pastoral exploitation (Ellis and Swift 1988). Where droughts or blizzards are frequent, livestock population fluctuations prevent plants and herbivores from developing closely coupled interactions, and ecosystems seldom reach a climatically determined equilibrium point (Ellis 1994). It is possible that non-equilibrial conditions may prevail in regions where long-term average precipitation (threshold level) is 266 mm or below (Ellis and Chuluun 1993). This includes over one-half of the Mongolian Steppe. The Mongolian Steppe shows high sensitivity to early growing-season precipitation and intensive rangeland management. Indeed recent past climate change with winter-spring warming and spring drought are already impacting on plant green-up and productivity of the Mongolian grasslands (remotely-sensed data and field observation by Chuluun & Ellis 2001). For example, the dry end of the steppe region appears to be the most vulnerable to climate change, especially where exists a high stocking rate.

Our simulation studies using CENTURY (Chuluun & Ojima 1996; Chuluun & Ojima 1999) confirmed that the Mongolian grasslands can lose significant amounts of carbon in continuous year-long or summer heavy grazing systems. The effect of different seasonal and year-long grazing treatments on soil carbon level also was simulated for 50 years. Heavy summer or year-long grazing for 50 years resulted in the largest loss of total soil carbon relative to other seasonal grazing scenarios, resulting in a 15% soil carbon loss.

a small number of private animals. Risk avoidance mechanisms improved as more hay could be produced using machinery, more winter-shelters were built, and livestock had improved access to water from wells. It provided a buffer against climate extreme events.
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Links to Policy

Pastoral systems, which have lost traditional resilience mechanisms of coping with climate variability, will be the most vulnerable to climate change. For example, livestock mortality has been reduced in pastoral community *neg-golynhon* (herders from one river) which were self-organized into collectives compared to other *neg-golynhon* which were not organized into the collectives during the last *zud* winter of 2000-2001 (Enh-Amgalan 2001). This shows that strengthening of traditional pastoral networks with rural development policy will increase the adaptive capacity of pastoral systems against climate variability.

Production goals for the livestock industry must be based on limits imposed by ecologically-based stocking rates that ensure the pursuit of social and economic goals does not result in irreversible deterioration of the pastoral resources (Sheehy 1993). Land use intensity has increased in many parts of the Mongolian steppe. The carrying capacity for livestock might be exceeded in central and western parts of Mongolia. During the past decade, grazing pressure has intensified in central and western aimags such as Arhangai, Bayan-Olgii, Uvs and Hovd aimags by 44-99% and in Ulaanbaatar city area even 33 times (Tserendash 2000). The old herders from central regions of Mongolia have also complained that the plant productivity has decreased by one third to half during their life (Ellis and Chuluun 1993 & 2001). Identification of the regions vulnerable to climate change and land use intensity, where livestock density exceeds carrying capacity and also the regions showing high turbulence in livestock dynamics, has a direct link to policy.

Relationship to Global Change Research Programme

This research effort is a direct follow-on from the LUTEA Symposium held in June 2001 in Ulaanbaatar, Mongolia. The research proposed here will further the research collaboration among scientists working on grassland ecosystems (GCTE) and pastoral (LUCC) systems in the region, a major research theme for LUTEA research.

Related Research Work

Pastoral systems, where humans depend on livestock, exist largely in arid or semi-arid ecosystems where climate is highly variable. Thus in many ways pastoral livestock systems are intimately adapted to climatic variability. In general, there is a direct relationship between climate variability and the spatial scale of pastoral exploitation (Ellis and Swift 1988). Where droughts or blizzards are frequent, livestock population fluctuations prevent plants and herbivores from developing closely coupled interactions, and ecosystems seldom reach a climatically determined equilibrium point (Ellis 1994). It is possible that non-equilibrial conditions may prevail in regions where long-term average precipitation (threshold level) is 266 mm or below (Ellis and Chuluun 1993). This includes over one-half of the Mongolian Steppe. The Mongolian Steppe shows high sensitivity to early growing-season precipitation and intensive rangeland management. Indeed recent past climate change with winter-spring warming and spring drought are already impacting on plant green-up and productivity of the Mongolian grasslands (remotely-sensed data and field observation by Chuluun & Ellis 2001). For example, the dry end of the steppe region appears to be the most vulnerable to climate change, especially where exists a high stocking rate.

Our simulation studies using CENTURY (Chuluun & Ojima 1996; Chuluun & Ojima 1999) confirmed that the Mongolian grasslands can lose significant amounts of carbon in continuous year-long or summer heavy grazing systems. The effect of different seasonal and year-long grazing treatments on soil carbon level also was simulated for 50 years. Heavy summer or year-long grazing for 50 years resulted in the largest loss of total soil carbon relative to other seasonal grazing scenarios, resulting in a 15% soil carbon loss.

Appendix 5. Open Symposium on "Change and sustainability of the pastoral land use systems in Temperate and Central Asia", June 28 – July 1, 2001, Ulaanbaatar, Mongolia

PROGAMME

June 27, Wednesday

1:00-8:00 Registration at the Ulaanbaatar Hotel
6:45pm Meeting at the lobby of the Ulaanbaatar Hotel
7:00pm Welcome reception at "Avtai Sain Khaany Orgoo" (for foreign participants)

June 28, Thursday

8:00-1:00 Registration at the **Symposium Hall of the Science and Technology Information Center**

(Chairperson: T. Chuluun)

9:00-9:45 **Opening ceremony**
Folk music presentation (Song for the Altai Mountains by Yavgaan's group) (10 min)
T. Chuluun, Chair of the Mongolian LUCC Committee (5 min)
B. Chadraa, Vice-Chair of the Mongolian IGBP Committee, MP & President, Mongolian Academy of Sciences (5 min)
B. Gungaadorj, Chair of the Ih Hural's (Parliament) Standing Committee on Rural Development and Environment (5 min)
Bolat, Vice-Minister of Nature and Environment (5 min)
B. Enhtuvshin, Vice-President, Mongolian Academy of Sciences & Director, International Institute for the Study of Nomadic Civilization (5 min)
Gerhard Breulmann (APN) (5 min)

Plenary talks

9:45 Dennis Ojima (USA) "Critical drivers of global environmental and Land Use changes in Temperate East Asia (LUTEA)"
10:15 D. Dagvadorj (Mongolia) "Climate change and its impact on ecosystems in Mongolia"
10:45 Caroline Humphrey & David Sneath (UK) "The end of nomadism? Pastoralism, state and the environment in Inner Asia"

11:15-11:30 **Coffee break**

11:30-1:00 **Poster session**
Review of the posters related to the parallel sessions 1, 2, 3 & 4

1:00-2:00 **Lunch**

All parallel sessions will be in the building of Ministry of Foreign Affairs.

2:00-3:45 **Parallel session 1. Vulnerability of pastoral systems to climate change and variability, co-chaired by Jim Ellis (USA) & Z. Batjargal (Mongolia)**

- Svetlana Nikulina (Uzbekistan) "Climate change detection and assessment in Aral Sea Basin" (20 min)
- Li Yinpeng (China) "Assessment of the impacts of climate change and social activities on grasslands of North China" (20 min)
- Lindsey Christensen (USA) "Simulation of vegetation state change due to grazing and climate change on the typical steppe, Inner Mongolia, China" (20 min)
- Z. Batjargal (Mongolia) "Lessons learnt from the multiple *zud* of 1999-2000 in Mongolia" (20 min)

General discussion
Concluding remarks by the Chairs

2:00-3:45 **Parallel session 2. Political and economic drivers affecting pastoral land use systems, co-chaired by Roy Behnke (UK) & Ts. Adyasuren (Mongolia)**

- D. Bazargur (Mongolia) "Pastoral land use change in Mongolia" (20 min)
- David Sneath (UK) "Pastoralism and socio-technical systems: decollectivization and rural reform in Mongolia" (20 min)
- Ts. Adyasuren (Mongolia) "Decision support system for pasture management & combat desertification" (20 min)
- Yuliy Drobyshev (Russia) "Ideology and nature management in contemporary Mongolia" (20 min)

General discussion
Concluding remarks by the Chairs

3:45-4:15 **Coffee break**

4:15-6:00 **Parallel session 3. Land use impact on rangeland ecosystems, co-chaired by Han Xingguo (China) & Dowon Lee (Korea)**

- Inessa Miklyaeva (Russia) "Comparative analysis of floristic dominant diversity and plant cover structure under pastoral digression in the main provinces of the Eurasian steppe region" (20 min)
- Chen Zuozhong (China) "Impact of grazing on vegetation-soil system of grassland in Inner Mongolia" (20 min)
- Ch. Dugarjav & D. Bayasgalan (Mongolia) "Optimal use of pasture based on its plant community" (20 min)
- Zhou Guangsheng (China) "Responses of typical grassland ecosystems to pastoral land use and climate change" (20 min)

General discussion
Concluding remarks by the Chairs

4:15-6:00 **Parallel session 4. Pastoral systems in regional and rural development, co-chaired by Teitaro Kitamura (Japan) & L. Tsedendamba (Mongolia)**

- Daniel Miller (US) "Homes on the range: The end of Tibetan nomadic pastoralism or a base for sustainable pastoral development on the Tibetan Steppe?" (20 min)
- A. Enkh-Amgalan & L. Tsedendamba (Mongolia) "Regional development of Mongolia, and change and sustainability of pastoral land use system" (20 min)
- Charles Krusekopf (USA) "Economic development and the pastoral commons in Mongolia" (20 min)
- S. Tserendash (Mongolia) "Pasture resources and its carrying capacity in Mongolia" (20 min)

General discussion
Concluding remarks by the Chairs

6:00-8:00 **Reception**

June 29, Friday

9:00-1:00 Registration at the **Symposium Hall of the Science and Technology Information Center**

(Chairperson: B. Enhtuvshin)

Plenary talks

9:00 Jim Ellis (USA) "Integrated assessment of climate and land use changes on rangelands of East and Central Asia"

9:30 B. Enhtuvshin (Mongolia) "Transformation of nomadic civilization in Central Asia"

10:00 Carol Kerven (UK) "The loss of livestock mobility in the new market economies of Kazakhstan and Turkemistan: Implications for rangeland degradation and regeneration"

10:30 Teitaro Kitamura (Japan) "Regional planning in Bulgan aimag"

11:00-11:20 **Coffee break**

11:20-12:50 **Poster session**
Review of the posters related to the parallel sessions 5, 6, 7 & 8

12:50-2:00 **Lunch**

All parallel sessions will be in the building of Ministry of Foreign Affairs.

2:00-3:45 **Parallel session 5. Integrated technologies (RS, GIS and modeling) for pastoral LUCC studies, co-chaired by Dennis Ojima (USA) & S. Khudulmur (Mongolia)**

- M. Coughenour (USA) "Integrated assessment for ecosystem state, conservation and human well-being" (20 min)
- S. Khudulmur (Mongolia) "Land use/cover map & pasture monitoring" (20 min)
- Zakarin (Kazakhstan) "Monitoring of dust storms in the Aral Sea region" (20 min)
- Wang Qinxue (China) "A GIS based study on grassland degradation and increase of dust storm in China" (20 min)

General discussion
Concluding remarks by the Chairs

2:00-3:45 **Parallel session 6. Conservation and pastoral land use, co-chaired by Robin Reid (USA) & Vladimir Karakin (Russia)**

- D. Avaadorj (Mongolia) "The current situation and trend of future changes of the Mongolian pasture quality" (20 min)
- V. Karakin (Russia) "Trans-boundary problems of biodiversity conservation in the Northeastern Asia" (20 min)
- D. Ariungerel (Mongolia) "Rangeland health monitoring in the Eastern Steppe of Mongolia" (20 min)
- Robin Reid (USA) "Land use change and fragmentation of rangeland ecosystems in East Africa: are there parallels with Mongolia?" (20 min)

General discussion
Concluding remarks by the Chairs

3:45-4:15 **Coffee break**

4:15-6:00 **Parallel session 7. Hydro-geomorphological impact on land use, co-chaired by Yu. Tanaka (Japan) & R. Batima (Mongolia)**

- Yukiya Tanaka (Japan) "Comparative study on the runoff characteristics of granite and paleozoic sandstone drainage basins around Ulaanbaatar" (20 min)
- R. Batima (Mongolia) "Climate change andf its impacts on water resources in Mongolia" (20 min)
- Peter Gunin (Russia) "Assessment and mapping of degradation processes of the Selenge river basin under trans-border interaction" (20 min)
- B. Tsedendamba (Mongolia) "Optimal water supply of pasture is one of the main goals of environmental protection" (20 min)

General discussion
Concluding remarks by the Chairs

4:15-6:00 **Parallel session 8. Agro-pastoral and urban-rural interface, co-chaired by K.S. Rajan (Japan) & David Sneath (UK)**

- K.S. Rajan (Japan) "Rural-urban migration, farming systems and impacts for land use changes" (20 min)
- D. Dash (Mongolia) "Land degradation in near Ulaanbaatar area" (20 min)
- Tesebekjapov (Russia) "Methodological aspects in the study on the problems of civilization and culture in the region of Central Asia" (20 min)
- Han Xingguo (China) " Restoration of Degraded Grassland Ecosystems in Inner Mongolia: Scientific, Social and Economic Considerations" (20 min)

General discussion

Concluding remarks by the Chairs

June 30, Saturday

A general Session will be held in the Symposium Hall of the Science and Technology Information Center

(Chairperson: Dennis Ojima)

Summary session

9:00 Joseph Canadell (Australia) "Global change and the limits of ecosystem functioning"

9:20 Summary presentations of parallel sessions by the Chairs (each session 10 min)

10:40 General discussion

11:00-11:20 **Coffee break**

Networking

11:20 Gerhard Breulmann (APN) "Introduction of the Asian Pacific Network for Global Change Research"

11:30 Hassan Virji (START) "The global Change SysTem for Analysis, Research and Training (START): Capacity building for global change"

11:40 Fu Congbin (TEACOM) "Regional climate modeling"

12:00 Discussion on lunching of grassland and pastoral network in Temperate and Central Asian region

- Gerard Begni (France) "Setting up a LUCC-oriented network in the Aral Sea basin: objectives and path finder initiatives" (20 min)
- Roy Behnke (UK) "Livestock population and land use changes following market reforms: a proposal to create and ad hoc network to undertake comparative policy research on pastoralism in Central and Inner Asia" (20 min)
- Discussion

1:00 **Closing remarks**
Dennis Ojima (5 min)
T. Chuluun (5 min)

1:10-2:10 **Lunch**

2:30 Leave for the overnight field trip to the Hustain Nuruu Reserve.

We will arrive from the field trip to Ulaanbaatar at 6PM on July 1, 2001.