







## POLICY FRAMEWORK FOR ADAPTATION STRATEGIES OF THE MONGOLIAN RANGELANDS TO CLIMATE CHANGE AT MULTIPLE SCALES

## **TERMINAL REPORT**

ULAANBAATAR 2008

## Acknowledgements

The project "<u>P</u>olicy Framework for <u>A</u>daptation Strategies of the Mongolian <u>R</u>angelands to <u>C</u>limate <u>C</u>hange at Multiple Scales (PARCC) is supported by a grant from Advancing Capacity in Support of Climate Change Adaptation (ACCCA), managed by the UNITAR and the START and funded by the European Commission EuropeAid Cooperation Office, the UK Department of Environment and Rural Affairs and the Netherlands Climate Change Support Programme. The PARCC project is endorsed by the Global Land Project.

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## Table of contents

- 1. EXECUTIVE SUMMARY
  - 1.1. Key issues addressed by the project
  - 1.2. Main findings and policy recommendations
- 2. INTRODUCTION
  - 2.1. Background
  - 2.2. Method and methodology
  - 2.3. Project goal, immediate objectives and outcomes
  - 2.4. Brief description of project sites
  - 2.5. Key stakeholders and partnerships
- 3. CLIMATE CHANGE AND RANGELAND ECOSYSTEM
  - 3.1. Climate change
  - 3.2. Rangeland ecosystem service
  - 3.3. Rangeland vulnerability assessment land use
  - 3.4. Traditional knowledge and cultural landscape of Mongolian rangelands
- 4. SOCIO-ECONOMIC RESEARCH
  - 4.1. Productivity of animal husbandry and poverty
  - 4.2. Socio-economic vulnerability assessment

## 5. ADAPTATION STRATEGIES TO CLIMATE CHANGE

- 5.1. Climate change scenarios 2020, 2050 and 2100
- 5.2. Development scenarios of herders' communities up to 2015 and 2021
- 5.3. Adaptation options to climate change at multiple scales
- 5.4. Policy adaptation recommendations for Mongolian rangelands

## 6. SUGGESTIONS FUTURE ACTIVITIES

6.1 Draft proposal on climate change adaptation demonstration sites

## Task implementation report of PARCC project

Task name	Description	Date	Percent
A1 – Conduct social learning and participatory research at community level	Social learning and participatory research were conducted in two stages. First, we have visited selected six herders' groups and we exchanged our information and knowledge. We have introduced our research findings on climate change, its impact on ecosystems etc. The herders introduced current state of information on climate, ecosystems, land use etc. At the second stage, we have organized participatory workshops community level. The program consisted of Al Gore's movie on Climate Change, Chuluun's presentation on CC issues at the country scale, preliminary analysis of CC vulnerability research for particular community, and it was followed by discussion on adaptation strategies.We organized community level workshop involving local government officers in order to facilitate decision-making, and did social learning and social questionnaire research from pastoral communities.Ind theLiterature on vulnerability and adaptation studies, particularly for Mongolia, 		100%
<u>1.1 – Conduct a</u> <u>literature review and</u> <u>data collection for the</u> <u>study areas</u>			100%
<u>1.2 – Gather data</u>			100%
<u>1.3 – Identify herder</u> groups to manage risks			100%

Task name	Description	Date	Percent
<u>1.4 – Conduct</u> integrated analysis studies	Vulnerability of pastoral systems was analyzed with index, which incorporates both zud (severe winter followed drought summer) and grazing relative to carrying capacity at community and sum levels; Change in cultural landscape use was studied at communities. Integrated analysis at community level was done fully. Under this task, project participants conducted integrate analyses of climate change trends, droughts and zud for the selected areas; vulnerability assessment of selected places to climate change; changes in cultural landscape use; socio-economic vulnerability of the communities and coping range dynamics. We introduced these results and composite index of social economic-ecological vulnerability assessments to all stakeholders during community participatory workshops,	Jun 2007– Nov2008	100 %
	local sum workshops and national workshop. Also, the results were presented at the Resilience Conference 2008 in Stockholm and more detailed results were presented at the IGC/IR Congress 2008 in Hohhot.		
<u>1.5 – Data synthesis,</u> analysis and preparation	<ul> <li>RS, GIS and modeling technologies were used for data synthesis, analysis and preparation for the decision-making workshops of sum level.</li> <li>Climate trends since 1960 were analyzed for sums with the meteorological station;</li> <li>Social vulnerability of herders' groups and sums was analyzed based on data collected during the social surveys and from the local administrations;</li> <li>Comparative analysis of vulnerability of herders' groups was done;</li> <li>Pasture use and carrying capacity were defined for each pastoral community;</li> <li>An assessment of the Hondlon spring ecosystem service to produce water was made and introduced to local herders and government officers.</li> <li>Some data were brought from the NREL, CSU. We have finished data analysis and synthesis related to pastoral communities and sum level.</li> <li>Previous analysis of climate and land use changes on rangelands, using RS, GIS and modeling were used for social communications widely.</li> <li>Above mentioned all data synthesis and analysis were done and some results</li> </ul>		100 %

Task name	Description	Date	Percent
<u>1.6 – Video</u> documentation	Adaptive rangeland and water management practices on vulnerability to spring and early summer drought trends and of climate change adaptation measures for the selected sites were documented. Video was taken during the early growing season and summer periods. It is great that we could continue it during winter and spring to capture all critical periods of the year. Video documentation (600 minutes) on best adaptation practices such as fencing of water sources, setting up legal communities etc., ecological and pastoral land use problems, and social learning activities such as participatory workshops at community level was produced during the 2 field trips. 15-20 minutes summary video documentation on adaptive rangeland and water management practices for the study sites was displayed during the workshops at sum and national levels.	ngeland and water management practices on vulnerability to spring ummer drought trends and of climate change adaptation measures cted sites were documented. aken during the early growing season and summer periods. It is re could continue it during winter and spring to capture all critical ne year. mentation (600 minutes) on best adaptation practices such as vater sources, setting up legal communities etc., ecological and d use problems, and social learning activities such as participatory at community level was produced during the 2 field trips. 15-20 nmary video documentation on adaptive rangeland and water nt practices for the study sites was displayed during the workshops national levels.	
<u>A3 – Develop</u> adaptation policy at various scales	We developed adaptation options and policies at local and national level. Our produced adaptation options and policies discussed by all stakeholders during local and national workshops. Also our papers on our project results were published in international scientific newsletters. For example, our project's preresult published in UPDATE newsletter. Everyone can see this article from IHDP website. (Chuluun Togtohyn, Climate Change Adaptation Strategies for Pastoral Communities of Mongolia's Central Mountainous Region, IHDP Update 2.2008, p 53-58) and IRC/IGC-2008 proceedings (A policy to strengthen pastoral communities and to restore cultural landscapes for climate change adaptation and sustainability. XXI Grassland and Rangeland Congress & VIII International Grassland Congress on "Multifunctional Grasslands in an Changing World" Volume II: 930).		90 %
<u>3.5 – Develop</u> <u>communication</u> <u>material</u>	Op tionWe produced brochures and video materials. Also our project website on www.drylandustainability.mn opened in 10 December 2008 in Mongolian. Our project brochure was published in 15 December 2008 and we distributed 300 brochures on "Adaptation policy of Mongolian dry-land rangelands to climate change" to all stakeholders during National workshop.Summary video documentation was produced and introduced to all stakeholders. Also, we have already produced the desertification brochure for Mongolia including our pilot study sites with the Swiss Agency for Development and Cooperation as collaborative effort with our project.		100 %

Task name	Description	Date	Percent
3.3 – Proposal for CC adaptation & development	A joint proposal was developed by stakeholders and will be submitted to the Government soon. The proposal related to administrative-territorial units, which incorporated cultural landscape as an increased adaptation mechanism to climate change and climate variability. For example, Sant sum's administrative and local herders made a decision to enlarge and unite their unit with neighboring sums and applied to the Aimag government it. Proposals for climate change adaptation mentioned in our publications in the international science proceeding and newsletter.	Jun 2008– Dec 2008	100 %
	Joint proposals on assignment of hay land, legalization of herders' group turning into registered NGO, spring protection fence improvement, setting up community based natural resource conservation and sustainable management, taking local sacred lands under sum government for effective conservation, cross sum boundary pasture use regulation, proposal on larger administrative unit restoring historic cultural landscape were developed.		
<u>3.4 – Develop</u> <u>additional adaptation</u> <u>implementation</u> <u>proposals</u>	<ul> <li><u>Develop</u></li> <li><u>tional adaptation</u></li> <li><u>ementation</u></li> <li><u>bosals</u></li> <li>We developed additional policies at communities, sum and national level by</li> <li>means of discussion local and national workshops. These proposals published</li> <li>in our brochures.</li> <li>Also, some additional adaptation implementation options were defined by</li> <li>means of social learning. Most of them are indigenous knowledge.</li> </ul>		100 %
<u>3.8 - Brochure, CD &amp;</u> video material	We produced and published 300 pieces our project brochure on "Adaptation policy of Mongolian dry land rangelands to climate change" in 15 December 2008. Desertification brochure was already produced and distributed to local communities. All stakeholders watched on the documentation movie for 15-30 minutes which we made in our pilot study sites during field trips and workshops in Ovorhangai and Hustai National Park in 18 and 21 November 2008.	Apr 2008– Dec 2008	90 %
3.6 - Website development and updating	Our project website on www.drylandsustainability.mn in Mongolian was opened in 10 December 2008. We are preparing to open this website in English and working update in every week.	Aug 2008– Dec 2008	85 %

Task name	Description	Date	Percent
<u>3.1 – Develop</u> recommendations	We published a draft of policy recommendations of adaptation to climate change in our project brochure. Then all stakeholders discussed and improved it during National Workshop. Climate change adaptation strategy must be based on "Win-Win" model. We combined climate change adaptation strategy of Mongolia with newly developing "National program to combat desertification", following the Strategic goal No.6, Environmental Policy, the "National Development Comprehensive Policy based on the Millennium Development Goals". A restoration of cultural landscapes at multiple scales and strengthening of traditional pastoral networks with modern technologies will enhance socio-ecological resilience and reduce vulnerability of pastoral systems to climate change. Recommendations on climate change adaptation options for similar ecological regions in Mongolia produced in collaboration with the Agency of Land Affairs, Geodesy and Cartography (ALAGAC) and Mongolian Development Institute (MDI).		85 %
<u>3.7 - Writing of</u> synthesis paper	A draft of synthesis paper was published in our project brochure and was distributed to all stakeholders. As a result of National workshop discussion, we have written synthesis paper of on climate change adaptation at the community and administrative-territorial unit levels. We are receiving some additional proposals on synthesis paper from some policy makers and scientists.	Aug 2008– Dec 2008	90 %
<u>3.2 – National</u> workshop, Ulaanbaatar	We successfully conducted National Workshop in Ulaanbaatar city in 18 December 2008. All stakeholders (65 participants) of our project including representatives from Ministry of Food and Agriculture, Ministry of Nature and Environment, Ministry of Foreign Affairs, local administrative, local herders, scientists and graduate students attended in the workshop. We all discussed and outlined the adaptation options and policy recommendations during the workshop. We distributed to all stakeholders our brochure on "Adaptation policy of Mongolian dry land rangelands to climate change". TV news about our workshop was broadcasted on national 3 TV channels and news were published by 2 national daily newspapers.	18 Dec 2008	100 %

Task name	Description	Date	Percent
<u>A2 – Climate</u> <u>change adaptation</u> <u>options</u>	Adaptation options at local level (herders' communities and sums) and national level were discussed by all stakeholders during the local workshop 18-21 November 2008 and National Workshop 18 December 2008. These adaptation options were published on our project brochure. Then we improved the adaptation options by means of national discussion. Synergies of climate change adaptation strategies were elaborated with other government policy with "National program to combat desertification" and "Pasture use law" for different ecological zones. Now we synthesized the findings and preparing for participatory workshops at local government scale. Water and riparian ecosystem management, pasture management restoring cultural landscapes (sum consolidation is one mechanism), diversification of income and transformation of some herders into farmers are critical components of the CC adaptation strategy.		100 %
<u>2.1 – Community</u> participatory workshops	<ul> <li>4 participatory workshops to develop adaptation strategies at community level were conducted with participation of scientists (including our national project advisers), herders and local government officers (sum governors, land officers and agricultural specialists) during 9 days fieldtrip, from 29 June 2007 to 8 July 2007. Participatory workshops were conducted in the pilot study areas to identify adaptation options/strategies to increase the resilience of the pastoral communities to climate change and land-use changes for particular sites. Social learning, scoring of adaptation options and scenario building methods were used.</li> <li>We displayed AI Gore's movie "Unpleasant truth" in the Mongolian language, climate impact on Mongolia overview and ecological, socio-economic issues for particular community and discussed adaptation strategies by each community at the community workshops.</li> </ul>		100 %
<u>2.5 - Facilitate</u> decision-making	acilitate n-making 2 springs of pilot sites were protected by local herders and officers along our initiative and scientific backgrounds. Sant sum's administrative and local herders made a decision to enlarge and unite their unit with neighboring sums to incorporate cultural landscape as an increased adaptation mechanism to climate change and climate variability. Proposals for climate change adaptation mentioned in our publications in the international science proceeding and newsletter. Decision-making with group leaders for long-distance movement of livestock to make use of summer and fall pastures outside of their current grazing areas will be facilitated through making agreements with pastoralists in these outlying areas.		90 %

Task name	Description	Date	Percent
2.7 - Use CCET for risk communication	We introduced to all participants rangelands vulnerability index including white winter disaster (zud) and future climate change scenarios up to 2020, 2050 and 2100 in our pilot study sites, using models of CCE tool, FAWSIM and CLIModel during the local participatory workshops (Hustai and Ovorhangai in November 2008). Our improved scenarios of future climate change by each community were introduced during National Workshop and were published in our project brochure.	Jul 2008– Nov 2008	100 %
2.9 - To develop simple mathematical models for decision- making	Decision support tool. We made our presentations for local workshops using some simple mathematical models. For example, human population increase, livestock increase, drought and zud index, socio-economic vulnerability index of herder communities, cost of springs for water services and socio-ecological composite index were calculated on simple mathematical models.	Jun 2007– Jul 2008	100 %
<u>2.8 - Socio-economic</u> <u>scenarios</u>	Young scientist Davaanyam introduced socio-economic scenarios by each community and sum level during local workshops 17-22 November 2008, using human population growth, livestock increase, product diversification, remoteness from market data. We improved and introduced these scenarios to all stakeholders for National workshop. Complexity scenarios by each community including socio-economic and ecological scenarios were published in our project brochure.		100 %
2.4 – Field trip 2 to re- visit all pilot study sites	We did our pilot sites field trip in 5-12 September, 2008 with our foreign colleagues from New Zealand, China and USA. We organized training workshop for learning on CCE tool, social survey and century model during the fieldtrip. We collected additional database and conducted additional social survey and questionnaire. We distributed our brochure "Desertification is knocking the door" including some research results of our project to all of herders households of our pilot sites.		100 %
2.6 - Facilitate consensus actions	Consensual actions related to giving summer and fall seasonal pastures, otor and hay-making lands were facilitated. Consensual actions related to facilitate fencing of vulnerable springs should be considered successful because at least one spring was already fenced and we raised awareness about fencing of another spring to protect it from destruction through overgrazing.		100 %
2.9.1 - Synthesize lessons learned	We have synthesized lessons learned during all field trips and participatory workshops. We developed adaptation options to climate change for each herders' communities and sum level during local workshops based on social learning.		100 %

Task name	Description	Date	Percent
<u>2.2 – Workshop-1,</u> <u>Tov aimag Hustai NP</u>	We organized 2 local participatory workshops including herders, local administration and project consultant during 16-22 November 2008. First workshop was held on 18-19 November 2008 in Hujirt sum's center including 3 sum's administration representatives (governors, land manager and ranger) and our project consutants. and second workshop was held on 20-21 November 2008 in Hustai National Park including 2 herders' communities, 3 soums' administration representatives (governors, land manager and ranger) and our project consultants. Totally, 63 participants attended in these		
<u>2.3 – Workshop-2.</u> <u>Ovorkhangi aimag</u>	<ul> <li>workshops. All participants watched a documentation film which we made in our pilot study sites during field trips and workshops. As a result these activities, we made policy recommendations, proposal on draft law of pastureland and adaptation options at multiple scale including herder's communities, sums and national level. We also together discussed adaptation options to climate change at multiple scales during the workshop.</li> <li>All stakeholders reached the consensus on importance of following aspects for improved CC adaptation:</li> <li>Restoration of cultural landscapes (hay lands, otor, seasonal pasture etc.);</li> <li>Development community based conservation and sustainable use of natural resources;</li> </ul>	Nov 2008	100%
	<ul><li>Consolidation of small administrative units;</li><li>Protection of water sources and surrounding ecosystems.</li></ul>		

## Geographic focus of the project:

Formal and informal herders groups from Altanbulag, Argalant and Bayanhangai sums of Tov aimag, Hujirt, Olziit, Sant and Harhorin sums of Ovorhangai aimag and Bugat sum of Govi-Altai aimag.

## Targeted sector or system of the project:

Livestock sector, land and water systems, herders groups

## Targeted decision makers/actors:

Herders, local land and government officers, young scientists and students, officials from Ministry of Construction and Urban Development, Ministry for Nature and Environment and Ministry of Food and Agriculture

## Purpose:

## Increase the resilience of pastoral communities living in transitional ecosystem zones of Mongolia to cope with climate change and climate variability in order to reduce rangeland degradation and improve water security

#### Specific objectives:

- Add to communities' and resource managers' knowledge of adaptive rangeland and water management practices currently in use on lands vulnerable to drying.
- Communities and local government develop and agree plans to revise the allocation of pastures for seasonal use, hay making lands, reserve pasture and sacred lands so as to be compatible with current and expected future climate stresses and with traditional cultural values.
- Reach consensus among the herders and other stakeholders about local solutions to be promoted to improve water security
- Reach consensus for selected pastoral communities sustainable development options, adapting to a changing climate;
- Reach an agreement among the stakeholders on new administrative-territorial unit opportunity which incorporate cultural landscape as an increased adaptation mechanism to climate change.

The adaptation to climate change strategies include:

- Long-term land ownership based on the traditional cultural landscape concept by pastoral networks such as *hot ail, neg golynhon* etc.
- Conserving critical ecosystem services, for cleaning water, providing hay and pasture during climatic extremes such as drought and *zud*;
- Restoration of cultural landscapes at community and administrative-territorial unit level.

### Summary

Mongolia is in a region that is experiencing the greatest warming on our Earth during the past century. It has warmed by the 1.8°C since 1940, with the greatest warming occurring during the winter months (approximately a 3.6°C increase) and in the spring (approximately 1.8°C increase). Annual precipitation has not change much, but the spring season is becoming drier, causing decreased plant biomass production and later plant onset in some parts of Mongolia. Frequency of *zud* (drought in summer followed by cold snowy winter) has increasing trend. Global warming is also reducing surface water, lowering underground water levels and decreasing snow covered days with consequences of black *zud* (winter drought conditions). Currently, Mongolia is the 20<sup>th</sup> most economically vulnerable country out of 112 countries. All these changes are making the coupled social-environmental systems in the Mongolian rangelands vulnerable to climate change.

Traditional pastoral networks evolved in the direction to increase human adaptive capacity to cope with climatic risks. Spatially large landscape is critical in arid lands to offset climate variability with extreme events such as *zud* and droughts. A fragmentation of the cultural landscapes in the arid and semi-arid lands of Mongolia has increased vulnerability and reduced the adaptive capacities to climate variability of traditional pastoral systems, which have evolved over thousands of years. The project's purpose was to **develop local adaptation strategies of the coupled social-environmental system to climate change in the Mongolian rangelands** as well as to synthesize these findings and apply them to similar ecological regions.

This project builds on a previous climate change vulnerability project in which remote sensing data was collected, and an ecosystem modeling analysis and ground surveys were conducted through the Assessment of Impacts and Adaptation to Climate Change (AIACC) program. Further work used higher resolution and detailed vulnerability assessment of the rangelands at pilot study sites in order to develop adaptation strategies to climate change in the most vulnerable zones. These were conducted with the participation of scientists, herders and local land officers. Knowledge gaps were identified.

A restoration of cultural landscapes at multiple scales, strengthening traditional pastoral networks, as a safety mechanism against extreme events will reduce poverty and support sustainable development. The project defined the best land management practices on fragile rangeland and pastoral systems to restore cultural landscapes at multiple scales improve water security and find alternative development options for pastoral communities to adapt to climate change.

Nomadic culture occurred as an emergent property in the highly variable climate and diversity of landscapes in arid and semi-arid lands (Chuluun 2000). Traditional pastoral networks evolved in the direction to increase human adaptive capacity to cope with those climatic risks. Spatially large landscape is critical to offset climate variability with extreme events such as *zud* and droughts.

Currently, the pastures are not privatized in Mongolia and only winter and spring pastures are owned by the herders. Vulnerability of rangelands and pastoral systems to recent climate change was studied using remote sensing information on NPP. The central part of Mongolia has decreasing NPP trend over last two decades. Spring drying trend have been a major climatic factor impacting on NPP decreasing trend. Vulnerability index of the rangelands defined as *zud* and land use intensity relative to carrying capacity had increasing trend in 1990s. Thus both climate and land use changes resulted in increased vulnerability of pastoral systems during 1990s. This study to climate change was done and vulnerable places with the most climate change, land productivity change and delayed green-up trends were identified. We need to introduce long-term land ownership regime in these vulnerable places, especially for summer and fall pastures. We think that traditional pastoral networks should be encouraged with new land reform policy in Mongolia.

The ALAGAC has local land officers. We collaborated with these local land officers and local herders to find the best adaptation decision making for particular vulnerable pilot sites. We have 6 pilot sites in each ecological zone: desert steppe, dry steppe, mountain steppe and forest steppe. Based on implemented adaptation options policy recommendations specific both to local place and broader similar region were adapted. Policy recommendations were generated at multiple scales and included in the policy papers. Specific land management option in pilot sites adaptive to climate change were included in the land use plan and submitted to the Sum Hural of Representative for approval.

<u>A restoration of these pastoral networks at multiple scales as safety mechanism against climatic</u> <u>extreme events will reduce poverty and support sustainability.</u> Strengthening sustainable livelihood with modern technology such wireless communication and renewable energy will further improve insurance of the herders against increasing climatic extreme events through business opportunities (Chuluun & Enh-Amgalan 2003). A restoration of old administrativeterritorial unit-*hoshuu* means a restoration of cultural landscape. Thus a new administrativeterritorial division, which restores cultural landscapes, was proposed to improve an adaptive capacity of the *hoshuu* as a coupled human-environmental system to climate change.

## Outreach and communication

The targeted stakeholders are herdsmen and policy makers. The serious gaps exist between science, policy and herdsmen in Mongolia. This project aims to improve this situation. The scientists still work primarily with their scientific interest, but less work is conducted in the field relevant for policy and development. Surveys with the herders are often not for their benefit, for instance, our previous survey with the herders were based more for confirming of our research findings. The policy makers still work mostly in their offices and they are lagging behind the real situation arising with market demands and environmental constraints in the pastoral systems. Policy is often political with little regard to science and users.

The first priority targeted stakeholders would be herders living in the vulnerable to climate change regions, which are about half of 170,000 herders' households in Mongolia (Mongolian Statistical Yearbook 2005). We worked with herders and land officers on the pilot sites to explore development options (land management, community strengthening, new administrative division to restore cultural landscapes at multiple scales) adaptive to climate change effects. The first of all, land management strategy, the best adapted to climate change in the particular place, will be identified and it will be discussed by the local administration responsible for land management. Long-term land ownership option will be implemented in the pilot sites in order to improve adaptive capacity of the community to climate change. Proposals for strengthening traditional pastoral networks with modern technologies will be developed further in collaboration with the herders.

Overgrazing is happening along the Tuul River because not only the herdsmen from Altanbulag sum, but the herders from Argalant and Bayanhangai sum, due to lack of summer and fall pastures (Management plan of the buffer zone of the Hustai National Park for 2006-2010. 2006). The management plan of the buffer zone of the Hustai National Park was developed.

All this local information and knowledge were synthesized to develop the following products for policy makers:

- The best adapted to climate change land management policy, especially in vulnerable regions;
- Adaptive to climate change development strategies for pastoral communities, living in rangelands with non-equilibrium dynamics;
- Vulnerability assessment of the current administrative-territorial unit as the human environmental system of Mongolia to climate change and proposal of new administrative-territorial division of Mongolia as adaptation mechanism to climate change.

#### Introduction

Nomadic pastoral systems are dissipative structure-functions (Nicolis and Prigogine, 1977, 1989) immersed in arid ecosystems of great temporal and spatial heterogeneity (Chuluun, 2000). Historically, traditional pastoral networks emerged in dry lands with scarce natural resources, subsequently evolving to increase human adaptive capacity in coping with climate variability and extreme climatic events such as drought and *zud*, a winter condition that can prove devastating for livestock. A large geographical landscape was critical in order to offset climate variability, as traditional pastoral networks used certain landscapes primarily for forage and water. There was thus a strong coupling between traditional pastoral groups and the landscapes they used. Traditional pastoral communities and their cultural landscapes, consisting of four seasonal land types in addition to reserve areas, *otor* pastures and hay lands, provides a prime example of a coupled social-ecological system or human-environmental system (Global Land Project: Science Plan and Implementation Strategy, 2005). These traditional pastoral social-ecological systems were sustainable for centuries.

The Mongolian cultural landscapes, however, were fragmented with the administrative-territorial division reform of the last century (Ojima & Chuluun, 2007). Now almost half of all sums or subprovinces lack one or two seasonal pastures. Interestingly, there wasn't much change in terms of cultural landscape use during the socialist period, although there were large changes in pastoral social-ecological systems during the socialist period between late 1950s and 1990. More complex dynamic changes in pastoral social-ecological systems have occurred since 1990 in the transition to a market economy. The number of herders has more than doubled since the early 1990s as a result of the economic migration spurred by livestock privatization. Traditional pastoral networks at the lowest level (hot ail) re-emerged and re-organized themselves during this period of time, as some younger and more inexperienced herders started to follow their parents or relatives, who had more herding experience. These pastoralists continued to use traditional cultural landscapes under the leadership of experienced herders. Some new herders started to live near the settlements and water sources, causing overgrazing as a result of their low mobility. Due to a rise in the price of cashmere, goat numbers more than tripled from 5.1 million in 1990 to 18.3 million in 2007 since the transition to open market economy (Mongolian Statistical Yearbook, 2008).

In addition to economic and social factors, global warming is becoming a slow but critical variable, affecting the reduction of water and food resources. Over the last 60 years, surface air temperature in Mongolia has increased by 1.94°C, which, along with its socio-economic vulnerability, makes Mongolia one Earth's hot spots. Spring is also becoming increasingly dry as a result of warmer temperatures and decreased precipitation.

This research aims to investigate change and transformation of open pastoral social-ecological systems (Gallopin, 2006) and develop climate change adaptation options for pastoral communities with participation of herders, local and national governmental officers and scientists (Vogel et al., 2007). A social survey among herders on local climate change observation and its impact on pastoral systems was conducted and participatory workshops with pastoral communities. These workshops aimed to communicate the current and future risks of climate change, land use changes and rangeland assessment techniques, as well as the socio-economic vulnerability of the herders to climate change.

## Methods

#### Assessment of climate risks

Climate trend and variability were analyzed for pilot study sites, using Climate Research Unit (CRU data) resolved spatially at 0.5 degree latitude and longitude from 1990 to 2000 of monthly climate (temperature and precipitation) and weather station data. The climate risks such as zud and drought (Batima et al. 2005) were analyzed, using risk ranking/scoring method. Vulnerability index of the rangelands (Chuluun et al., 2004 & 2005) consists of *zud* index (Nazagdorj and Sarantuya 2004) and land use intensity index. Higher *zud* index and higher land use intensity (exceeding the carrying capacity) results in higher vulnerability of the rangelands to climatic extreme events. This index is an attempt to make rangeland vulnerability assessment both to climate and land use changes, however, interaction of these two factors are not considered and carrying capacity assessment needs an improvement. Vulnerability and adaptive capacity indexes for the rangelands were developed and calculated for pilot research sites. Calculation of the carrying capacity was improved, basing on RS data and modeling exercises. Socio-economic vulnerability assessment and spider (web) analysis were conducted for each pilot site at multiple scales.

## Use of integrated technologies for decision support

We used remote sensing derived information (Ellis et al., 2002, Ojima et al., 2004, Boone et al., 2007) for climate risk communication. Plant onset trends of grassland ecosystems of the Mongolian Steppe have been analyzed using a long-term RS data identifying the zones with delayed or advanced plant onset trends in the Mongolian rangelands (Ellis et al., 2002). The delayed green-up zone forms band along the boundary area of the dry steppe and the Gobi desert steppe and covers the desert steppes located in the southern slopes of high mountains such as Altai, Hangai and Khan-Khohii. Mean annual rainfall in most of the delayed green-up zone is 100-200mm. The delayed green-up in dry ecosystems seen here could be linked to lower photosynthetic rates, lower CO<sub>2</sub> uptake and reduced primary production rates. These changes would certainly be viewed as negative for the herbivores and human who depend on high latitude grassland environment for their sustenance and support. Central part of Mongolia has decreasing NPP trend over last two decades (Ojima et al., 2004). These RS results in addition to ecosystem modeling analysis with CENTURY and ground survey conducted with the AIACC project would be scientific basis for the project. Additional higher resolution RS information depending on availability such as landsat data will be used for our pilot sites.

Current and historic land use patterns (cultural landscapes) for our pilot research communities were introduced into the GIS data. The concept of **the cultural landscape** was widely used. According to the definition by the UNESCO World Heritage Convention (2005), cultural landscapes are cultural properties and represent the integrated workings of nature and of humans. They are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal.

The cultural landscape in the Mongolian rangelands consist of four seasonal pastures, *otor* (pasture used to fatten animals), reserve pasture (used during the drought and *zud*) and sacred lands (protected by local herders for the religious purposes). A cultural landscape at multiple scales for the *hot ail, ner golynhon* and *neg nutgiinhan* wil be used. A fragmentation of the cultural landscapes in arid lands (Ojima, D. and T. Chuluun. 2007) increases vulnerability reduces resilience and an adaptive capacity to climate variability of pastoral systems, evolved over thousands of years. Also biodiversity is reduced and economic input is increased with fragmentation of arid and semi-arid lands (Galvin etc. 2007). For instance, fragmentation of cultural landscapes occurred with the artificial division of the administrative-territorial division of Mongolia during the socialist period: almost half of *sums* (administrative-territorial unit of Mongolia) do not have 1 or 2 seasonal pastures.

We used the climate change explorer tool for climate change scenarios for our study sites. We also were able to calculate drought and *zud* indexes until 2021 in our study sites as well.

## Participatory Activities:

We divided our activities into three stages: social learning and participatory research at community level (March-August 2007), climate change adaptation options/strategies development at the community level (September 2007 – March 2008) and climate change adaptation policy development at community, regional and country scales (April-December 2008).

## Stage 1 Social learning and participatory research at community level

- Literature and related projects review, and data collection for our study areas;
- Gathering the detailed data on climate, land use change (including cultural landscape use change, cropping, urban development and protected areas etc.), livestock sector and socio-economic system for herders groups from Altanbulag, Argalant, Bayanhangai sums, Tov aimag, and "Hustai" National Park and its buffer zones; Hujirt, Harhorin, Olziit and Sant sum, Ovorkhangai aimag and Bugat sum, Govi-Altai aimag;
- Identification of the four herders' groups in the forest steppe, steppe/govi and the Altai mountain areas in Altanbulag sum of Central aimag, Hujirt and Sant sums of Ovorhangai aimags, and Bugat sum of Govi-Altai aimags to manage risks to food and water security from drought, white and black *zud*;
- To conduct integrated analysis of climate change trends, drought and zud for selected areas, vulnerability of selected places to climate change, changes in cultural landscape use, socio-economic vulnerability of the communities and coping range dynamics to select the four communities for the project implementation;
- Use of RS, GIS and modeling technologies for data synthesis, analysis and preparation for the decision making workshops;
- Video documentation of adaptive rangeland and water management practices on vulnerability to spring and early summer drought trends (during all field trips) and of climate change adaptation measures for our selected sites.

## Stage 2 Climate change adaptation options development at the community level

- To conduct three participatory workshops in our pilot study sites to identify adaptation options/strategies to increase the resilience of the pastoral communities to climate and land use changes for particular sites. Social learning, scoring of the adaptation options and scenario building methods will be used;
- To facilitate decision making with group leaders for long-distance movement of livestock (otor) to make use of summer and fall pastures outside of their current grazing areas making agreements with pastoralists in these outlying areas; in addition, setting aside haymaking areas ...
- To facilitate taking the consensus actions related to giving summer and fall seasonal pastures, *otor* (long-distance pasture used to fatten animals) and hay making lands for the community's ownership (currently only winter and spring seasonal pastures have household ownership), and taking reserve pastures and sacred lands under protection of local government in order to restore cultural landscapes for selected pastoral communities, and to finding local solutions to improve water security, affected by climate change;
- To make synthesis based on lessons learned from pilot study research. Draft synthesis working papers climate change adaptation at community level will be produced and circulated through the ACCCA network;

## Stage 3 Adaptation policy development at community, regional and country scales

- A recommendation of climate change adaptation options for similar ecological regions in Mongolia will be produced in collaboration with the Agency of Land Affairs, Geodesy And Cartography (ALAGAC), and organization of the climate change adaptation workshop at the national level;
- Joint proposal by the stakeholders on administrative-territorial units which incorporate cultural landscape as an increased adaptation mechanism to climate change and climate variability will be submitted to the Government. A draft working paper will be produced and circulated through the ACCCA network;
- To document in video the results of taken actions with participation of stakeholders on climate change adaptation and develop proposals for additional implementation of suggested adaptation options such as fencing of vulnerable riparian ecosystems, wetlands and water sources and hay making etc. The proposal will include broader development vision for selected pastoral communities came out during the scenario building process;
- Production of the brochures and video materials on CD for each pilot site, and synthesis paper on climate change adaptation at the community and administrative-territorial unit levels.

## **Outcomes and outputs**

Working papers, synthesis paper, brochures, video materials and TV program on climate change adaptation policy will be produced, and three local participatory workshops for local government and land officers and vulnerable herders' groups, and national workshop will be organized. Local legal regulation documents, allowing summer, fall and *otor* for community owner ship, and taking reserve pasture and sacred lands under local government protection will be produced. A number of formal and informal herders' groups will be formed during the project implementation.

Based on climate change adaptation activities for pilot sites, the following recommendations and proposals were produced:

- A recommendation of climate change adaptation options for similar ecological regions based on lessons learnt from pilot sites
- Proposal of administrative-territorial units to the Government, which will increase the resilience of these units to climate change
- Proposal for suggested adaptation options (which require additional funding), including broader development vision for selected pastoral communities

## Study Sites and Research Findings

Figure 1 Map of Pilot Study Sites



Two out of six study sites for pastoral social-ecological systems were selected in the buffer zone of the Khustai Nuruu National Park, where wild horses known as tahi were re-introduced. These socialecological systems in the buffer zone were selected so as to increase knowledge on the between conservation interaction land and pastoral systems. especially those in close proximity to the city of Ulaanbaatar. Four other sites were selected along ecological

transects: forest steppe, mountain steppe, dry steppe and desert steppe. Prior to socialism, three of the sums along this gradient used to make up one administrative-territorial unit. One old herder from Sant sum said that his parents used to spend summer in mountains of Khijist sum. This confirms that there was free pastoral movement between mountains and steppe within the old administrative unit and old administrative-territorial divisions were primarily based on cultural landscape principles.

Hondiin Zaraa and Erdene-Ovoo, herders' groups at Sant sum, and Ih Burd at Hijirt sum, were led or guided by the old experienced herders who had lived in these areas for generations. Thus, traditional indigenous knowledge was basis for grazing management in these pastoral communities, and they followed their nomadic cultural legacy better than other herders' groups. Interestingly, the *zuds* of 1999-2002 prompted an increase in the formation of herders' groups due to several reasons such as legacy of cooperation and social learning, as well as government and donors support. Generally, relatively poor herders tended to form herders' groups, exemplified by Batsumber and Santbayanbulag herders' groups along the Tuul and Orhon rivers. These groups were not led by an experienced herder, but by a former administrative worker or teacher. These group leaders were intelligent people, quickly learning the advantage of cooperation for relatively poor households.

Migration from the rural areas to the big cities of the central area started to increase in mid-1990s. The migration from the rural areas was a result of environmental change, following summer droughts and intensifying after the 1999-2002 *zuds*. The herders who had lost their livestock during these disasterous climatic events were forced to leave the area and can be referred to as environmental refugees. The Batumber and Altganat herders are examples of the migration of herders from the rural to the central region of Mongolia. In addition, the Khustai Nuruu National Park probably attracted herders due to its beneficial buffer zone management programmes. Thus both the Batsumber and Altganat herders' groups have the shortest local ecological knowledge as only one household in each community was native, with the rest of the herders having migrated from the western Aimags. The Tuul river valley served as a market pathway for the transfer of animals from the western Aimags to Ulaanbaatar city, and it was kept free of grazing by local herders during socialism. State agricultural farms existed in the region north of the Hustai Nuruu National Park between the late 1950s and 1990, but the farmers have since moved out of the area. The fields, abandoned after the transition to a market economy in 1990, have still not recovered from server soil erosion caused by the farming of these drylands.

The central region close to Ulaanbaatar, the capital city, and the Khustai Nuruu National Park were attracting people from remote areas of Mongolia. Thus, the majority of herders living in the buffer zones of the park are migrants, mainly from the western Mongolia. They enjoy double economic benefits from being closer to the market of Ulaanbaatar and the support from the park (see table 1 for their income level compared to herders from other regions). Interactions of the herders living in park buffer zone are mutually beneficial. The herders assist in conservation of the park and they benefit from the park's assistance in building fences around springs, or in constructing wells. The herders are allowed to use park pasture during *zuds*. However, their impact on the ecosystems outside of the park is large, as overgrazing from their herds has led to ecosystem degradation. Herders living along the Tuul River developed a more sedentary lifestyle, moving only twice a year and covering only short, two to three kilometre distances. This has greatly concerned the Altanbulag sum government, which has passed regulations prohibiting grazing alongside river during between late June and late August. The herders, however, do not obey this regulation.

Some research findings are summarised in Table 1. Livestock per capita is well correlated with income per capita due to the fact that the herders' main income for comes from livestock. The

Batsumber and Altganat pastoral communities have the highest income. Four other communities, those of the forest steppe, the mountain steppe, the dry steppe and the desert steppe, live along transect. In the herders' group, the livestock per household as well as the income per capita and overall richness of the cultural landscape has increased along this transect. In terms of cultural landscape, Batumber and Santbayanbulag herders living in the riparian zones during the summer and fall lack three pasture types out of seven (4/7). Thus most ecosystem degradation was observed in the riparian zones where herders have become more sedentary. Cultural landscape is better conserved in Sant (6/7) as compared to Hujirt. As a consequence, the ecological condition in Hujirt is worse than in Sant, and it seems that this is already affecting the incomes of the herders (see table 1). There are signs that this trend may continue unless the proper measures are taken. The environment and poverty is interlinked. The socio-economic vulnerability of each community was calculated based on its proximity to the market, its income, the loss of animals during the 1999-2002 *zud* and the level of economic diversification. The pastoral communities of Tov aimag showed less socio-economic vulnerability due to higher income and shorter distance to the markets of Ulaanbaatar city.

Name	Sum & Aimag	Ecosystem Type	Number of	Livestock	Income	Cultural landscap	Socio- economic vulnerabil
Batsumber	Altan-bulag Tov	Riparian/ forest steppe	21	100	1,200	4/7	2.3
Altganat	Arga-lant Tov	Forest steppe	15	181	1,877	5/7	2
Santbayanb ulag	Hujirt Ovor-hangai	Riparian/ forest steppe	8	41	574	4/7	3.3
lhburd	Hujirt Ovor-hangai	Mountain steppe	8	49	618	5/7	3.2
Hondiin Zaraa	Sant Ovor-hangai	Dry steppe	15	83	827	6/7	3.4
Erdene- Ovoo	Sant Ovor-hangai	Desert steppe	17	79	972	6/7	3.5

Table1. Studied	pastoral	communities
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The herders were very sensitive to water availability during both the warm and cold seasons and there was also ecosystem degradation as a result of overgrazing around the wells and the few remaining springs that had not already shrunk due to climate change impact. The herders were very sensitive to snow cover change as well. For instance, Nogoon Suuri, a herder of Hujurt sum, indicated that 6 springs had disappeared and that only a single watering point remained for 14 households with 3,000 livestock. This only remaining spring was prone to freezing, leaving these households without water in early December 2006 (See photo). As there is usually snow on the ground during this time of year, the herders dispersed, moving away from their winter camps so that they could use the snow as winter water source.

## Discussion

Livestock density exceeds carrying capacity in central Mongolia. The herders' economic wellbeing has generally improved with increased livestock numbers. Do to a rise in the price of cashmere, goat numbers have tripled since 1990. Water and foraging sources are becoming depleted due climate change in central Mongolia and the depletion has been amplified due to increasing land use intensity. Herders complain that goats further ecosystem degradation because they dig out the roots of young plants in the spring. Plant species composition is shifting with a decreasing number of edible plant species. Plant biomass may have already been reduced in non-linear fashion due to the interaction between climate change and overgrazing in central Mongolia. Spring drying trends have delayed the onset of plant growth in Gobi-dry steppe boundary area (Ellis et al. 2002) and plant biomass decreased in central Mongolia during the 1990s, primarily due to climate change (Ojima et al. 2004). Livestock numbers have increased since the early 1990s causing increased overgrazing effects with a reduction of dominant plant species known by the herders as Mongolian grasses. Observations of grassland ecosystem conditions in inner Mongolia, China and in Ovorhangai Aimag taken in 2002 and 2007 indicate that central Mongolia may be headed towards ecosystem degradation and desertification problems of the type already experienced in inner Mongolia.

In the central Mongolia study sites, small stream, lake and spring disappearance was also observed. Decreases in snowfall, increased tree cutting, the melting of permafrost, intensifying drying trends, destruction of riparian zone shrubs and swamps, and overgrazing all interacted in a non-linear way, resulting in the disappearance of water sources. Regional climate may be affected due to the albedo change that comes with land and snow cover changes. Last summer, large floods in Hujirt sum territory due to both heavy rainstorms and drought conditions were observed. Riparian ecosystems appear to have keystone value in coupled pastoral social-ecological systems. The collapse of these critical ecosystems' ability to provide water would greatly impact the pastoral community, as water is the most valuable resource for both people and animals in drylands.

The complexities of coupled social-ecological systems increased with Mongolia's transition to a market economy and there are three general categories of herders and communities that are affected to different degrees. A wealthy class of herders with more than 500 livestock per household is emerging, making up only about 5% of herder households. A middle class with 200-500 livestock per household now makes up almost 20% of all herder households, and this group of herders has more choices to increase their resilience and adaptive capacity. Herders with less than 200 animals per household will have the advantage if they join formal herders' groups such as NGOs or informal traditional networks, as well-organized cooperation will give opportunities for economic, social, ecological, technological and cultural benefits. More than half of herders are considered poor with less than 100 animals per household. These poorer herders typically live near the cities and along the rivers. The link between environmental degradation and poverty is notable among this group. Some would benefit from re-training and the institution of sustainable farming systems with the introduction of productive livestock breeds and the diversification of their economy to include pigs, chickens and vegetables as sources of income.

Climate change adaptation options for cultural landscape restoration suggested in participatory community workshops included the introduction of community based conservation and sustainable use of natural resources, the addition and protection of water points for additional pastureland, the agreement between neighboring sums for communal use of *otor* and reserve pastures, and the enlargement of administrative-territorial units, for instance, by combining

several sums into one unit in order to restore cultural landscapes. For pastoral communities living in the riparian zones, diversification of the economy and intensification of the livestock industry through ecotourism and farming, the prevention of riparian ecosystems from degradation and desertification and taking animals to *otor* pastureland during the summer period were suggested options. Protection of springs from degradation by livestock was critical for communities living in the mountain and forest steppe.

## Models for pastoral social-ecological systems



Research findings and thoughts for future adaptation strategies for pastoral social-ecological systems can be summarized in the scenarios diagram below.

*Traditional system:* Cooperation within traditional pastoral networks serves as a mechanism enhancing resilience to climatic disasters. Communal disaster relief mechanisms, assisting the most affected herders in many different ways, were in place. Traditional pastoral communities used cultural landscapes to cope with climate variability and climatic extremes. Due to proper management, rangeland ecosystems used for traditional grazing and ecosystem services were in good condition.

*Tragedy of the commons:* The rangelands are still State owned in Mongolia although livestock has been privatized. This has been the main reason for the increased overgrazing and ecosystem degradation near both settlements and water sources under capitalism. Poor herders especially have tended to become less mobile, living near towns, infrastructures and water sources as a result causing dry land fragmentation. Generally, herders have not cooperated and have competed more for resources in this scenario. Many herders in this model have lost their traditional resilience mechanisms to cope with climate variability and extremes, and potentially 50% of herders live in poverty. Deterioration of the social-ecological system with ecosystem degradation and increasing poverty happens in this model.

"Western models": Only 5-10% of herders became wealthier through the transition to a market economy. Generally, these rich herders don't cooperate with a larger pastoral community. They often take advantage of the current State ownership of pasture, often causing more damage to ecosystem services. Some of herders have small communities and use traditional cultural landscapes. Thus, some of the traditional networks that use cultural landscapes in sustainable ways can be included in the win-win model, with social and ecological benefits. This group of

herders needs to be encouraged through proper pasture and culture landscape ownership mechanisms.

*Win-win model:* In the win-win scenario, the majority of herders must be transformed. The most desirable pathway for pastoral systems would be direct transformation from a traditional system to a win-win state, strengthening traditional pastoral communities with modern technologies such as renewable energy and communication information technology. High levels of literacy among the Mongolian herders (98%) and the suitability of the nomadic culture in concert with wireless communication make such a sustainable transformation very attractive. There is a great opportunity to conserve natural, cultural and social capital in order to maintain the adaptive capacity and resilience of Mongolian pastoral social-ecological systems to climate change and globalization. Teaching sustainable farming techniques to herders living near settlements and water points would be another pathway to reach a *win-win* situation and escape the *tragedy of the commons* state. A reform of administrative-territorial divisions that restores cultural landscapes appears to be the best, most cost effective adaptation option in order to promote the sustainability of coupled social-ecological systems with increased adaptive capacity and resilience to climate change at supra-pastoral community scales.

## Conclusion

Pastoral land systems central Mongolia are becoming very vulnerable to climate change. Water and forage availability is changing due to global warming. Land use change, especially since Mongolia's transition to a market economy in 1990, have become a critical factor in the vulnerability of pastoral social-ecological systems. The traditional coping mechanisms enhancing the resilience of pastoral communities in the face of climate variability will be lost in Mongolia as in the surrounding countries of Central Asia, China and Russia unless alternative development agendas are taken. The opportunity of using the existing cultural landscape at community and cross-administrative boundary scales in Mongolia appears to be the most costeffective resilience option for climate change adaptation in pastoral communities. Many international projects on pastoral development, poverty reduction or nature conservation in the Mongolia only consider parts of the problem. More holistic approaches are needed to achieve win-win scenarios. Strengthening traditional pastoral networks with modern technologies to enhance social wellbeing as well as legal framework development for cultural landscapes at community and administrative unit scales for ecosystem service conservation are required to promote sustainability in pastoral social-ecological systems.

## Recommendations for national strategy on climate change adaptation

"<u>Policy Framework for Adaptation Strategies of the Mongolian Rangelands to Climate</u> <u>Change at Multiple Scales</u> (PARCC)" project, supported by a grant from Advancing Capacity in Support of Climate Change Adaptation (ACCCA), managed by the UNITAR and the START and funded by the European Commission EuropeAid Cooperation Office, the UK Department of Environment and Rural Affairs and the Netherlands Climate Change Support Program, and endorsed by the Global Land Project.

## Highlights of research findings/observations:

- Key resource and ecosystems for pastoral social-ecological systems are water and its supporting riparian and forest ecosystems. Pastoral systems are becoming vulnerable to any change in water resources with global warming: disappearance of water sources, reduction of water resources, delayed or early melted snow, and no snow condition. Protection of "natural green walls"- riparian ecosystems and forests are more valuable for their service to deliver water and water purification compared to building of artificial "green walls", which do not deliver any water service.
- Overgrazing became large-scale problem for ecosystem degradation not only near settlements and water sources. Vulnerability to climate change is amplified due to overgrazing. Thus all transitional zone between the Gobi and forests appear to become more vulnerable because of interacting climate change and overgrazing. The cumulative effect is more than the sum climate change + overgrazing. Ecosystem degradation and desertification has potential to reduce well-being of herders.
- A fragmentation of cultural landscapes in arid and semi-arid lands of Mongolia has increased vulnerability and reduced the adaptive capacities of traditional pastoral systems to climate variability and extremes. We observed "tragedy of commons"-the most environmental degradation results in the most fragmented set of resources, mainly along the river valleys. There is an evidence of economic performance reduction with fragmentation of cultural landscapes.

- Social resilience based on traditional pastoral communities tends to be lost. Herders' groups not based on traditional herders' groups may be have short life. In contrary, traditional pastoral communities existed for centuries are eroding.
- Win-win model. We have learned many projects are fragmented, aiming to achieve fragmented goals: only conservation or poverty reduction etc. We need to reach win-win situation both ecologically and socially. The best transformation pathway is to strengthen traditional pastoral community-cultural landscape system with opportunities of renewal energy, wireless communication technology (further opening opportunities for distance learning and diagnosis), cultural and ecological tourism and developed industry based on livestock raw materials.

## Policy recommendations:

- Climate change adaptation strategy must be based on "Win-Win" model. We could combine climate change adaptation strategy of Mongolia with newly developing "National program to combat desertification", following the Strategic goal No.6, Environmental Policy, the "National Development Comprehensive Policy based on the Millennium Development Goals". A restoration of cultural landscapes at multiple scales and strengthening of traditional pastoral networks with modern technologies will enhance socio-ecological resilience and reduce vulnerability of pastoral systems to climate change.
- Synergies of climate change adaptation strategies with other government policy with "National program to combat desertification" and "Pasture use law" for different ecological zones:
  - The Gobi region as "Globally significant agricultural heritage systems" (FAO/UNESCO):
    - Great biodiversity, nomadic culture and social resilience;
    - Conservation of larger scale lands is critical in face of climate change;
    - Opportunity of wireless communication technology to support nomadic culture.
  - Short grass steppe (150-200mm) and desert-steppe plateau:
    - High vulnerability to climate change due to climate change impact on delayed plant growth in spring;
    - Vulnerability enhancement with overgrazing with desertification consequences;
    - Flexibility of pasture regulation and mobility over large scale rangeland are necessary to cope with climate variability and extremes, which cause non-equilibrium rangeland dynamics in this part of the world;

#### • Southern slopes of the Khangai Mountains:

- High vulnerability to climate change due to climate change impact on delayed plant growth in spring because of the mountain's southern slope nature;
- Rivers and river basins are the key resources of the region. Both forests and riparian ecosystems should have strong protection to improve climate change adaptation of the region;
- Vulnerability enhancement with overgrazing with desertification consequences;

## • Biodiversity in the Eastern steppe

- Biodiversity issue is number one in this region. Thus, conservation and tourist industry development should be main economic activity to reach socially and ecologically win-win situation;
- Early green-up was observed in this part. Longer growing season may lead to changing ecosystem structure-function, perhaps increase in warm season grass such as *Cleistogenes squarosa* may be observed;
- Sandy lands are highly susceptible to intensive land use.
- Forest steppe:
  - Mountain steppe and some forest-steppe region, especially in central part
    of Mongolia, already became vulnerable to climate change due to
    overgrazing. Plant biomass decreasing trend was observed since 1990
    according to remote sensing study. Plant biomass reduction and livestock
    number increase are making this region even more vulnerable to climate
    change and its extremes such as drought and *zud*;
  - (Traditional) community based Forest conservation appears to be the most important resilience building event for this region. Southern boundary of forests may be already experiencing global warming impact mainly due to permafrost melting.

## • Orhon-Selenge river basin/agro-ecosystems

 In order to reach win-win situation in this region, involvement of poor herders/farmers in environmentally-friendly efficient small scale farming is the best way for long-term sustainability;

## • Forest ecosystems

- The southern boundary of the Siberian taiga located on the territory of Mongolia. All transitional zones are the first to be impacted by global warming. Thus, climate change impact on forests in Mongolia needs to be investigated better;
- Human impact on forest ecosystems certainly huge, reducing forest cover from 10% to 7% since 1990.

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## Draft proposal

## Demonstration sites of pastoral social-ecological systems to climate change adaptation in Mongolia

**Objective:** To select and develop demonstration sites of pastoral social-ecological systems in each ecological zones of Mongolia. Main idea is to explore new development alternatives of pastoral systems, enhancing traditional adaptive capacity with modern technology such as renewal energy, wireless communication, and cultural and ecotourism.

We have following goals in order to achieve the main objective:

- 1. To make a socio-ecological vulnerability assessment for selection of climate change adaptation demonstration sites;
- 2. To make video recording of good adaptation options;
- 3. To identify additional adaption measures to strengthen an adaptive capacity of the selected pastoral systems, and to write proposal for the development and monitoring;
- 4. To develop demonstration sites and broadcast the prime examples of the adapted pastoral systems to climate change, video recording all advances or making the movie.

## Introduction

Total territory of Mongolia is 156.4 million hectares, of which 72.1 percent or 112.8 million hectares belong to pasture and hay making area. This is currently base of livestock sector development which is one of major sources of socio economic development of Mongolia. According to the end of 2008 years' census 43.3 million heads of livestock (camel, horse, cattle, sheep and goat) were counted. In 1999-2002, 30 percent of total livestock lost because of natural disaster drought and zud, which confirms that pastoral system is very vulnerable to climate extremes. Share of livestock sector in GDP and Gross Agricultural Product is 21 and 80 percent respectively and livestock sector provides 1/3 of total labor force.

Unfortunately, pasture productivity and capacity is decreasing year by year due to the multiple negative influences of human factors and environmental issues like warming, seasonal change of annual precipitation, drought etc. The main factor leading to pasture degradation is overgrazing, loss of traditional knowledge and lack of technologies for rational use, protection and improvement of pasture land on the one hand, and on the other hand, there is no proper legal environment and optimal pasture management suited for market economy condition. Degradation of pasture land accounting for 70-80% of the whole territory of the country and the desertification process possess real danger leading to ecological catastrophe.

Mongolia is in a region that is experiencing the greatest warming on our Earth during the past century. It has warmed by the 2.01°C since 1940, with the greatest warming occurring during the winter months (approximately a 3.6°C increase) and in the spring (approximately 1.8°C increase) (Final Report of AIACC Project No. AS 06,2006). Annual precipitation has not change much, but the spring season is becoming drier, causing decreased plant biomass production and later plant onset in some parts of Mongolia. Frequency of *zud* (drought in summer followed by cold snowy winter) has increasing trend. Global warming is affecting the arid and semi-arid

lands, reducing surface water (big river water reduction, disappearance of small rivers and springs), lowering underground water level, decreasing snow covered days with warming (which cause black zud condition in fall and perhaps in spring, and causing future vulnerability due to the permafrost thaw and glaciers melting. According to the registration made by the Ministry of Environment (2004) 702 rivers and streams, 1484 small springs, 10 mineral spring and 760 lakes and ponds have been dried out during last years.

Warming in winter and spring, and drying trend in the spring is impacting on plant growth in several ways as RS study for over 20 years period showed:

- Reducing plant biomass, especially in the central part of Mongolia;
- Plant onset trend is advanced in areas where moisture is available for the growth early spring and delayed where moisture is not available. Eastern Steppe and northern slopes of the Altai Mountains have advanced green-up trends, but dry end of the Mongolian steppe and southern slopes of high mountains have delayed green-up trends.

Pastoral systems in these vulnerable eco-regions with reduced plant biomass and/or delayed green-up trends will become even more vulnerable due to reduction of carrying capacity in spring or over the entire year. Traditional pastoral networks evolved in the direction to increase human adaptive capacity to cope with climatic risks. Spatially large landscape is critical in arid lands to offset climate variability with extreme events such as *zud* and droughts. A fragmentation of the cultural landscapes in the arid and semi-arid lands of Mongolia has increased vulnerability and reduced the adaptive capacities to climate variability of traditional pastoral systems, which have evolved over thousands of years.

Currently, Mongolia is the 20<sup>th</sup> most economically vulnerable country out of 112 countries (). All these changes are making the coupled social-environmental systems in the Mongolian rangelands extremely vulnerable to climate change.

## Highlights of research findings on climate change adaptation of pastoral systems in Mongolia (ACCCA: PARCC 2007-2008):

- Win-Win model. Many projects in Mongolia are fragmented, aiming to achieve fragmented goals such as only conservation, pasture management, poverty reduction, socio-economic development etc. We need Win-Win situation both ecologically and socially in order to be sustainable for long-run. <u>The best transformation pathway is to</u> <u>strengthen traditional pastoral community-cultural landscape system with opportunities</u> <u>of renewal energy, wireless communication technology (further opening opportunities for</u> <u>distance learning and diagnosis), cultural and ecological tourism and developed industry</u> <u>based on livestock raw materials.</u>
- Global warming, reduction of water and forage resources, goat number increase, human population change, renewal energy and information communication technology increase may serve as <u>critical slow variables</u> driving pastoral social-ecological system dynamics.
- Key resource and ecosystems for pastoral social-ecological systems are water and its supporting riparian and forest ecosystems. Pastoral systems are very sensitive to any change in water resources due to global warming: disappearance of water sources, reduction of water resources, delayed or early melted snow, and no snow condition.

Protection of "natural green walls"- riparian ecosystems and forests are more valuable for their service to deliver water and water purification compared to building of artificial "green walls", which do not deliver any water service.

- The cumulative effect of climate change and overgrazing is more than the sum of them because of their interaction. Vulnerability to climate change is amplified due to overgrazing of rangelands. Overgrazing of rangelands became large-scale problem for ecosystem degradation not only near settlements and water sources. Thus ecosystems in transitional zones between the Gobi and forests became degraded with different degrees because interaction of climate change and overgrazing. Ecosystem degradation, leading to desertification, has potential to reduce well-being of herders.
- A fragmentation of cultural landscapes in arid and semi-arid lands has increased vulnerability and reduced the adaptive capacities of pastoral systems to climate change. We observed "tragedy of commons"-the most environmental degradation in the most fragmented set of resources. There is some evidence of economic performance reduction with fragmentation of cultural landscapes.
- Social resilience based on traditional pastoral communities tends to be lost. Herders' groups not based on traditional pastoral communities may have short life. In contrary, traditional pastoral communities, sustainably existed for centuries, are eroding.

## Policy recommendations for climate change adaptation of the Mongolian pastoral systems:

- Climate change adaptation policy must be based on "Win-Win" model. We could combine climate change adaptation strategy of Mongolia with newly developing "National program to combat desertification", following the Strategic goal No.6, Environmental Policy of the "National Development Comprehensive Policy based on the Millennium Development Goals". <u>A restoration of cultural landscapes at multiple scales</u> and strengthening of traditional pastoral networks with modern technologies will enhance socio-ecological resilience and reduce vulnerability of pastoral systems to climate change.
- Synergies of climate change adaptation strategies and rural development for different ecological zones:
  - <u>To consider the Gobi region as "Globally significant agricultural heritage systems"</u> (FAO/UNESCO) due to of its:
    - Rich biodiversity, nomadic culture and social resilience;
    - Conservation of larger scale lands is critical in face of climate change;
    - Opportunity of wireless communication technology to support nomadic culture;
    - Conservation of nomadic culture in the Gobi rangelands with nonequilibrium dynamics is critical for sustainability of pastoral socialecological systems.

- <u>Great lakes depression/ Short grass steppe (150-200mm) and desert-steppe</u> plateau/ Southern slopes of the Khangai Mountains
  - High vulnerability of rangelands to climate change due to climate change (impact on delayed plant growth in spring);
  - Vulnerability enhancement with overgrazing with desertification consequences;
  - Flexibility of pasture regulation and mobility over large scale rangeland are necessary to cope with climate variability and extremes, which cause non-equilibrium rangeland dynamics in this part of the world;
  - Rivers and river basins are the key resources of the region. Both forests and riparian ecosystems should have strong protection to improve climate change adaptation of the region;

## o Biodiversity in the Eastern steppe

- Biodiversity must be number one importance in this region. Thus, conservation and tourist industry development should be main economic activity to reach socially and ecologically win-win situation;
- Early green-up was observed in this part. Longer growing season may lead to changing ecosystem structure-function, perhaps increase in warm season grass such as *Cleistogenes squarosa* may be observed;
- Sandy lands are highly susceptible to intensive land use.

## • Forest steppe/meadows:

- Mountain steppe and some forest-steppe region, especially in central part
  of Mongolia, already became vulnerable to climate change due to
  overgrazing. Plant biomass decreasing trend was observed since 1990
  according to remote sensing study. Plant biomass reduction and livestock
  number increase are making this region even more vulnerable to climate
  change and its extremes such as drought and *zud*;
- Riparian ecosystem management needs to be the first priority in this region.
- In order to reach win-win situation in this region, involvement of poor herders/farmers in environmentally-friendly efficient small scale farming is the best way for long-term sustainability.

## Workplan

## 1. To make a socio-ecological vulnerability assessment for selection of demonstration climate change adaptation sites;

Many herders groups were formed during last few years with different goals such as community based nature conservation, sustainable pasture management, sustainable livelihood, disaster mitigation and management systems etc. Unfortunately, many of them were set up just use an advantage of the project assistance, often one sided, and climate change adaptation option wasn't considered. We would like to cooperate with these projects for identification of demonstration sites. However, we still need to make own assessment on climate change vulnerability and adaptive to climate change capacity of pastoral systems.

Potential ecological zones for demonstration climate change adaptation sites:

- The Gobi region
- The eastern steppe
- Forest steppe
- Southern Khangai mountains, which have forest, mountain steppe and desert steppe

Selection criteria for climate change adaptation demonstration sites:

- Good state of ecosystem services and use of cultural landscape (ecological resilience)
- Formation of herders group based on traditional pastoral community (social resilience)
- Introduction of ecologically friendly technologies such as renewable energy, CIS, and other technologies (innovation, adaptation to globalization)
- Low socio-economic vulnerability

## 2. To make video recording of good adaptation options;

Video, movie and TV programs are powerful tools for reaching out a broader audience. We can make video recording of not only good adaptation options, but the most vulnerable conditions as well. A decrease of water and forage resources, and shifts in seasons, and climate change impacts on people, livestock and rangeland ecosystems will be recorded.

# 3. To identify additional adaption measures to strengthen an adaptive capacity of the selected pastoral systems, and to write proposal for pastoral development and monitoring;

We would expect that there still will be other developments even for the best cases. We would like to identify this transformation opportunity with participation of the herders, especially young generation of herders. We would like to make financial estimates for additional development in order to enhance climate change adaptive capacity of pastoral system prime models in dry lands of Central Asia.

## 4. To develop demonstration sites and broadcast the prime examples of the adapted pastoral systems to climate change, video recording all advances or making the m

It would be ideal if we could develop these demonstration sites by ourselves in participation of herders. Main idea of demonstration sites' development for climate change adaptation, based on traditional resilience mechanisms and enhanced with modern technologies, would be to demonstrate sustainable transformation of nomadic pastoral systems. We can monitor and record every step of discussion, implementation and output with video recording. Ideally, it would be great if could make a movie in order to reach broader audience in effective way.