



MINISTRY OF ENVIRONMENT  
AND GREEN DEVELOPMENT

# Making Grasslands Sustainable in Mongolia

## Herders' Livelihoods and Climate Change





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AND GREEN DEVELOPMENT

# Making Grasslands Sustainable in Mongolia Herders' Livelihoods and Climate Change

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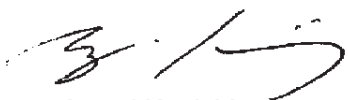
# Foreword

Mongolia is severely impacted by desertification and climate change. The Gobi Desert continues to expand northward, and more than 70% of Mongolia's land is degraded through overgrazing, deforestation, and climate change. Degradation is a downward spiral, as degraded lands are less resilient to climate change impacts. Average mean temperature increases are more than 2°C, and climate models indicate that temperatures will continue to rise. More than 80% of the country's territory is defined as highly vulnerable to climate extremes. Climate-related disasters, including droughts, severe storms, and flash floods, with high social and economic costs (particularly for herders), have doubled in frequency.

The Asian Development Bank (ADB) supports regional cooperation among the countries of Northeast Asia to combat dust and sandstorms resulting from desertification. ADB is strengthening the capacity of the governments of the People's Republic of China and Mongolia in accessing carbon financing to sustainably manage grasslands. ADB recognizes that healthy ecosystems are more productive, more resilient, and provide valuable ecosystem services, such as carbon sequestration. Healthy ecosystems form the firm foundation for herder's natural resource-based livelihoods.

In close cooperation with the Government of Mongolia's Climate Change Coordination Office under the Ministry of Environment and Green Development, this knowledge product was prepared for local herders and the general public to raise awareness of climate change impacts on people, livestock, and grassland ecosystems, and to provide potential responses. This publication aims to (i) explain how good pasture management and livestock productivity are important for increasing incomes, as well as combating and adapting to climate change; and (ii) provide information on adaptation practices, including those that have been prioritized by the Government of Mongolia and promoted under its Mongolian Livestock Program.

The threats posed by climate change have significant impacts on Mongolia's grassland ecosystems and herders' livelihoods. This knowledge product identifies sustainable management practices that will increase communities' resilience to climate change, improve environmental quality, and increase local revenue.



**Ayumi Konishi**  
Director General  
East Asia Department  
Asian Development Bank



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# Abbreviations

|         |  |
|---------|--|
| ADB     | Asian Development Bank   |
| ALACGAC | Administration for Land Affairs, Construction, Geodesy and Cartography |
| cm      | centimeter   |
| GHG     | greenhouse gas   |
| kg      | kilogram   |
| M&E     | monitoring and evaluation  |
| NAMA    | nationally appropriate mitigation action                               |



# Glossary

|              |  |
|--------------|--|
| <i>aimag</i> | refers to province or the first administrative division of Mongolia  |
| <i>bag</i>   | (sometimes spelled <i>baghs</i> ) refers to subdistrict or the third administrative division of Mongolia; it is the lowest administrative unit in Mongolia; <i>soums</i> are divided into <i>bags</i>  |
| <i>dzud</i>  | summer drought followed by a severe winter, generally causing serious loss of livestock; extreme weather events or conditions that can be caused by sudden heavy snowfall, long-lasting or frequent snowfall, extreme cold, or storms that cause often massive livestock deaths from hunger, exhaustion, and cold; Mongolian herders distinguish different types of <i>dzud</i> caused by snow, cold, ice, lack of grass due to drought in previous year, or combinations of these |
| <i>otor</i>  | long-distance migration of Mongolian herders, typically in autumn, to fatten livestock for winter  |
| <i>soum</i>  | rural administrative and territorial unit; an <i>aimag</i> is divided into <i>soums</i>  |

# Executive Summary

As herders have experienced over the past decades, temperatures have increased and rains during the growing season have decreased. Autumn and winter precipitation (rain and snow) has increased slightly. Snow is melting earlier in springtime. Average winter temperatures have increased more than average summer temperatures. The period of summer heat is getting longer, especially in Western Mongolia. The period of winter cold is getting shorter, especially in the Gobi region. All of these climatic changes are having an impact on nature, pasture, people, and livestock.

This publication seeks to explain climate change, its impacts on livelihoods and ecosystems, and its causes for herders and the general public. It explains basic processes, such as the greenhouse effect, and outlines how the Government of Mongolia is responding through the National Action Program on Climate Change and the National Livestock Program. It identifies actions and practices that can help herders and local communities adapt to climate change impacts, particularly the negative impacts on livelihoods.

In addition, the publication explains how herders and local communities can reduce greenhouse gas emissions from livestock and degraded grasslands, and discusses potential new financial incentives for sustainable practices from voluntary carbon markets and nationally appropriate mitigation actions. Collaborative planning and implementation of sustainable pastureland management practices are identified as essential to building community resilience to climate change.

# Climate Change in Mongolia and Its Effects on Nature, Pasture, People, and Livestock: What Is Happening?

## Observed Changes and Impacts

Climate change impacts differ across the world. Coastal countries are impacted by rising sea levels caused by the melting of glaciers and large masses of inland ice that cover Antarctica and Greenland. Also, as the oceans warm, the water expands; and the sea level rises along the coastlines. Strong storm events, floods, and droughts are occurring more frequently in many countries. Ecosystems and the distribution and population size of species are changing. All countries and communities are vulnerable to varying degrees and in different ways to the impacts of climate change; and everywhere, including in Mongolia, efforts are underway to mitigate and adapt to climate change.

As herders in Mongolia have experienced over the past decades, temperatures have increased and rains during the growing season have decreased. Autumn and winter precipitation (rain and snow) has increased slightly. Snow is melting earlier in springtime. Average winter temperatures have increased more than average summer temperatures. The period of summer heat is getting longer, especially in Western Mongolia. The period of winter cold is getting shorter, especially in the Gobi region. These are general trends, but specific changes differ between local areas. Because of the local variations in weather pattern trends, the knowledge and observations of herders and other local citizens can make important contributions to monitoring and evaluating climate change impacts, and can be combined with scientific data to develop local adaptation strategies.

In addition to changes in long-term climate trends, the frequency and intensity of natural disasters, such as drought, *dzud*,<sup>1</sup> heavy rainfall, severe snow, dust storms, and floods, have increased. Damage to livelihoods from such disasters has doubled over the last 20 years, and the number of accidents and loss of human life has increased greatly. Both current climate variability and the possible impact of future climate change on livelihoods and the ecological environment are causes for concern.

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<sup>1</sup> A *dzud* is a Mongolian term referring to a multiple natural disaster consisting of a summer drought resulting in inadequate pasture and production of hay, followed by very heavy winter snow, winds, and lower-than-normal temperatures. *Dzuds* occur when the extreme snowy winter conditions prevent livestock from accessing pasture or finding fodder through the heavy snow cover; consequently, large numbers of animals die of starvation and cold.

## Water, Pasture and Livestock, Ecosystems, and Livelihoods

The drying up of water sources is progressing rapidly. As rivers, springs, and lakes disappear, the concentration of livestock near the diminishing number of water points intensifies pasture degradation. Pasture yield and plant species diversity are decreasing. About 3,000 water sources, including 680 rivers and 760 lakes, were recorded as having dried up by the beginning of this century. The Gobi Desert steppe zone is moving further northward every year. Scientists predict that more areas will become part of the Gobi Desert, particularly in the eastern region, and the dry steppe zone will probably spread north into the current forest-steppe zone.

In recent years, pasture degradation has increased almost everywhere in Mongolia and pasture yields have decreased. Many experts claim that this is happening because traditional pasture use practices have been lost, while many herders say that it is caused by a reduction in precipitation. Both factors contribute, and the effects on pasture resources are multiplied by increased herd sizes and overgrazing.

Pasture growth reaches its annual peak in August. But, currently, this is only about 75% of the peak growth observed 40 years ago. There is less pasture growth in spring when livestock need it urgently. There are fewer highly nutritious plants, and invasive plants have become common, or even dominant, in many pastures. Hay harvests have also decreased.

The average weight of livestock has declined. Between 1980 and 2000, the average weight of sheep decreased by 4 kilograms (kg), goats by 2 kg, and cattle by 10 kg. Wool and cashmere yields also decreased. Animals already suffer due to the hotter summer temperatures, and scientists predict that, with the climate warming, livestock will graze for fewer hours per day. This will further reduce the summer weight of animals and will therefore affect growth, fertility, and productivity.

Nature has already been degraded through human activities, including climate change. Forests have been cut, streams and rivers polluted, springs trampled by livestock, wildlife poached, pastures overgrazed, and soils eroded. Climate change further stresses the ecosystems and natural resources upon which livelihoods depend (water, pasture, forests, and soil). This is threatening livelihoods and food security in many countries, including Mongolia. There is an urgent need for all countries to take actions to reduce climate change and adapt to the changes that are already happening.

### Degraded and dry pastureland in Mongolia



Source: Altangerel Ochirbat, June 2013.



Recovering pasture (top) and improved pasture (bottom) in Mongolia



Source: Altangerel Ochirbat, June 2013.

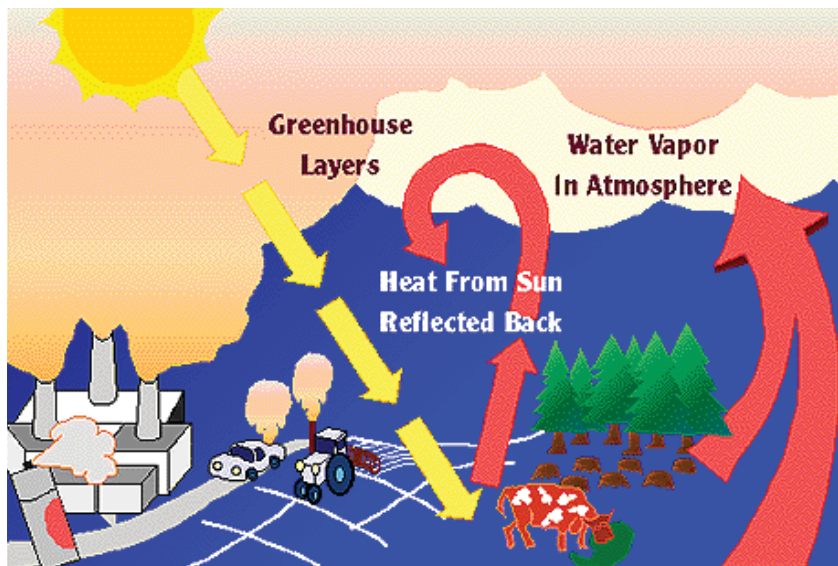
# Climate Change and Its Causes: Why Is This Happening?

## The Greenhouse Effect

The earth's climate has always changed, and the planet has warmed and cooled over very long periods of time. But, nowadays, the planet is warming at a much faster rate. This is primarily due to human activities (Figure 1).

The burning of fossil fuels (such as gas, oil, and coal) to generate electricity, run cars and airplanes, operate factories, and heat houses releases gases into the atmosphere. Agriculture (including livestock husbandry, use of fertilizers), land clearing, mining, and fires also contribute such gases. Fossil fuel burning, land clearing, mining, and fires emit mainly carbon dioxide. Livestock husbandry emits mainly methane. These gases have been concentrating in the earth's atmosphere because the use of fossil fuels has increased, particularly since 250 years ago when industrialization began in western countries.

**Figure 1: Human Activities That Contribute to Global Warming**

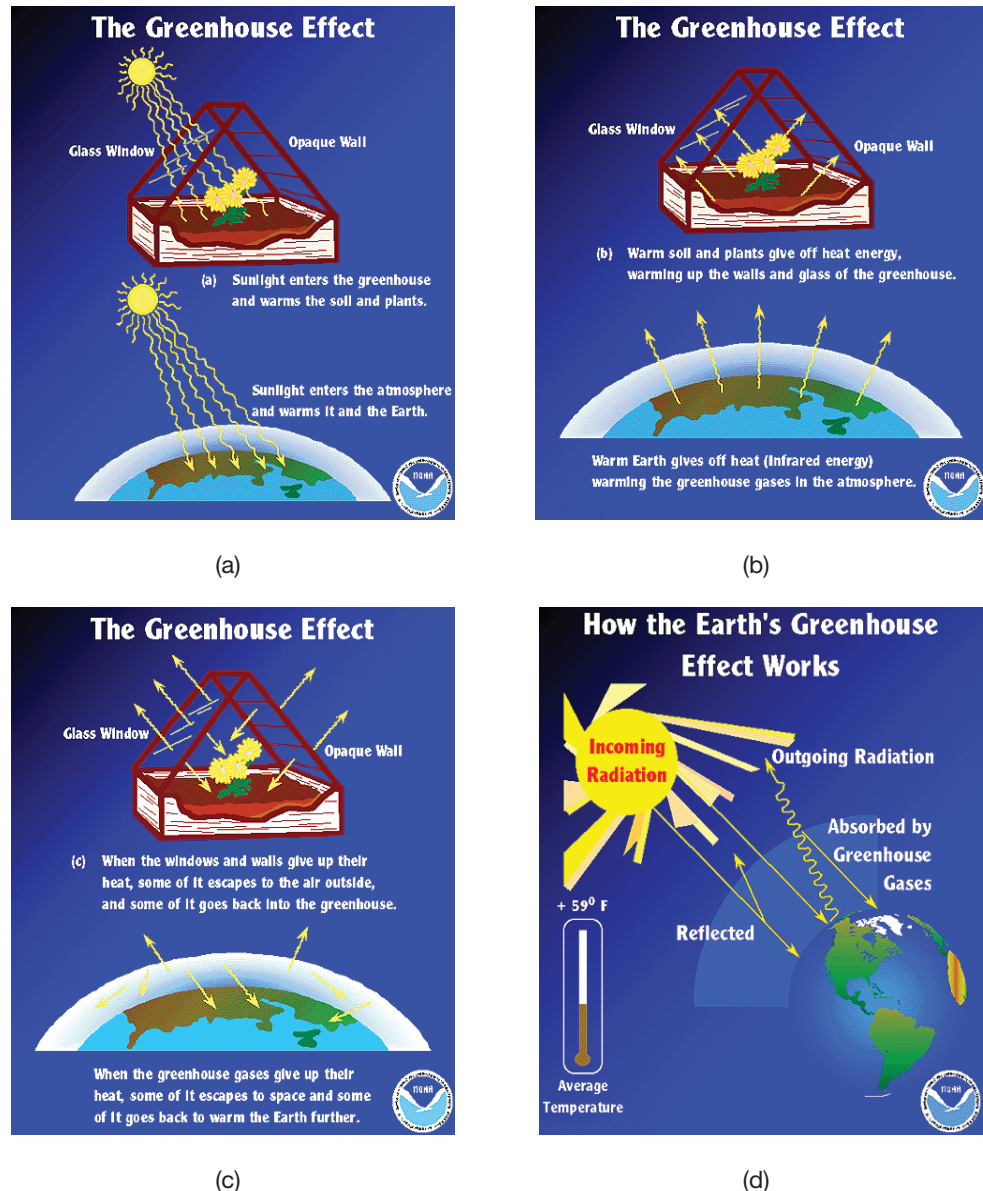


Source: National Oceanic and Atmospheric Administration of the United States Department of Commerce. Earth System Research Laboratory. Global Systems Division. CLIMGRAPH: Educational Graphics on Global Climate Change and the Greenhouse Effect. [www.esrl.noaa.gov/gsd/outreach/education/climgraph/CG\\_Figure\\_20a.gif.html](http://www.esrl.noaa.gov/gsd/outreach/education/climgraph/CG_Figure_20a.gif.html)



Now, with higher concentration of these gases, the atmosphere acts like a greenhouse. It traps the heat that radiates from the earth and reflects it back to earth. Temperatures at the earth's surface are increasing, and the water temperature of the oceans has increased. This effect is often called the "greenhouse effect" (Figure 2).

Figure 2: The Greenhouse Effect



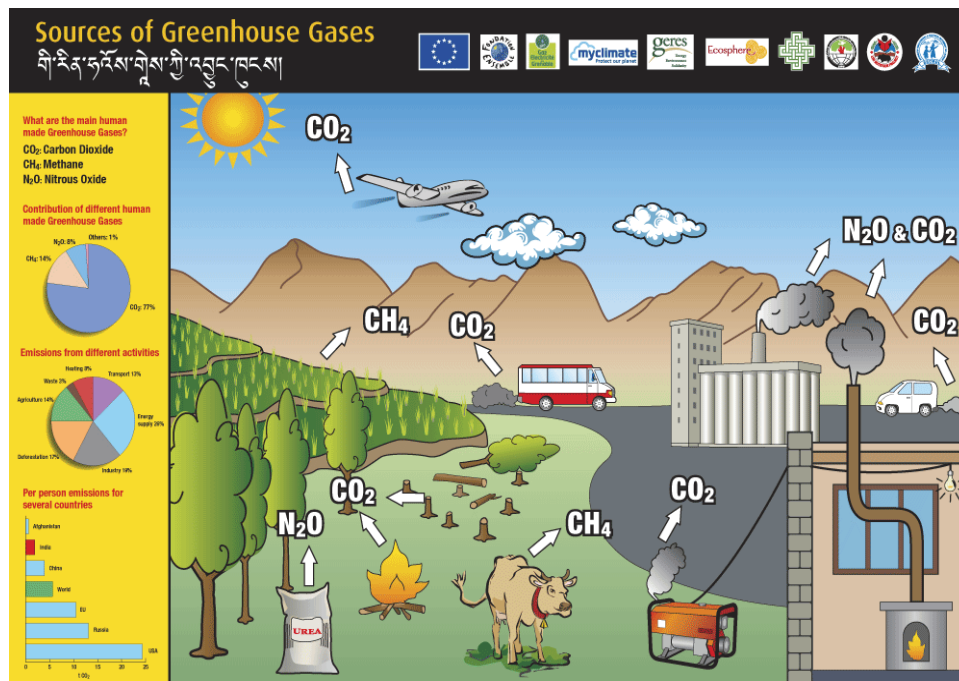
Source: National Oceanic and Atmospheric Administration of the United States Department of Commerce. Earth System Research Laboratory. Global Systems Division. CLIMGRAPH: Educational Graphics on Global Climate Change and the Greenhouse Effect. [www.esrl.noaa.gov/gsd/outreach/education/climgraph/CG](http://www.esrl.noaa.gov/gsd/outreach/education/climgraph/CG)

## Major Sources of Greenhouse Gas Emissions in Mongolia and the World

The biggest contributors of greenhouse gas (GHG) emissions in Mongolia are energy, mining, vehicles, and animal husbandry (Figure 3). Carbon dioxide makes up about 50% of the emissions, and methane about 40%. Compared with countries with larger populations and more industry and transport, Mongolia's total emissions are low. But on a per person basis, the country's emissions are relatively high because of the long, cold winter which requires a lot of heating, and the low energy efficiency of older technologies.

The concentration of GHGs is influenced by the amount of emissions into and removals from the atmosphere. Carbon dioxide, the most common GHG, is stored in plants and soils. Forests and grasslands store large amounts of carbon. But as forest and grassland areas are used for other purposes, such as farming or urban development, and as forests are felled and grasslands degraded, large amounts of stored carbon are released into the atmosphere. The oceans—with their microscopic plants in the water—as well as wetlands and the northern permafrost areas also store carbon. Melting permafrost, including in northern Mongolia, releases methane.

Figure 3: Sources of Greenhouse Gases



$\text{CH}_4$  = methane,  $\text{CO}_2$  = carbon dioxide,  $\text{N}_2\text{O}$  = nitrous oxide.

Source: Climate Emergency Institute. State of the Climate: Global greenhouse gas emissions.  
[www.climateemergencyinstitute.com/uploads/GHG\\_sources.gif](http://www.climateemergencyinstitute.com/uploads/GHG_sources.gif)

## Mitigation and Adaptation

Climate change mitigation means to undertake measures that counteract the causes of climate change. Examples of activities that reduce the emission of GHGs include (i) introducing fuel-efficient technologies and (ii) restoring and protecting natural resources that capture or store GHGs, preventing their release into the atmosphere.

Adaptation means to make changes to better cope with the effects of climate change. Climate change impacts will continue to increase in our lifetimes, even if strict measures to limit emissions are taken now. This is because GHGs can persist in the atmosphere for a long time. Therefore, adaptation measures are being developed and implemented in all countries and sectors to protect economies and livelihoods.

## The National Action Program on Climate Change

Mongolia's National Action Program on Climate Change, which was approved by the State Great *Khural* (Parliament) in January 2011, identified the following as priority adaptation measures: (i) conserving natural resources, especially natural pasturelands; (ii) strengthening the bio-capacity of domestic animals; (iii) enhancing the capacities and livelihood opportunities of rural communities; (iv) increasing food security and supply; (v) improving understanding of climate extremes, and strengthening disaster risk capabilities; and (vi) introducing new and reliable insurance systems.

## Mongolia's National Livestock Program

The National Mongolian Livestock Program makes important contributions to the country's objectives of helping traditional economic activities adapt to climate change and reducing GHG emissions.<sup>2</sup> The purpose of the program is to support the livestock sector through (i) developing good governance in the sector; (ii) improving livestock breeding to increase productivity and market competitiveness, including the production of high-quality, ecologically friendly livestock products and raw materials; (iii) raising veterinary service standards to international levels and protecting public health through securing Mongolian livestock health; (iv) developing livestock production that is adaptable to climatic, environmental, and ecological changes with strengthened risk management capacity; and (v) developing targeted markets for livestock and livestock products, and establishing processing and marketing structures.

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<sup>2</sup> Government of Mongolia. 2010. *National Mongolian Livestock Program*. Ulaanbaatar. p. 3.

# Adapting to Climate Change in Mongolia's Grasslands: What Can I Do to Reduce Climate Change Impacts on My Livelihood?

Natural resources and ecosystems are under threat globally from climate change impacts, direct human activities, and poor management practices. This is also true for Mongolia and its resources. Forests have been depleted through unregulated activities. Pastureland is degraded, and desertification is increasing as traditional pasture management practices have been abandoned and pastures are overused without allowing adequate resting times. Water sources are affected by the concentration of livestock around them, and many are being lost due to climate change and/or extraction rates that exceed replenishment.

Many herder families are still trying to increase their livestock numbers, even though the pasture is degraded and yields are decreasing each year. They generally do this because of (i) the challenges they face in adding value to livestock products through processing, (ii) their dependence on livestock for cash in the absence of bank loans, and (iii) difficulties they face marketing their products. As *dzuds* and droughts become more frequent, the risk of losing livestock rises. So, with no insurance, a large herd may seem the best strategy to ensure survival. However, this is a faulty strategy, as although it may provide short-term benefits, it has long-term costs. Pasturelands are already degraded, and expanding herd sizes further degrades the pasture resulting in (i) less food being available for livestock; (ii) poorer livestock health; (iii) higher death rates among livestock; (iv) less milk, meat, and wool production per head; and (v) reduced incomes for herders. Continuing to increase livestock numbers will only lead to more overgrazing and increased poverty.

Therefore, it is very important to improve animal productivity and herders' livelihoods by maintaining or restoring good-quality pasture and vegetation and improving breeding, animal health, and fodder production. The National Mongolian Livestock Program supports all of these activities, as well as the improvement of processing and marketing (footnote 2). New legislation, particularly the Law on Cooperatives (2010) and the Law on Agricultural Commodities Exchange (2012), also provides incentives for processing and marketing through cooperatives. To achieve the planned outcomes under the National Mongolian Livestock Program, a livestock unit with three officers per unit was established in every *soum*.<sup>3</sup>

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<sup>3</sup> A *soum* is a middle-level administrative division of Mongolia, equivalent to a district or county.

## Breed Improvement

If livestock quality is improved through breeding—e.g., increasing growth potential for wool and milk production—productivity will increase, and it may be possible to generate the same income from fewer livestock. The pressure on pastureland would be reduced with fewer livestock, leading to additional benefits for livestock productivity. Moreover, this will have the added benefit of reducing GHG emissions. Absorption of carbon dioxide will be improved through better pasture condition, and the emissions of GHGs per ton of meat, wool, or milk produced will be reduced if the yield per animal is increased.

Improving sheep production is one opportunity to increase family income. The first step would be to select breeding stock with high meat and wool productivity in areas where infrastructure is developed and ecological conditions are conducive for forage production. Local herders can be provided with selected pedigree animals for breeding to improve the quality of their herds. Breeds of sheep that are known to have better meat and wool yield and that should be preferentially raised and bred include *Barga* and *Uzemchin* in the eastern region; *Altanbulag* and *Bayantsagaan* in the central region; *Baidrag*, *Darhad*, *Hotont*, and *Tamir* in the Khangai region; and *Bayad*, *Gobi-Altai*, *Kerei*, *Sartuul*, and *Torguud* in the western region. Efforts to improve livestock quality should not be limited to insemination from good-quality breeding males. It is also important to create local core stocks (nucleus herds) for breed improvement. Yo Zagdsuren, a livestock specialist, has described how livestock quality can be improved through the creation and growth of a nucleus herd. The information is available as a pamphlet titled *Improvement of Local Breeds to Increase Sheep Productivity*, which was published by the Green Gold Project in 2011.

A nucleus herd should consist of at least 200 breeding female animals that produce 20% more yield in live weight or wool compared with the average yield of local sheep. Therefore, it is generally necessary for several families to cooperate. The fewer livestock households have, the greater the number of households needed to cooperate for breed improvement by creating a nucleus herd of the best animals from each family's herd. Herders who combine their livestock into a nucleus herd should conduct activities jointly. These activities include (i) determining the body size and weight, (ii) marking and registering each breeding animal, (iii) ensuring that livestock receive timely treatment against parasites and to prevent infectious diseases, (iv) fattening sheep before winter through *otor*<sup>4</sup> movement, (v) reserving sufficient forage for lambs and acquiring bran to feed lambs and increase their weight, (vi) monitoring production parameters of the offspring to ensure that the best animals are returned to the nucleus herd, and (vii) selling surplus young breeding rams. These activities can be profitable, and profits can be shared by the participating households based on their investments and labor contributions.

## Animal Health and Registration

Regular veterinary care, including vaccinations, reduces losses from livestock diseases. Another important strategy to improve livestock productivity and herders' livelihoods is to increase the competitiveness of livestock products in the market to meet international standards. This requires registration procedures documenting certificates of origin, regular veterinary care, and health certificates. Healthy, registered livestock achieve higher prices in the in-country market, and the strategy will also improve Mongolia's opportunities to sell livestock and livestock products outside the country. Local government officials can provide information on how to access external markets.

<sup>4</sup> *Otor* refers to long-distance migration of Mongolian herders, typically in autumn, to fatten livestock for winter.



### Herders with their goats and sheep in a Mongolian pasture



Source: Altangerel Ochirbat, June 2013.

### Rotational Use of Pasture

Herders who live close to each other should cooperate in establishing a rotating and resting scheme for their pastureland. A useful tool to help with developing the system is to make a map of the pastureland, its condition, and families' camps and movements. Seasonal changes in pasture use are part of traditional nomadic practice in Mongolia. In recent times, fencing of certain pasture areas, mainly for hay making or to let areas recover, has been practiced more often. One of the most effective and important ways to use pasture sustainably and reduce degradation is to use summer pasture in monthly or annual rotations.

To restore degraded pasture, long-period rotation must be used. Short-period rotation may be used for pasture that is in good condition. If pasture is overused again after resting when grass yield has just recovered, it provides only a very short-term gain and becomes more degraded. The pasture rotation schedule should be based on the requirements for plant growth, and should allow for pasture restoration, if necessary.

It is important that all rotation schedules incorporate herders' own proposals. Herders' proposals are introduced and discussed at the *bag*<sup>5</sup> citizens' public meeting, and then sent to the *soum* land officer. The *soum* land officer, together with the *soum* comanagement group, should finalize the annual pastureland management plan, based on the suggestions

<sup>5</sup> *Bag* (sometimes spelled *bagh*) refers to subdistricts, the third-level administrative division of Mongolia; it is the lowest administrative unit in Mongolia. *Soums* are divided into *bags*.

from all *bags* and the ecological requirements for pasture restoration, before submitting it to the *soum* citizens' representative meeting for approval. When the plan is developed in this way, the chances of successful implementation are higher as it incorporates local suggestions. Along with the rotation scheme for their pasture area, herders should also (i) determine the costs of implementing their rotation scheme and other pastureland management activities; (ii) discuss how these costs can be covered by herders or a group fund, if one has been established; and (iii) identify what support is needed from the *soum* development fund.

### Improving Pasture Water Supply—Collecting Snow and Rainwater

When pasture is degraded, much of the rainwater runs off and little is absorbed into the soil. As plant coverage on the ground is reduced, water absorption decreases, and palatable plants are not able to grow due to the lack of soil moisture. It takes several hundred years for 2 centimeters (cm) of topsoil to form; but through mismanagement of the land, these 2 cm of soil can be destroyed in 10 years or less. Also, too many wells—both hand-dug, shallow wells and deep wells—can deplete water in aquifers and lower the water table. The placement of wells should be done with proper engineering support and consideration of optimal water extraction rates.

Pasture plant growth depends on moisture supply, particularly in springtime (May)—the period of revitalization. At this time, it is important to create favorable conditions for the soil to absorb and retain a sufficient supply of moisture.

Snowmelt and summer rainwater can be collected through building small stone dams along slopes to slow down the runoff of water and allow more of it to be absorbed into the soil. Other simple measures to improve pasture water supply include piping water from rivers and springs or building water collection structures, such as small reservoirs and water tanks. However, it is important that the total volume of annual rain and the location of the collection structure are considered carefully to avoid overextraction of water, as well as to minimize water loss.

The protection of springs by fencing them to keep livestock out and prevent trampling of plants is very important. Protecting a larger catchment area, rather than just the immediate area around the spring, is even more effective. Another method to prevent trampling is to construct a collection pool at the spring and then channel or pipe the water to the pasture field or into a trough from which livestock can drink. Fences or other simple structures can be erected to trap drifting and blowing snow so that it will melt on the pasture in springtime or can be collected and stored. A storage structure for snow or ice can be made with stone walls 20 cm thick (bound by concrete) and a concrete floor. Such a structure should be shaded and out of the way of the spring flood. The stored snow can be covered with a thick layer (30 cm) of straw or other insulating materials.

### Increasing Hay Harvest

Irrigation and fertilizer are useful for increasing the harvest from natural hayfields. Fertilization with manure increases the amount of microorganisms in the soil and enriches the humus content, thereby increasing soil fertility. Sheep dung is the best fertilizer, followed by horse dung. Cattle dung is of the lowest quality. The best time to apply fertilizer is early spring or late autumn. When using fertilizer, it is very important not to use too much. Excess fertilizer wastes money and resources, and can damage pasture



**New deep well structure for watering livestock and providing water for herders funded by ADB**



Source: Altangerel Ochirbat, June 2013.

and pollute soil and water. For 1 hectare of hayfield, pasture researchers recommend applying 20 tons of fertilizer in autumn and 30 tons in springtime. Benefits are highest with irrigation. The volume of hay harvested can be doubled by applying manure. Even without irrigation, spreading manure on hayfields is effective in areas with more moisture, such as in riparian areas, in mountain meadows, and around lakes.

Commercial fertilizer is expensive, requires specific storage conditions, and needs to be accurately measured and applied according to the instructions. Also, commercial fertilizer emits large amounts of carbon dioxide. The use of commercial fertilizer is therefore not recommended.

### Planting Forage Species and Preparing Supplementary Feed

The nutritional value of summer and autumn pasture is 2–3 times that of winter and spring pasture. When grazing in summer and autumn, livestock get sufficient feed from natural pasture, but in winter and spring, pasture provides only about half of the required feed for the animals. Therefore, animals need supplementary feed during this time to keep them in condition to maintain productivity or for survival in harsh conditions.

Herders need to improve their knowledge and skills regarding planting forage species suited to local conditions, and preparing supplementary fodder such as silage for semi-intensive dairy farming in peri-urban areas. Mongolian researchers have identified 15 species of forage plants that are most suitable for planting in the country. They are described in the *Guideline for Planting Technical Forage Species*, published by the Association of Seed Producers, and include *Medicago falcata*, *Agropyron cristatum* (Chuluut), *Agropyron cristatum* (Nart), *Bromus inermis*, *Elymus sibirica*, *Elymus dahuricus*, *Psathyrostachys juncea*, *Stipa sibirica*, *Megicago varia*, *Agrostis mongolicum*, *Trifolium lupinaster*, *Zea mays*, *Sorgium* species *Hordium vulgare*, and *Avena sativa*.

### Value Addition, Marketing, and Diversifying Livelihoods

Forming a cooperative for product processing to add value is an important strategy because it enables a group to access credit to acquire processing equipment. Herders should ask the livestock unit officers what support is available to help establish a cooperative; apply for credit; and receive training in skills for processing, enterprise development, and marketing.

Diversifying livelihood strategies to include sources other than livestock is another important strategy to minimize risk to household livelihoods. Opportunities vary by local area, and skills and knowledge are needed to take advantage of them. They may be most feasible when a group of households pools their resources and shares the workload.

Alternative livelihoods funded through ADB—  
making felt handicrafts and shoes (top) and bakery (bottom)



Source: Altangerel Ochirbat, June 2013.

# The Role of Livestock and Pastures in Emission and Absorption of Greenhouse Gases: How Do I Play a Role?

## Greenhouse Gas Emissions from Livestock Husbandry

Animal husbandry contributes significantly to the greenhouse effect because it emits methane and nitrous oxide. Most of the methane (85%) is generated during the digestion process and discharged by the animals, and some (15%) is emitted from animal manure. Methane is a very powerful GHG, 23 times more potent than carbon dioxide. Methane emissions from livestock in Mongolia account for 91% of all agricultural emissions and 52% of the country's total emissions contributing to climate change.

## Carbon Storage in Pasture Plants and Soil, and the Role of Good Pasture Management

Green plants need water, sunlight, and carbon dioxide to grow. The sunlight provides energy to transform water and carbon dioxide into carbohydrate (a form of sugar) necessary for plant growth. Carbon is incorporated into the plant's structure, and oxygen is given off as a waste product. This process is called photosynthesis. The same basic process takes place in all green plants—in trees and in the grasses and forbs of the pastureland. Part of the carbon absorbed is allocated to plant roots, and as plants drop leaves or die and decay, carbon is incorporated into the soil. Soils may contain even more carbon than the pasture plants above ground. Good vegetation cover and healthy plant communities with well-developed root systems add organic matter into soils. This generates fertile soils that are able to support higher levels of production, and also hold water better so they are more resilient to drought.

The grasslands of the steppes evolved over millions of years with large herds of grazing wildlife. Grazing is compatible with grasslands, but must be managed well for grasslands to be sustainable. Good management practices include adjusting livestock numbers and the schedule of livestock movement (rotation across pastures). However, when pasture is used without rotation, it degrades and its productivity declines. As a result, less carbon is stored in plants and soils. In pastures under high stress, biomass can decrease by 30%–40% in a few years. This shows how much potential for carbon dioxide absorption can be lost. Mongolian pasture researcher and professor S. Tserendash recommends that, to use pasture properly, 50% of the pasture should be under rest at any given time to be restored. Practicing pasture rotation increases pasture productivity and therefore raises



Livestock grazing (yaks, top, and horses, bottom) on summer pasture



Source: Altangerel Ochirbat, June 2013.

livestock productivity and herders' livelihoods. It also makes an important contribution to helping stabilize the climate.

Careful monitoring of changes in soil quality and condition and in vegetation cover and species composition is very important for two reasons. First, it allows herders to assess pasture condition and plan appropriate measures, such as rotation, to avoid degrading pasture productivity and undermining household livelihoods. Second, it helps evaluate carbon content as a measure of the impact of climate change mitigation actions taken in grasslands (one of the necessary conditions for eligibility for potential carbon financing). By studying the soil and the plant biomass above and below ground, pasture researchers can estimate how much carbon dioxide is stored in the soil and vegetation. The amount varies depending on pasture type, soil type, and ecological region, and researchers have established comparable values for carbon amounts in different soil types and ecological zones. With baseline information and regular monitoring of pasture condition, it is possible to estimate how carbon content increases in pasture plants and soils that are well managed—or how it decreases under poor management practices.

# Incentives for Improving Pasture and Livestock Management

## Potential Financial Incentives—Opportunities for Climate Finance and Increased Incomes through Greenhouse Gas Emission Reduction and Absorption

Developed countries have committed to providing financial support to developing countries by supporting mitigation and adaptation in ways suited to their sustainable development needs. Developing countries are preparing proposals for activities they plan to undertake to reduce emissions and that could receive financing from developed countries. These are called nationally appropriate mitigation actions (NAMAs). The Government of Mongolia is preparing a NAMA for the livestock sector, and is seeking support for limiting the increase in the total number of livestock by raising livestock productivity. There are also carbon market mechanisms in which foundations, private sector companies, international organizations, and bilateral and/or multilateral development agencies pay for projects that reduce emissions in a developing country as a way of offsetting carbon emissions elsewhere. Currently, activities in the grassland and livestock sectors are only eligible for voluntary carbon markets (the offsetting of greenhouse gas emissions voluntarily by private sector and various organizations), and depend on donor funds.

Under NAMAs and carbon market mechanisms, activities that may provide potential opportunities for revenue generation in the future are those that measurably affect GHG emissions. These include better pasture management (which increases the potential for carbon storage in soil and vegetation) and improved livestock productivity (which reduces emissions intensity). At present, there are very few opportunities, but more opportunities may arise in the future.

To receive such finance, it will be necessary to make a formal application when the opportunity becomes available (either with local government or through a nongovernment organization or a private sector company), and to provide accurate information on how reductions in carbon emissions are estimated or calculated. Therefore, reliable monitoring and evaluation are essential. Reports will need to be prepared carefully, and the reported data will need to be measurable and verifiable. “Measurable” means that it is possible to compare an initial or baseline estimate of the carbon contained in the soils and plants before better pasture management practices are introduced with carbon estimates taken after improved practices are implemented. The goal is to maintain carbon values in good-quality pasture and to increase them in degraded pasture. “Verifiable” means that the methodology is documented, there are double-checks, and the results are the same when a measurement is repeated. Voluntary carbon projects pay a negotiated amount for the verified results.



Winter livestock shelters built from stones (top); improved winter livestock shelter built with ADB funds (bottom)



Source: Altangerel Ochirbat, June 2013.

At present, local officers and experts are responsible for collecting and evaluating technical data. Herders and *bag* governors, however, should also have responsibilities for monitoring and evaluation (M&E), and should contribute their knowledge of local pasture conditions and use. In voluntary carbon projects, local community members generally have a specified role in M&E.

However, there are other, even greater incentives for improving pasture and livestock productivity than revenues generated through carbon finance projects. Increased productivity means higher yields of meat, milk, wool, and cashmere, which result in higher income, especially if processing and marketing mechanisms are improved at the same time.

## Environmental Incentives—Mitigating Global Climate Change and Protecting Local Ecosystems

The environmental incentives for improving pasture and livestock management through the measures described are significant as the measures protect the natural resource base upon which herders and the whole country depend. The loss of water sources is a threat not only to herders but also for city dwellers. The provision of water to cities depends on effective watershed (pasture and forest) management. Careful management of pastures and livestock is a key element in protecting Mongolia's ecosystems and natural resources upon which much of its economy depends. Mongolia's ecosystems provide clean water, air, nature to enjoy, and the scenic beauty that attracts tourists to the country. Moreover, Mongolian herders are the guardians of one of the largest remaining grasslands on Earth. Through proper management of the grasslands, herders can make an important contribution to global climate change mitigation.

## Legal Incentives—The New Law on Soil Conservation and Desertification Control

Sound pasture management and nature conservation practices are deeply rooted in Mongolia's traditional beliefs and rules, and the new legislation emphasizes the individual responsibilities of each citizen to protect the soil and prevent desertification. The Law on Soil Conservation and Desertification Control<sup>6</sup> was passed in 2012. It defines responsibilities and measures for soil conservation and rehabilitation and for preventing desertification. Some of the most important responsibilities include (i) using seasonal rotation in grasslands, while matching livestock numbers to the specific pasture's carrying capacity; (ii) establishing special needs areas, including inter-*aimag*<sup>7</sup> reserve (*otor*) pastures and haymaking fields of state fodder reserves under rotation; and (iii) planting protective barriers at locations prone to erosion.

## Responsibilities and Rights of Citizens

The new law provides citizens with rights and obligations to demand public servants to (i) halt operations that have caused soil degradation and desertification, (ii) eradicate soil pollution, and (iii) rehabilitate soil. Parties that are found to be responsible for soil degradation are obligated to provide true and factual information on soil degradation and

<sup>6</sup> Mongolian Parliament. 2012. Law on Soil Conservation and Desertification Control. Ulaanbaatar.

<sup>7</sup> *Aimag* refers to province or the first-level administrative division of Mongolia.

### Herders supported by ADB build pasture fences to grow fodder



Source: Altangerel Ochirbat, June 2013.

desertification to authorized organizations. Citizens and legal entities responsible for soil degradation are required to rehabilitate the soil by implementing measures described in Article 7 of the new law.

Article 10 of the new law states that citizens, entities, and organizations shall be granted incentives for soil conservation and desertification control activities, as set out in Article 46.1 of the Law on Environmental Protection.<sup>8</sup> These activities include efforts by cropland owners and users to improve soil productivity, the establishment of windbreaks around croplands, planting and fencing of fruit trees and bushes, the creation of employment in local areas through soil conservation and desertification control operations, voluntary soil conservation and rehabilitation on land under common use, the introduction of state-of-the-art and environmentally sound technology in mining, and the use of pasture under seasonal rotation.

Most of the activities that contribute to adaptation to climate change also help to mitigate climate change. Pasture improvement and soil protection raise productivity (adaptation), while also increasing the soil's capacity to absorb carbon (mitigation). The successful implementation of the National Mongolian Livestock Program will result in higher productivity (adaptation) and higher incomes (adaptation), while reducing emissions from livestock production (mitigation). Appendix 1 of this publication provides a list of adaptation and mitigation activities.

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<sup>8</sup> Mongolian Parliament. 1995. Law of Mongolia on Environmental Protection. Ulaanbaatar.

# Collaboration in Planning and Implementation of Pastureland Management

To implement the National Mongolian Livestock Program and manage pasture successfully, effective cooperation at the local level is crucial, both among the herders themselves and between herders and local government. Many activities, such as establishing a nucleus herd for breeding and managing common-use summer pasture, are collective activities. To develop practical plans and implement them effectively, joint planning by all involved is one of the biggest factors in achieving success. Herders' own initiatives and participation are another important success factor.

## Collaborative Management at the *Soum* Level

Herders and local government officers—including the land officer, livestock unit officers, meteorological technicians, environmental inspectors, and *bag* governors—need to work closely to plan the use of pasture, water, and other natural resources. The local government and herders both have responsibilities for improving pasture management, and therefore it is vital to create joint management structures. Many *soums* have established joint management structures, such as comanagement committees, which have proved to be effective mechanisms for working collaboratively. The structures support herders' participation, joint decision making, and implementation of complex measures of pasture rotation and restoration. It is the herders' responsibility to develop proposals, and it is the land officer's duty to develop the pastureland plan, taking into account the herders' proposals. A joint management structure should establish a schedule of meetings, and should define the duties, responsibilities, and activities of each participating individual or group.

## Collaboration among Herders

To improve the effectiveness of *soum*-level cooperation between herders and local government, two other mechanisms are important: (i) the herders' own organizations and (ii) close cooperation of the local officers as a unit. There are different forms of new herders' organizations. The models have been developed mostly with support from various development projects. Most herders' organizations are based on pastureland that traditionally is used jointly by the member households. Within such groups, households can form subgroups for processing or income generation, and the government provides incentives and support for them to establish themselves as cooperatives. Experiences from herders' organizations have generated lessons on success factors. These include establishing a joint fund for the herders' organization, having a council or committee that supports the work of the elected leader, and deciding on norms of operation that all members agree on.



### Herders discussing water and pasture use with an ADB project team



Source: Altangerel Ochirbat, June 2013.

### Cooperation among *Soum* Government Officers

Close cooperation of all *soum* officers working on environmental issues and natural resources has been shown to improve the officers' effectiveness, both in their service provision to citizens and for joint planning and management of pasture and other resources. In some *aimags* (in the eastern and western regions), such environmental units have already been officially established by decree of *aimag* governors.

### Regulations and Guidelines on Planning, Implementation, and Monitoring and Evaluation of Pastureland

The new Regulation and Guideline for Monitoring and Evaluation of the Implementation of the Land Management Plan (2012) provides procedures and methodologies for annual M&E of pastureland. This exercise is to be led by the land officer and undertaken with the participation of officers of the livestock unit, a meteorological technician, and an environmental inspector.<sup>9</sup>

<sup>9</sup> The regulation and guideline was developed by ALACGAC; and the development of Chapter 2 and its appendixes was supported by ADB's regional capacity development technical assistance, Strengthening Carbon Financing for Regional Grassland Management in Northeast Asia (TA 7534-REG). The new regulation promotes impact monitoring as opposed to performance monitoring, and aids in the implementation of the new legislation on soil conservation.

Additional regulations and guidelines prescribe the procedures and methodologies for annual planning and M&E of pastureland management at the *soum* level. Resolution No. 131 (30 June 2006) by the Administration of Land Affairs, Construction, Geodesy and Cartography (ALACGAC) and its appendixes prescribe the Methodology for the Development of Annual Land Management Plan at *Soum* Level.<sup>10</sup> Its principles for planning are to (i) develop pasture management according to the local geography and pasture use traditions; (ii) reflect requirements for rational use and rehabilitation of the pastures in the division of the *soum* pastureland into winter, spring, summer, and autumn pastures and *otor* areas; (iii) develop activities to prevent erosion and pollution; and (iv) promote rehabilitation and preservation. Annex 3 of the ALACGAC methodology document includes advice for herders to determine the yield and calculate the carrying capacity of their pasture.

Appendix 2 of this publication provides additional materials on best practices. Herders are further advised to work with their local government officers in planning and efforts to improve pasture and livestock productivity.

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<sup>10</sup> The methodology was developed based on provision 25.1.4 of the Law on Land of Mongolia and the Methodological Guidelines for General Land Management, approved by Resolution No. 28 of 2002 of the Government of Mongolia.



## Appendix 1

# Adaptation and Mitigation Practices

| No.  | PRACTICE  | Adaptation | Mitigation <sup>a</sup> |
|--|---|------------|-------------------------|
| <b>I. PASTURE MANAGEMENT</b>   |   |            |                         |
| <b>A. Managing Movements (annual, seasonal, emergency)</b>   |   |            |                         |
| 1  | Pasture (summer and/or autumn) rotation and resting   | X          | X                       |
| 2  | Designating <i>otor</i> areas and/or common reserve pasture   | X          | X                       |
| 3  | Organizing <i>otor</i> and/or long-distance movements (for rehabilitation of pasture, and in drought and/or <i>dzud</i> )   | X          | X                       |
| 4  | Providing (mobile) government services in <i>otor</i> areas and summer pastures   | X          |                         |
| 5  | Seeding and/or reseeding with native grasses and forbs (in conjunction with fencing to exclude livestock)   | X          | X                       |
| <b>B. Strengthening Institutions, Collaboration, Planning, and Allocation and/or Tenure of Resources</b> |   |            |                         |
| 6  | Concluding (group) possession contracts for winter and/or spring pasture  | X          |                         |
| 7  | Strengthening herders' collective action institutions (traditional networks and pasture user groups (and other groups for natural resource management and/or conservation); recognition of pasture user groups and delineating group pasture area | X          |                         |
| 8  | Possession and/or certificates for winter and spring camps  | X          |                         |
| 9  | Pasture use fees (piloting)   | X          | X                       |
| 10   | Community and/or group funds (risk management, credit for members, joint investments in pasture management or other)  | X          |                         |
| 11   | <i>Soum</i> -level comanagement institutions and/or procedures for pastureland management and monitoring  | X          |                         |
| 12   | Cooperation of Environmental Unit of <i>soum</i> government officers (institutionalized in some <i>aimags</i> already)  | X          |                         |
| 13   | Inter- <i>soum</i> (and inter- <i>aimag</i> ) cooperation to regulate <i>otor</i> movements and cross-boundary ( <i>soum</i> and/or <i>aimag</i> ) migrations and/or residence  | X          |                         |
| 14   | Preparing and implementing pasture management plans by pasture user groups at <i>bag</i> level  | X          | X                       |
| 15   | Preparing and implementing annual pasture management plans at <i>soum</i> level   | X          | X                       |
| <b>C. Improving Pasture Water Supply</b>   |   |            |                         |
| 16   | Deep, engineered wells in unused pastures (with proper prior assessment, monitoring of recharge, and management structures in place)  | X          |                         |
| 17   | Hand-dug wells in unused pastures   | X          |                         |
| <b>D. Biological Rodent Control</b>  |   |            |                         |
| 18   | Rodent control through protection and/or support of natural predators; install posts as perches for birds of prey from where they can hunt rodents; protect and/or do not kill foxes  | X          | X                       |
| 19   | Manual control (with water and/or drowning, traps, or hunting)  | X          | X                       |

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Table continued

| No.   | PRACTICE  | Adaptation | Mitigation <sup>a</sup> |
|---|---|------------|-------------------------|
| <b>E. Risk Management and Disaster Preparedness</b>                           |   |            |                         |
| 20  | Emergency grazing reserves and/or <i>otor</i> areas (inter- <i>soum</i> , inter- <i>aimag</i> )   | X          |                         |
| 21  | Weather, disaster, and livestock forage conditions forecasting (livestock early warning system): monitoring and processing data and outreach and/or information delivery to herders (local FM stations—repeater and radios, cell phone coverage and/or capacity and alerts of forecasts, TV stations to broadcast accurate and timely forecasts produced by the National Agency for Meteorology and Environmental Monitoring) | X          |                         |
| 22  | Information technology for rural areas and/or herders   | X          |                         |
| 23  | Protecting bushes and/or shrubs, forest understory, and riparian areas for emergency grazing  | X          | X                       |
| 24  | Hay and/or fodder storage facilities  | X          |                         |
| 25  | Livestock shelters in remote common reserve pasture ( <i>otor</i> ) areas   | X          |                         |
| 26  | Index-based livestock insurance   | X          |                         |
| 27  | Preparing risk management and contingency plans ( <i>soum</i> level)  | X          |                         |
| <b>II. LIVESTOCK MANAGEMENT</b>   |   |            |                         |
| <b>A. Livestock Productivity and/or Quality (Breeding, Health, Nutrition)</b> |   |            |                         |
| 28  | Improving local breeds through establishing core stock (nucleus herd)   | X          | X                       |
| 29  | Artificial insemination, “speeding adaptation” to develop more resistant or more productive species (for suitable exotic species, e.g., highly productive dairy cattle in peri-urban areas)   | X          | X                       |
| 30  | Vaccinations  | X          |                         |
| 31  | Infectious disease management (monitoring, treatment)   | X          |                         |
| 32  | Parasite treatment (sheep dipping)  | X          |                         |
| <b>B. Fodder and/or Feed Production</b>                                       |   |            |                         |
| 33  | Allocating hayfields to groups of households  | X          |                         |
| 34  | Improving hay yield (fencing, fertilizing, seeding, irrigation)   | X          | X                       |
| 35  | Growing fodder (oats, rye, introduce drought-resistant species)   | X          |                         |
| 36  | Growing maize, making silage  | X          |                         |
| 37  | Silage from native species (dependent on ecological zone): <i>Urtica canabina</i> , <i>Chenopodium album</i> , <i>Allium polyrrhizum</i> , <i>Allium mongolicum</i> , <i>Glycyrrhiza uralensis</i> (sweetgrass) (unpalatable in early stages of maturity)   | X          |                         |
| 38  | Producing supplementary feed and/or minerals (pressed blocks)   | X          |                         |
| 39  | Buying supplemental fodder (oats and bran)  | X          |                         |
| 40  | Handmade fodder, traditional  | X          |                         |
| <b>C. Herd Management and Herding Practices</b>                               |   |            |                         |
| 41  | Selling, slaughtering animals before winter   | X          | X                       |
| 42  | Slaughtering animals at a younger age   | X          | X                       |
| 43  | Adjusting herd structure to establish traditional ratio of small–large livestock; reducing number of goats  | X          | X                       |

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Table continued

| No.   | PRACTICE  | Adaptation | Mitigation <sup>a</sup> |
|---|---|------------|-------------------------|
| 44  | More active (traditional) herding/managing livestock (to prevent grazing in riparian areas, wetlands, steep slopes, forest, and degraded grassland)   | X          | X                       |
| 45  | Mobgrazing—high-density grazing whereby livestock is moved frequently, grazing small pasture areas and leaving nearly 50% of forage. The rationale is that trampling by a high-density herd improves the soil as it transfers organic matter into the ground. The grazed sections then need a long rest period. The method is used in many parts of the world, including Australia and the United States. It requires very intensive planning and very active herd management. This is especially suitable for smaller, limited grazing land areas.   | X          | X                       |
| <b>D. Intensification—Dairy Farming in Suitable Peri-Urban Areas</b>        |   |            |                         |
| 46  | Warm livestock shelters (closed stables) for dairy cattle   | X          |                         |
| 47  | Exotic cattle species with higher yields (milk)   | X          |                         |
| 48  | Milk storage facilities   | X          |                         |
| <b>III. ECOSYSTEMS PROTECTION AND RESTORATION</b>                           |   |            |                         |
| <b>A. Land Management, Combating Desertification, and Soil Conservation</b> |   |            |                         |
| 49  | Silvopastoralism—tree planting (elm, tamarisk, or sea-buckthorn depending on ecoregion); and possible intercropping with sweetgrass, willow, or crop species (such as currants) depending on ecoregion in grazing areas; and shelter belts (tree and/or bush planting around and/or along vegetable, fodder fields)   | X          | X                       |
| 50  | Sand and/or sand dune stabilization: (i) square-shaped barriers and/or straw grids to prevent sand movement, planting shrubs and/or trees inside grid; (ii) grids and/or mechanical barriers with clay, netting, stones, wood; planting shrubs on the lower one-third of sand dunes' windward side to decrease wind velocity near the base of the dune to prevent sand from moving; (iii) planting trees atop the flattened surface of dunes that have been leveled off by high winds; (iv) planting grass and other plants in checkerboard patterns to prevent erosion; and (v) lignin sand-stabilizing material—an innovative method used in the People's Republic of China. Lignin is extracted from the black liquor of straw paper mills; the new material is called sand-stabilizing lignin, and is proving effective, economical, environmentally friendly, and plant-friendly in fugitive dune fixation. It can be used with forest and/or grass planting simultaneously. This technique not only creates a new method for desertification control but also reduces water contamination.<br><br>It is most feasible where lignin is produced as a by-product (described in: Wang, H., Dagvadorj, D., and Pitman, A. 2005. <i>The Degraded Ecosystem Restoration in the Arid and Semi-Arid Northern China-Mongolia Region</i> . Final report for APN project 2005-23-NSY-Wang. Asia-Pacific Network for Global Change Research). | X          | X                       |
| 51  | Soil conservation techniques in cultivation, including contour plowing, grassland and/or crop strip rotation, and multicrop rotation  | X          | X                       |
| 52  | Enforcing <i>aimag</i> land use plan (mining licensing, rehabilitation of mining areas)   | X          | X                       |

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Table continued

| No.       | PRACTICE   | Adaptation | Mitigation <sup>a</sup> |
|-----------|--|------------|-------------------------|
| <b>B.</b> | <b>Water Resources Protection and/or Management—Riparian Conservation and Restoration, Protection of Wetlands, Lakes, Ponds, Oasis (<i>burd</i> in Mongolian language)</b> |            |                         |
| 53        | Stream bank protection and restoration (temporary fencing)   | X          |                         |
| 54        | Stream channel restoration (barriers, logs, and/or rocks to slow flow of water)  | X          |                         |
| 55        | Managing livestock access to streams (fenced access)   | X          |                         |
| 56        | Establishing watering troughs off site   | X          |                         |
| 57        | Fencing springs  | X          |                         |
| 58        | Watering schedules for herds in critical habitats (lakes, ponds)   | X          |                         |
| 59        | Limiting and managing access to lakes, ponds (fencing)   | X          |                         |
| 60        | Establishing and/or strengthening watershed administrations  | X          |                         |
| 61        | Establishing and/or strengthening watershed councils and subcouncils   | X          |                         |
| 62        | Preparing river basin and subbasin management plans  | X          |                         |
| <b>C.</b> | <b>Forest Management and/or Protection</b>   |            |                         |
| 63        | Sustainable forest management  | X          |                         |
| 64        | Establishing and supporting forest user groups   | X          |                         |
| 65        | Fuel efficient stoves and pressed fuels  | X          | X                       |
| 66        | Protecting and rehabilitating saxaul ( <i>Haloxylon sp.</i> ) forest (desert steppe) to stabilize sand and as camel forage   | X          | X                       |
| <b>D.</b> | <b>Upland Protection</b>   |            |                         |
| 67        | Avoiding grazing on steep slopes (small livestock)   | X          | X                       |
| <b>E.</b> | <b>Water Harvesting and Conservation</b>   |            |                         |
| 68        | Small-scale dams and reservoirs  | X          |                         |
| 69        | Trapping and/or slowing rainwater, slowing erosion (contour lines, shallow ditch patterns)   | X          |                         |
| 70        | Snow collection and/or trapping  | X          |                         |
| 71        | Channels, piping and/or pipelines, and tanks   | X          |                         |
| 72        | Nighttime irrigation to reduce evaporation loss  | X          |                         |
| 73        | Drip irrigation  | X          |                         |
| 74        | Water conservation measures in urban areas, mining operations  | X          |                         |
| 75        | Increase moisture retention capacity of soil (mulching in vegetable and crop fields)   | X          |                         |
| <b>F.</b> | <b>Protected Areas</b>   |            |                         |
| 76        | Designating local protected areas (including traditional sites, new categories)  | X          | X                       |

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Table continued

| No.  | PRACTICE  | Adaptation | Mitigation <sup>a</sup> |
|--|---|------------|-------------------------|
| <b>IV. LIVELIHOODS</b>                         |   |            |                         |
| <b>A. Value Addition to Livestock Products</b> |   |            |                         |
| 77   | Establishing herder groups and/or women's groups as small enterprises and/or cooperatives for processing and/or access to credit  | X          |                         |
| 78   | Cow, camel milk products  | X          |                         |
| 79   | Wool and fiber (sheep, yak, camel)  | X          |                         |
| 80   | Meat  | X          |                         |
| <b>B. Diversification</b>                      |   |            |                         |
| 81   | Vegetable growing   | X          |                         |
| 82   | Cultivation of bushes and/or berries (sea-buckthorn, currants, etc.)  | X          | X                       |
| 83   | Nontimber forest products   | X          |                         |
| 84   | Timber (forest) user groups   | X          |                         |
| 85   | Tourism   | X          |                         |
| 86   | Hay and fodder production as enterprise   | X          |                         |
| 87   | Producing breeding stock as enterprise  | X          |                         |
| 88   | Vocational training and/or employment in nonlivestock sector  | X          |                         |
| <b>C. Marketing</b>                            |   |            |                         |
| 89   | Branding and certification (for international marketing)  | X          |                         |
| 90   | Establishing and/or strengthening cooperatives for marketing  | X          |                         |
| 91   | Local or mobile slaughterhouses   | X          |                         |
| <b>V. MAINSTREAMING ADAPTATION</b>             |   |            |                         |
| <b>A. Strategic Planning and Budgeting</b>     |   |            |                         |
| 92   | Preparing governor's action plan, <i>soum</i> development plans, and <i>soum</i> development strategy that mainstream adaptation  | X          |                         |
| 93   | Needs-based budget planning for implementation of pasture management plan and livestock program activities; identify costs and provide budget from <i>soum</i> development fund                           | X          |                         |
| <b>VI. RESEARCH</b>                            |   |            |                         |
| 94   | Conducting further research on adaptation and mitigation, such as opportunities in feed changes to reduce livestock methane emissions that are feasible in Mongolia, and drought-resistant fodder species | X          | X                       |

<sup>a</sup> Mitigation activities identified were those that could have a measurable impact on reducing carbon emissions and deemed most likely to be eligible for consideration as part of a potential future carbon project.

Source: Project team.



## Appendix 2

# Educational Materials on Best Practices in Pasture and Livestock

The extension service website at [www.agrinfo.mn](http://www.agrinfo.mn) offers a wealth of information. If you have queries about the publications listed here, please contact your extension officers.

### 1. Pasture

Center for Policy Research. 2005. Pasture Management. In World Bank, *Community Based Pasture and Risk Management*. Ulaanbaatar: Munkhiin Useg. pp. 122–156.

Government of Mongolia, Ministry of Food, Agriculture and Light Industry. 2011. Pasture Rotation. In Food and Agricultural Organization of the United Nations. *Adaptation of Animal Husbandry to Climate Change in Mongolia*. Ulaanbaatar: Munkhiin Useg.

\_\_\_\_\_. 2011. *Recommendations for Pasture Rotation and Rest*. Ulaanbaatar: United Nations Development Programme.

Jigjidsuren, S. 2005. *Pasture Management*. Ulaanbaatar: Admon Publishing.

\_\_\_\_\_. 2011. Experiences from Results of Rotation of Degraded Pasture. In Swiss Agency for Development Cooperation. *Golden Rules of Pasture Use*. Ulaanbaatar: Selengepress. pp. 53–64.

\_\_\_\_\_. 2011. Methods and Knowledge of Sustainable Pasture Use. In Swiss Agency for Development Cooperation. *Golden Rules of Pasture Use*. Ulaanbaatar: Selengepress. pp. 18–34.

Research Institute of Animal Husbandry. 2011. *50th Anniversary of the Research Institute of Animal Husbandry*. Ulaanbaatar: Munkhiin Useg.

\_\_\_\_\_. 2011. *Fifty Years of Rangeland Research*. Ulaanbaatar: Research Institute of Animal Husbandry.

Swiss Agency for Development Cooperation. 2006. *Improvement of Pasture Management*. Ulaanbaatar: Green Gold Project Report, Swiss Agency for Development Cooperation.

Tserendash, S. 2011. *Methods of Sustainable Pasture Use*. Ulaanbaatar: Munkhiin Useg.

\_\_\_\_\_. 2011. Pasture Management and Fodder Production. In Government of Mongolia Ministry of Food, Agriculture, and Light Industry. *Handout for Animal Breeders*. Ulaanbaatar: Munkhiin Useg. pp. 209–266.

## 2. Soil

- Avaadorj, D. 2010. *Soil Organic Matter and Its Role in Ecology*. Ulaanbaatar: Selengepress.
- Institute of Geo-Ecology. 2010. *Simple Methods to Improve Soil*. Ulaanbaatar: Swiss Agency for Development Cooperation.

## 3. Protecting Water Sources and Improving Pasture Water Supply

- Center for Policy Research. 2005. Rational Use of Water Resources. In World Bank. *Community Based Pasture and Risk Management*. Ulaanbaatar: Munkhiin Useg. pp. 47–49.
- Oyunsuren, R. 2008. *Instruction to Dig Hand Well in Desert Steppe Area*. Ulaanbaatar: Admarket.
- United Nations Development Programme. 2011. *Sustainable Use and Protection of Springs*. Sustainable Land Management for Combating Desertification Project Report.
- United Nations Development Programme. 2011. *Water Harvesting in High Mountain Areas for Irrigation and Animal Husbandry*. Sustainable Land Management for Combating Desertification Project Report.

## 4. Improving Livestock Quality and/or Breeding

- Center for Policy Research. 2005. Practices to Protect Livestock Health. In World Bank. *Community Based Pasture and Risk Management*. Ulaanbaatar: Munkhiin Useg. pp. 39–45.
- Government of Mongolia, Ministry of Food, Agriculture and Light Industry. 2011. Herd Composition. In Food and Agriculture Organization of the United Nations. *Adaptation of Animal Husbandry to Climate Change in Mongolia*. Ulaanbaatar: Munkhiin Useg. pp. 72–75.
- Jigjidpurev, S. et al. 2011. Livestock Breed Selection. In Government of Mongolia, Ministry for Food, Agriculture and Light Industry. *Handout for Animal Breeders*. Ulaanbaatar: Munkhiin Useg. pp. 77–205.
- Minjigdorj, B. et al. 2011. *Guidance for Classification of Horse, Cattle, Sheep, Goat*. Ulaanbaatar: MN Technology.
- Zagdsuren, Y. 2011. *Improvement of Local Breeds to Increase Sheep Productivity*. Ulaanbaatar: Green Gold Project, Swiss Agency for Development Cooperation.

## 5. Hay Making, Fodder Production

- Center for Policy Research. 2012. *Methods to Prepare Different Types of Fodder*. Ulaanbaatar: Bitpress.
- Dugersuren, S. 2011. *Technology of Fodder Preparation in the Desert and Steppe Zones*. Ulaanbaatar: Arvai.
- \_\_\_\_\_. 2012. *Best Practices and Management of Dairy Farming*. Ulaanbaatar: Admon.
- \_\_\_\_\_. 2012. *Potential of Planting Fodder in Desert and Steppe Zone*. Ulaanbaatar: Arvai.
- Tumenjargal, D. 2009. *Guideline for Planting Technical Forage Species*. Ulaanbaatar: Association of Seed Producers.

## **Making Grasslands Sustainable in Mongolia**

### **Herders' Livelihoods and Climate Change**

The threats posed by climate change have significant impacts on Mongolia's grassland ecosystems and herders' livelihoods. This publication discusses the causes of climate change and its impacts on livelihoods and ecosystems for herders and the general public. It explains how good pasture management and livestock productivity are important for increasing incomes and provides information on adaptation practices. It also identifies sustainable management practices that can increase communities' resilience to climate change, improve environmental quality, and increase local revenue.

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