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Provision of technical assistance for enhancing climate-resilience and economic sustainability of livestock farming in a rural community in Mongolia

Deliverable 3.1:
Report on pastureland management practices and associated technologies and their impacts on climate-resilient livestock farming

Submitted to:
The United Nations

alinea

About the project

The project will strengthen climate-resilient livestock farming while deriving the economic sustainability for vulnerable herding communities in Bayantümen soum and contributing to the Nationally Determined Contributions (NDC) and national climate change adaptation and mitigation priorities for Mongolia. Alinea implements this project with the Alberta Biodiversity Monitoring Institute (ABMI) and the R&D Center for Climate Change and Sustainable Development (CCSD) in Mongolia (www.climatechange.mn).

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Acronyms and abbreviations

ABMI	Alberta Biodiversity Monitoring Institute
CCSD	Center for Climate Change and Sustainable Development
ESD	Ecological Site Description
ESG	Ecological Site Group
NDC	Nationally Determined Contributions
NEARC	Northeast-Asian Environmental and Agricultural Research Center
PUG	Pasture User Groups
SCD	Swiss Development Corporation

Executive Summary

The steppes of Eastern Mongolia, which includes Dornod *aimag* and Bayantumen *soum* have long been praised for excellent grasslands, excellent horses and vast herds of Mongolian gazelle migrating across the grasslands. Much of the rangeland in Bayantumen soum, especially the areas used for winter-spring pastures, are still in good condition. There is considerable potential to create more climate-resilient, sustainable livestock farming systems in Bayantumen *soum*. There are, however, a number of challenges impeding this goal.

Increasing livestock numbers raised by local herders are now placing increasing grazing pressure on the pastures, especially in riparian areas (along rivers and streams) which are mainly used as summer pasture. In recent years, there has been an influx of herders from Central and Western Mongolia who have heard of the good pastures in Dornod and have moved in with their livestock from other parts of Mongolia, placing additional stress on pasture resources. There has also been a significant increase in the numbers of horses, often owned by rich, absentee owners who value large herds of racehorses. This trend of growing livestock numbers is likely to continue which raises concerns about the sustainability of current pasture and livestock management practices.

There is considerable scientific information available about the ecology of the rangelands in Bayantumen *soum* in terms of vegetation types, the state of health of the rangelands, forage yield, recommended stocking rates, maps of seasonal pastures and rangeland monitoring data (available on the internet at www.egazar.gov.mn with soum level data). However, it appears that little of this information is currently made use of by herders or by local officials in the planning of rangeland and livestock development. Technical advice and extension material that is available is often not provided to herders in a practical, appropriate form for them to readily use.

Growing market demand for quality livestock products from Bayantumen *soum* grasslands in local markets, in Ulaanbaatar and for export offers considerable potential for local economic development and improved livelihoods of herders but is hampered by the ineffective control of livestock diseases. Promoting more climate-resilient, sustainable livestock farming systems will also require greater integration between the crop and livestock sectors, especially the growing of forage for winter feed and fattening/finishing of cattle and sheep for meat.

Climate resilient livestock farming systems in Mongolia are influenced by a variety of ecosystem properties that fall into two broad categories, 1) abiotic and 2) biotic[1]. Although important to consider in planning range and livestock management and development, abiotic processes cannot be directly influenced with management. In contrast, biotic properties of the rangeland ecosystem can be influenced by management. The key to robust biotic resilience in rangelands and livestock farming systems will be about maintaining and promoting healthy rangelands.[2] Sustainable production of livestock and livestock products from Mongolia's rangelands can be socially responsible, environmentally sound and economically viable. This requires awareness of the complex relationships among the three pillars of society/culture, environment and economics.

[1] *Description. Biotic and abiotic factors are* ***what make up ecosystems****. Biotic factors are living things within an ecosystem; such as plants, animals, and bacteria, while abiotic are non-living components; such as water, soil and atmosphere.*

[2] *Concept adapted from: D. Johnson, et.al. 2022. Ratcheting up resilience in the northern Great Basin, Rangelands 44(3): 200-209.*

1 Introduction

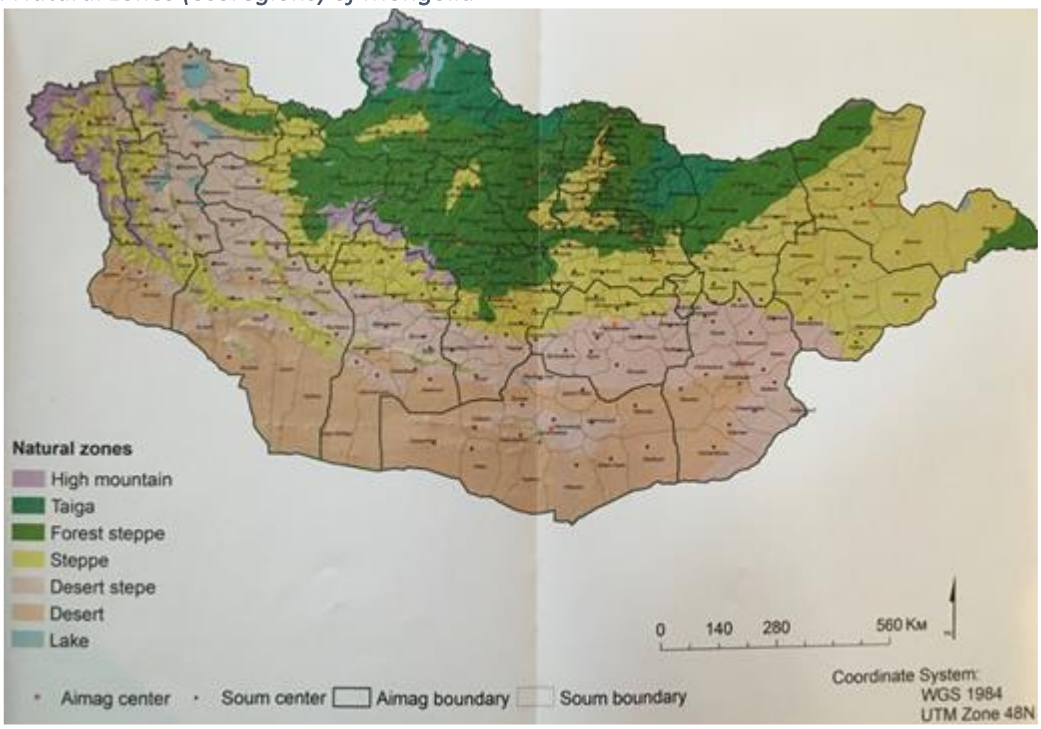
From June 2 to 14, 2022, pastureland management and livestock production practices and associated technologies were assessed in Bayantumen *soum* of Dornod *aimag*. A field trip in Bayantumen *soum* was undertaken on June 4-10 to visit pastures and hold discussions with herders and officials in the *bags*, *soum* and *aimag*. Discussions were also held with officials in Ulaanbaatar both before and after the field trip. The field visits and discussions enabled the Consultant Team to develop an understanding of how current pasture and livestock management practices are impacting the promotion of climate-resilient livestock farming systems. This report provides: 1) an Executive Summary of findings; 2) background data on pastures and livestock farming system in general in Mongolia and in Dornod *aimag;* and 3) information and insights on pastureland management and livestock production practices obtained from literature review, field visits, feedback from stakeholder discussions in Bayantumen *soum*, and discussions in Ulaanbaatar. In late August – early September 2022 another mission is planned that will identify the most appropriate pastureland management practices and associated technologies for promotion of more sustainable, climate-resilient livestock farming in Bayantumen soum (Deliverable 3.2).

2 Mongolian Rangeland Resources and Management Initiatives

2.1 Mongolian rangeland and current conditions

Encompassing 1.56 million square kilometers, Mongolia is twice the size of the state of Texas in the United States. About 75 percent of Mongolia is classified as grazing-land; ranging from desert to desert-steppe, steppe, forest-steppe, taiga and to alpine meadows which provide forage for livestock, habitat for wildlife and deliver important watershed functions. (Figure 1).

Figure 1: Natural zones (ecoregions) of Mongolia

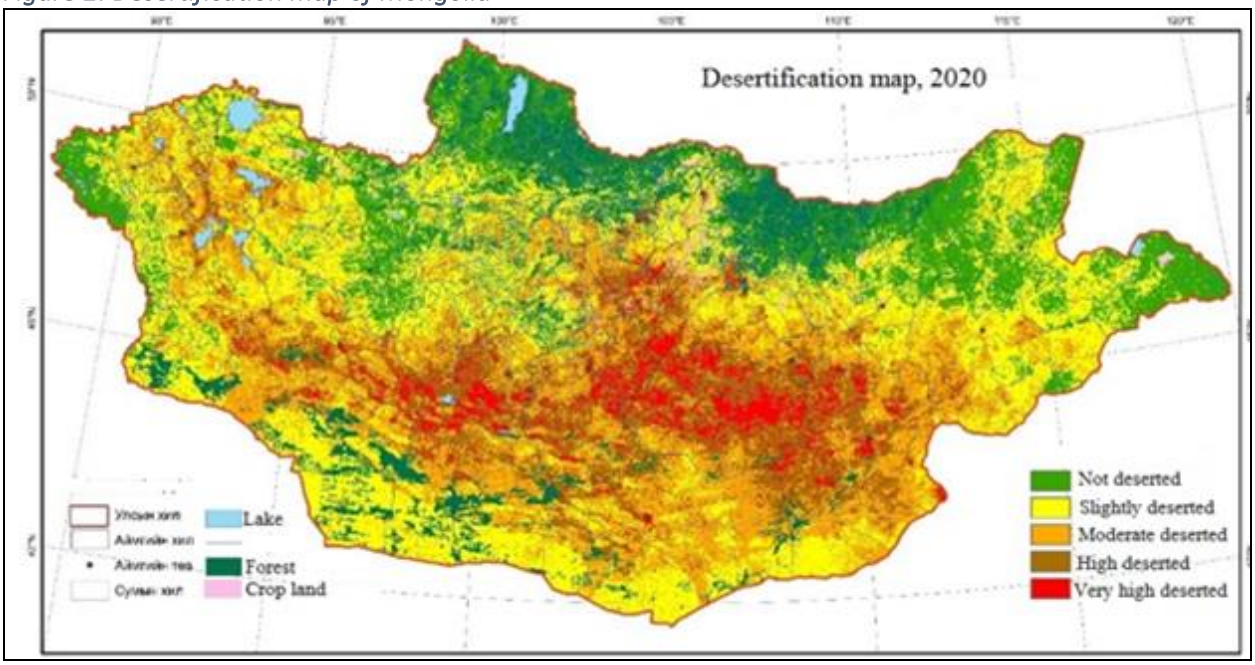


Mongolia has a long history of livestock grazing; large mound graves and "deer stones", constructed 3,000 years ago by early nomads and found across Mongolia, are evidence of complex social organizations that once existed on the rangelands. Traditional nomadic pastoralism that existed for millennia was transformed during the socialist period (1921-1990) and especially with organization of collectives in the 1960s when livestock production was centralized on state farms. In 1991, with the transition to a market economy, Mongolia experienced another change in land use as state-owned livestock were privatized to individuals and, with the demise of centrally provided services and markets, the livestock population increased. In 1991, there were 22 million head of livestock; now there are about 70 million head. Livestock provide livelihoods for 181,000 herder households and contributes 86% of agricultural production.

The increase in livestock numbers in many areas of the country has led to widespread overgrazing, range degradation, conflicts with wildlife, disputes over land use, and concerns about the sustainability of current

livestock production practices. About 76% of Mongolia's rangelands are now considered to be degraded (Mongolians often use the term desertified to refer to degradation of pastures) to some degree (see Figure 2).

Figure 2: Desertification map of Mongolia



Source: National Agency for Meteorology and Environmental Monitoring (2021)

Fortunately, much of the rangeland in Dornod aimag is not heavily degraded or only slightly degraded (see Figure 2 above). According to the national rangeland health monitoring results of 2015, healthy rangelands make up about 62.9 percent of total rangeland area. Only 31.4 percent of total rangelands in Dornod aimag were found to be slightly altered with respect to their plant species composition of the reference communities. The slightly altered rangelands have the potential to recover in 3-5 years through proper grazing management. Rangelands which have degraded moderately and been changed in vegetation composition with unpalatable species dominating the community only comprise 5.5 percent of the rangeland area of Dornod and have a potential to recover in 5-10 years with improved management. (Note: This data is now seven years old, and the extent of degraded rangeland has now reportedly increased especially in the summer pastures.)

2.2 Rangeland Management Initiatives

2.2.1 Rangeland Monitoring Systems

With the support of the Swiss Development Corporation (SDC), rangeland monitoring systems with nationally standardized methodology and concepts are in place and used to produce Rangeland Health Reports that describe rangeland health and degradation[3]. Ecological site descriptions (ESDs) are used for assessment and monitoring and for making management decisions. Following the ESD concept, Mongolian

[3] *National Report on Rangeland Health*, 2018 and *National Report on the Grazing Impact Monitoring of Mongolia*, 2021.

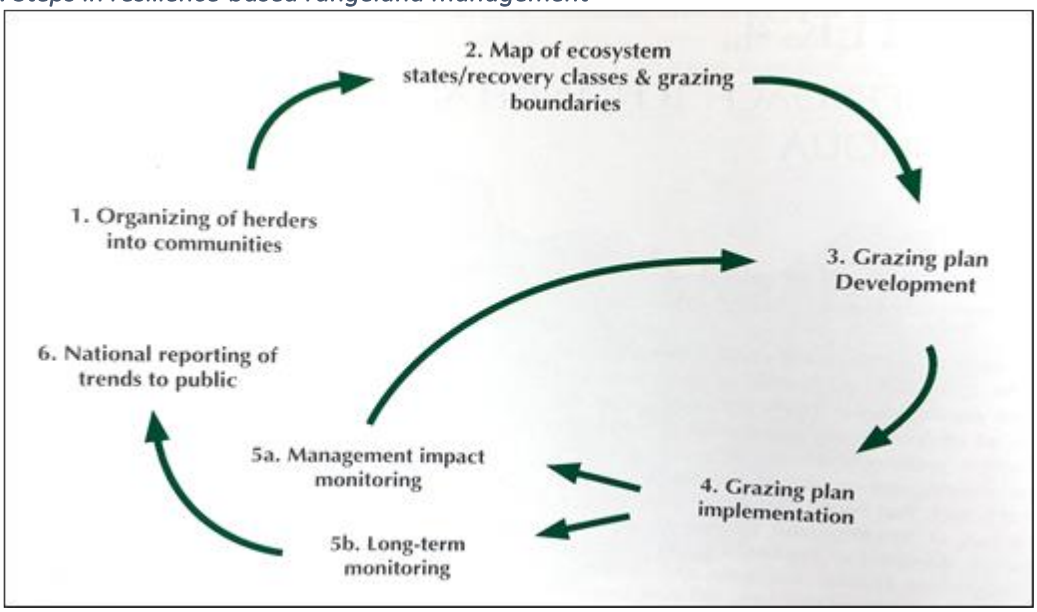
rangelands are classified into 22 ecological site groups (ESG) and each of them have a "state-and-transition model" that describes how rangeland ecosystems have changed and can recover with improved management. The ESD concepts and state and transition models are approved by the Mongolian Academy of Sciences and used by government agencies as a management tool. State and transition models describe different states or health of rangelands based on a reference vegetation (healthy) and alternative states for specific types of soils (ESGs) within ecoregions of Mongolia. Transition between states and vegetation community phases can be interpreted as degradation or restoration and related to specific management actions that can be used to prevent or reverse degradation over time.

2.2.2 Resilience-based rangeland Management

Resilience-based rangeland management is now being implemented in many areas of Mongolia. It is focused on the sustainable production of meat, fiber, and other environmental goods and services from the rangelands in the face of environmental and economic variability. Resilience-based rangeland management enables herders, local officials, and rangeland managers to jointly identify range and livestock management problems and to recommend and implement improved management and other solutions to address the problems at the local level. It uses herders' customary organizations such as Pasture User Groups (PUGs), herder groups and local government offices to implement range improvement programs and to monitor rangelands.

The steps outlined in Figure 3 are part of Rangeland Use Agreements that create a structure for herders and local government to negotiate and agree on tasks to maintain rangeland health and livestock productivity. There are now almost 20,000 herder households belonging to about 1,000 PUGs across Mongolia that are implementing improved rangeland management plans. Manuals, technical guides, and user-friendly documents providing information about ecological sites descriptions and state-and-transition models assist herders and officials in monitoring rangelands and grazing management. Most herders understand the need to reduce and regulate livestock numbers and adjust animals to stocking rates, but face challenges in not knowing how to start and what to do with excess animals. Technical support is needed for herders to make the transition from subsistence-based nomadic pastoralists to producing livestock and livestock products for emerging markets. To improve competitiveness of Mongolian livestock products, efforts are also underway to establish traceability systems that allow for validation of product origin and improved access for buyers to sustainably sourced products.

Figure 3: Steps in resilience-based rangeland management



3 Rangeland and livestock production assessment, Bayantumen Soum

3.1 Condition of rangelands

Rangelands in Bayantumen soum can be broadly classified into either Forest Steppe or Steppe Zone (or Ecoregion). There are seven different ESGs found in Bayantumen soum which are summarized below[4]. In the Forest Steppe Zone there are three ESGs:

- Small Bunch Grass-Forbs Mountain Steppe Rangeland in Loamy Fan ESG (***widespread in Bayantumen soum).
- *Stipa baicalensis*-Forbs Steppe Rangeland in Mountain Valley ESG (not widespread in Bayantumen soum).
- Grass-Forbs Riparian Rangeland in High Water Table ESG (***widespread in Bayantumen soum).

In the Steppe Zone there are four ESGs:

- *Stipa krylovii* – Small Grass – Forbs Dry Steppe Rangeland in Gravelly Hills and Fan ESG (not widespread in Bayantumen soum).
- *Stipa krylovii* – Grass Dry Steppe Rangeland in Sandy Loam Alluvial Fan and Plain (not widespread in Bayantumen soum)
- *Stipa grandis-Elymus chinensis*-Forbs Dry Steppe Rangeland in Sandy Loam ESG (***widespread in Bayantumen soum).
- *Achnatherum splendens* rangeland in high water table ESG (***widespread in Bayantumen soum).

Four ESGs are widespread in Bayantumen soum: 1) Small Bunch Grass-Forbs Mountain Steppe Rangeland in Loamy Fan; 2) Grass-Forbs Riparian Rangeland in High Water Table; 3) *Stipa grandis-Elymus chinensis*-Forbs Dry Steppe Rangeland in Sandy Loam; and 4) *Achnatherum splendens* rangeland in high water table.

Table 1 provides information on the seven ESGs found in Bayantumen soum, including information on forage yield in kg/ha and recommended carrying capacity (stocking rate – sheep units/100 ha) for each state from reference to degraded. This provides a measure of the health or condition of the rangeland. Most ESGs have four different states, but some only have three states identified. Each state has a unique vegetation composition. These "state and transition" models or states provide an indication of the health of the rangeland and how a site has degraded in terms of plant composition, forage yield and recommended carrying capacity. With improved range management, an ESG in a degraded state can be restored.

The most productive ESG in terms of forage yield is the *Stipa baicalensis*-Forbs Steppe Rangeland in Mountain Valley ESG, but this is not widespread in Bayantumen. Both the Small Bunch Grass-Forbs Mountain Steppe Rangeland in Loamy Fan ESG and Stipa grandis-Elymus chinensis-Forbs Dry Steppe

[4] *State and Transition Models of Mongolian Rangelands. 2018.*

Rangeland in Sandy Loam ESG are similar in forage yield and carrying capacity and are fairly widespread in Bayantumen. stocking rates. Many of the winter-spring pastures are in these ESG and because they receive little grazing pressure in the summer growing season they are in fairly good to excellent condition.

The Grass-forbs riparian rangeland in high water table ESG and the *Achnatherum splendens* rangeland in high water table ESG are found in the riparian areas along rivers and streams and are mainly used for summer-fall grazing. As such, many of these areas are heavily grazed by livestock and are degraded. Although they appear green in the summer many of the more valuable forage plants are gone because of years of heavy use. These are the areas that require most urgent management. Since these ESGs are also usually associated with better soils they have the potential for more carbon sequestration.

Table 1: Forage yield and recommended carrying capacity (stocking rates) for different states (health) for seven ecological site groups found in Bayantumen Soum

Forest Steppe Zone			
Small bunch grass-forbs mountain steppe rangeland in loamy fan ESG			
Reference State	Grass-thinned state	Dominant species gone	Degraded state
1200-1400 kg/ha	920-1100 kg/ha	740-830 kg/ha	710-810 kg/ha
73-83 sheep unit/100 ha	55-67 sheep unit/100 ha	41-45 sheep unit/100 ha	35-40 sheep unit/100 ha
***Stipa baicalensis*-forbs steppe rangeland in mountain valley ESG**			
Reference state	*S. baicalensis* thinned	Dominant plants changed	Degraded state
2100-2700 kg.ha	1500-1900kg/ha	850-970 kg/ha	120-540 kg/ha
124-158 sheep unit/100 ha	83-105 sheep unit/100 ha	47-48 sheep unit/100 ha	6-27 sheep unit/100 ha
Grass-forbs riparian rangeland in high water table ESG			
Reference state	Grass-thinned state		Degraded state
760-808 kg/ha	660-750 kg/ha		330-380 kg/ha
41-44 sheep unit/100 ha	33-38 sheep unit/100 ha		16-19 sheep unit/100 ha
Steppe Zone			
***Stipa krylovii* – small bunch grass – forbs dry steep rangeland in gravelly hills and fan ESG**			
Reference state	Grass-thinned state		Degraded state
970-1030 kg/ha kg/ha	900-940 kg/ha		362-679 kg/ha
57-62 sheep unit/100 ha	49-52 sheep unit/100 ha		18-34 sheep unit/100 ha
***Stipa krylovii* – grass dry steppe rangeland in sandy loam alluvial fan and plan ESG**			
Reference state	Grass-thinned state	*Artemisia frigida* or *Kochia prostata* dominate	Degraded state
890-1000 kg/ha	550-620 kg/ha	370-425 kg/ha	370-425 kg/ha
30-34 sheep unit/100 ha	30-34 sheep unit/100 ha	18-21 sheep unit/100 ha	18-21 sheep unit/100 ha
***Stipa grandis-Elymus chinensis*-forbs dry steppe rangeland in sandy loam ESG**			
Reference state	Forb decreased state	*Stipa grandis* decreased	Degraded state
1300-1470 kg/ha	760-800 kg/ha	670-710 kg/ha	350-370 kg/ha
78-86 sheep unit/100 ha	41-44 sheep unit/100 ha	34-36 sheep unit/100 ha	17-18 sheep unit/100 ha
***Achnatherum splendens* rangeland in high water table ESG**			
Reference state	Grass decreased state		Degraded state
380-400 kg/ha	150-290 kg/ha		80-130 kg/ha
22-24 sheep unit/100 ha	8-16 sheep unit/100 ha		4-7 sheep unit/100 ha

Source: State and Transition Models of Mongolian Rangelands (2018)

3.2 Status of Pasture User Groups

In Bayantumen soum PUGs started to be organized in 2017 in all four bags. Every bag has two PUGs. Each PUG has about 40 herder households as members. Only about 60% of the total herder households are members of the PUG. It was reported that for 40% of the herders in the soum, access to pastureland is not an issue and so herders do not see the need to join a PUG. There are both soum level PUGs and bag level PUGs and was informed that a soum level PUG is kind of like an NGO is given more recognition than a bag level PUG. A PUG agreement is for two years, and the PUG members agree on seasonal use of pastures, including *otor* pasture, but there does not appear to be restrictions on numbers of livestock. The PUG agreement calls for rangeland monitoring to be done every two years, but this is not well implemented. The leadership of the PUGs was reported to be "richer" herders – those with over 500 sheep.

With many herders moving into the soum from central and western Mongolia, cooperation among herders is difficult. With a largely open access regime, especially on summer-fall pastures, herders maximize their own private benefits and there are no accountability mechanisms in place for overgrazing and degradation. And there is no incentive mechanism in place to ensure rangelands are stocked at the recommended stocking rate. Herders rationally choose maximizing animal numbers as the dominant economic behavior, mainly because there are no incentive structures for them to limit livestock numbers.

Many young herders lack a certificate for the grazing land they use, especially the younger herders. Getting certificate for winter-spring pastures seems especially onerous and can take years to obtain. Herders complained that the system is corrupt as many of the rich herders coming from outside can get certificates easily and that they seem powerless to be able to do anything about it as the rich herders have contacts with politicians and officials. Stakeholders at the bag level in numerous meetings indicated that all the new herders from outside and rich absentee livestock owners with large horse herds coming into Bayantumen soum in the last three years is a growing concern. Numerous stakeholders mentioned that the huge herds of horses are degrading the pasture.

3.3 Use of pasture condition/monitoring information

There is considerable scientific information about the ecology of the rangelands in Bayantumen soum in terms of vegetation types, the state of health of the rangelands, forage yield, recommended stocking rates, maps of seasonal pastures and rangeland monitoring data (available on the internet at www.egazar.gov.mn with soum level data and in publications by Green Gold and others). However, little of this information is currently made use of by herders or by local officials in the planning of rangeland and livestock development. Stakeholders informed the team that herders cannot understand the material that is available because it is too scientific. An official with the National Federation of PUGs for Dornod Aimag remarked that herders do not know how to articulate the climate change impacts that on the rangelands that they see taking place. Officials at aimag and soum get some range training but more is needed.

There is a need to ensure technical advice and extension material for herders is practical and in an appropriate form for them to readily use. For example, all herders have cell phones and they could probably easily start to do photo monitoring of the pastures that they use if they are properly instructed.

3.4 Fodder crops

Forage/fodder crops are not widely grown in Bayantumen soum. Most herders rely on grazing the year round although the use of native grass hay to feed to weaker animals in the winter is increasing. Dornod province is well-known for native grass hay which is cut and baled and sold throughout Mongolia. Of the fodder crops that are planted by crop farmers, only oats are planted for making hay ("green feed"). There are some forage trials being done in Bayantumen soum with forages such as alfalfa and other perennial grasses. These were planted in June this year, so more information will hopefully be available during the next Mission in August. There was also some alfalfa that was planted at the Northeast-Asian Environmental and Agricultural Research Center (NEARC) previously, but the field observed this June was not very productive.

Improving livestock production in Bayantumen soum will require more use of feed/fodder in the winter. There are opportunities for better integration between the crop and livestock sectors. For example, crop farmers are well-positioned with land and equipment to grow some forage crops as cover crops in rotation with wheat. Existing crop farmers could also easily start to fatten/finish some cattle or sheep with forage/feed they could grow. With intensive livestock farming being promoted, especially for dairy, crop farmers could provide the forage/feed for dairy operations to provide milk to Choibalsan City.

3.5 Livestock production practices

Herders in Bayantumen soum raise horses, cattle, sheep and goats. There are very few camels. Livestock production is a pastoral-based system and there is little specialization or emphasis given to raising livestock for markets. Discussions with Dornod Aimag Food and Agriculture Department officials reported that the main issues are quality of livestock and proper feeding of animals. Officials recognize the need for feed and fodder and proper animal nutrition all year round to meet the non-stop meat demand that now exists.

In 2022, the Aimag government has approved what breeds of cattle and sheep should be promoted for livestock improvement. For sheep, the Barak breed will be given importance. For cattle, it is Dornod Red, and Black and Red Angus. These are the "approved breeds" for the aimag. There is one Angus breeder in Bayandum soum north of Bayantumen raising both Red and Black Angus breeding stock. The Government is promoting "intensive livestock farming" but there appears to be poor understanding on the part of herders in what that means and how they would go about it given the resources available to them. Herders reported that a total of about 500 animals is now needed to have a "comfortable life." This would mean about 200 goats, 200 sheep, 50 cattle and 50 horses. Herders noted, "If we have 500 head, we can lose half in a bad winter and still be able to start over."

Most of the cattle observed in early June in Bayantumen soum appeared to be in rather poor condition, despite the winter being an easy winter. Cattle appeared to be a mix of types and breeds – with some Simmental and Hereford and Dornod Red genetics. Sheep, with their wool still on, were harder to determine condition, but they were probably also in poor-fair condition like the cattle. (Note: since mid-June there has been considerable rain in Eastern Mongolia and forage available for grazing by livestock on the pastures has increased. As a result, livestock I saw in the area in late July/early August were in much better condition).

Animal health is a nation-wide issue in Mongolia. There are two private veterinarians in each bag in Bayantumen *soum* and each vet is supposed to be responsible for about 40,000 head of livestock, so their ability to adequately provide services to all herders is a huge challenge. Foot and mouth disease (FMD) is widespread in Eastern Mongolia, including in Bayantumen *soum*. Until more comprehensive animal health measures are implemented with disease protocols strictly followed, FMD will undoubtedly continue to be an issue. This greatly hinders the export of beef and lamb from Mongolia. Veterinarians require good practical training, access to good medicine and vaccines and vehicles to travel to herders to do vaccination and other required animal health procedures. Slaughterhouses and meat processing facilities also need to be regularly inspected and meet food safety and sanitary requirements.

Markets provide the opportunities for herders to start to emphasize quality in animals instead of quantity of animals and change how they raise livestock. Changing herd structures so that fewer unproductive animals are kept will be a start and will also be a chance to relieve grazing pressure on the rangelands. Improved nutrition and animal health will complement these efforts in changing herd structures to meet market demands.

3.6 Gender

Women play a key role in livestock production in Bayantumen *soum.* Survey results from June 2022 in Bayantumen revealed that female members of a herder household are much more active in milking, milk processing and home chores (that includes childcare, cleaning, washing and cooking) than men. Almost 90 percent of the milking and preparing dairy products is done by women and 84 percent of the household work is done by women. While men are generally believed to be more at risk from severe climate effects (rainstorms, snowstorms, wind, etc) because they spend more time outside herding and looking after livestock than women, the survey found that climate change may expose greater risks to women who are financially disadvantaged. Women and young herders with fewer head of livestock are also more vulnerable in terms of their ability to prepare enough hay or fodder for livestock in the winter.

3.7 Impact on Climate-Resilient Livestock Production

Several the herders' traditional pastureland management and livestock production practices in Bayantumen *soum* are climate-resilient or promote sustainable, climate-resilient livestock farming. For example, herders traditionally and even today make seasonal pasture movements and have recognized winter, spring, summer and fall pastures. A traditional practice known as "otor" where herders take livestock to specially reserved pastures in the fall to fatten for the winter is another climate-resilient practice that herders employ.

The livestock that herders traditionally raised – the "five snouts" as they are known in Mongolia: camels, horses, cattle (which includes yaks), sheep and goats – are adapted to the environmental conditions in Mongolia. Calving and lambing seasons were organized so that young animals could spend sufficient time grazing on pasture to grow and accumulate sufficient fat reserves to survive the winter. These livestock production practices were inherently climate resilient.

3 Rangeland and livestock production assessment, Bayantumen Soum

Herders in Bayantumen *soum* as elsewhere in Mongolia cut some native grass hay from the rangelands to make into hay to feed livestock in the winter. This hay was normally only fed to weak animals in late winter or at calving or lambing time in early spring, which helped livestock survive especially harsh winters. Some local herbs in the rangelands (such as stinging nettle, *Urtica cannabina*) were also harvested as used as a special fodder in the winter for livestock. Other plants were known for their traditional medicinal purposes for both humans and livestock.

In recent years with the increase in livestock numbers, there is increasing evidence of overgrazing and pasture degradation. This is especially apparent in the summer pasture areas along the Kherlun River in Bayantumen *soum*. The influx in the number of herders from Central and Western Mongolia with their livestock and the large numbers of horses is adversely affecting the summer pastures in Bayantumen *soum.* This is also reducing the climate resiliency of the livestock-farming system.

With climate change and increasing temperatures, there is concern that plant species composition on some rangelands in Mongolia is changing. Overgrazing by livestock and increased pasture degradation because of grazing will have negative impacts on the climate-resiliency of livestock production systems.

The wealth of traditional ecological knowledge herders have of the environment, pastures and livestock is a resource that should be capitalized on and used when considering new, innovative approaches to developing sustainable, climate-resilient livestock farming systems. This vast traditional knowledge needs to be combined with modern scientific technologies and information.

4 Innovative options for livestock production in Bayantumen Soum

4.1 Climate-smart pasture management options

There are a number of technologies (or actions) that could be introduced to livestock farming systems in Bayantumen to improve pasture and livestock productivity and enhance climate resilience. Table 2 is a list of actions prioritized by stakeholders during the key stakeholders meeting and training event on June 10 at the end of the Assessment Mission. Adjusting livestock numbers to the carrying capacity, improving herd composition and proper distribution of livestock on pastures are the most important actions identified.

Table 2: Stakeholder Prioritization of Actions to Improve Pastures and Livestock Production

1	Right stocking rate (#1 = 12 votes) • Match livestock # to carrying capacity • Herd composition
2	Improve Herd Composition (#2 = 10) • Cull unproductive breeding animals • Sell livestock sooner (3) • Limit horse numbers (3)
3	Proper distribution of livestock over the pasture (#3 = 10) • Watering points; Salt and mineral points • Seasonal use • Daily herding of animals over pasture
4	Improve livestock productivity and quality (#4 = 9 votes) • Improve genetics for more productive animals • Provide supplementary feed – hay, fodder
5	Winter feeding & Improve animal health (#5 = 8 votes)
6	Find new/better markets (#6 = 5 votes
7	Pasture Monitoring (#6 = 5 votes) • Herder participation in pasture monitoring
8	Pasture Improvement (2) • Reseed good native plant species
9	Rest and recovery (1)
10	Proper grazing system (1) • Deferred grazing (protect spring pasture)
11	Rotational grazing (1) • Otor pastures
12	Proper timing and intensity of grazing (0) • Month of year • Rest and rotation • Otor pastures • Leave 50% of the plant

Although herders gave the highest ranking to having the right stocking rate (animal numbers matching the recommended carrying capacity of the pastures), almost all herders seek to maximize livestock numbers. Without clearly defined individual herder pasture boundaries (much of the pasture is open access, especially in the summer) there are currently no incentives for herders to reduce livestock numbers to the proper carrying capacity of the pastures. A "tragedy of the commons" situation is starting to emerge on Mongolian rangelands, especially in the summer pastures. Although recommended stocking rates are known for the different ecological site groups and the state (or stages) of health of the rangeland (this information is readily available in Green Gold produced reports) and government officials and grassland scientists encourage herders to reduce livestock numbers to the carrying capacity of the pastures, there is no concerted effort by authorities to make it happen.

One promising pasture management approach that herders could take in the short-term is to start to do photo-monitoring of their pastures with their phone so they begin to understand better what the condition (degree of overgrazing and degradation) of their pastures are. They would then be able to identify areas that needed additional rest from grazing either during the entire growing season or in the early part of the grass growing season (deferred grazing). Herders would only need minimal training to be able to do this.

Handbooks or training materials to help herders identify key forage plants and undesirable plants on the rangelands would also be very useful. Much of this information is already available in an academic-like form and needs to be adapted so it can be easily be used by herders.

Herders gave the second highest ranking priority to improving herd composition. Of all the possible approaches that herders could take to start to reduce livestock numbers, bring more efficiency to their livestock production practices, earn more income, and develop more sustainable, climate-resilient livestock farming systems, is the restructuring of herds is the most promising. Emerging domestic markets for quality beef and lamb as well as export markets provide opportunities for herders change how their raise livestock. Herders do not need to totally change what they are doing, but simply need to adapt their livestock farming system to what the markets demand.

Herd restructuring will reduce numbers of unproductive livestock, produce more productive cattle, increase offtake, reduce the number of cattle that have to be fed and managed in the winter, and lead to increased income from sale of young animals. Table 3 below depicts the current cattle herd structure for a typical herder and a "new" herd structure that is organized for beef production to produce calves that would go into a feedlot to finishing for quality beef. Recognizing the need for a herder family to have milk for their household consumption of dairy products, the "new" herd has five good Alatau or Black and White or Simmental cows (dairy or dual-purpose breeds) that would be milked. With this new herd structure, it is estimated that a herder could make about three times as much money from selling weaned calves (24 million MNT with the new herd structure compared to 8.9 million MNT in the current herd structure).

Feedlots for finishing beef cattle are being planned for both Dornod province and nearby in Khentii province, which would provide the markets for herders to sell their weaned calves to. Awareness building and training for herders will be needed to make the changes to this new herd structure. There are also

examples from Bulgan and Selenge aimag where herders are already starting to make these changes and adaptations to their livestock-farming system.

The same type of approach to a more sustainable, climate-resilient livestock farming system could be taken with sheep. Markets are increasingly demanding younger sheep, such as 8 to 9-month old lambs, which herders could provide in October or November if they change their livestock management practices.

Table 3: Restructuring of cattle herds to produce calves for finishing in feedlots for quality beef

Current Cattle Herd Structure	New Cattle Herd Structure
Herd structure (in September of the year): • 20 Mongolian cows being milked • 20 calves born this year • 18 one-year old cattle (assuming death loss) • 17 two-year old cattle (both male and female) • 8 three-year old oxen • 7 four-year old oxen • 1 local bull • 55 total head of adult cattle plus 20 calves	Herd structure: (in September of the year): • 40 Selenge or Hereford/or Angus cross cows. • 40 calves born this year. • 5 Alatau cows to provide milk for herder family. • 5 Alatau-Holstein or Simmental calves born this year. • 5 one-year old replacement heifers • 5 two-year old replacement heifers • 2 good breeding bulls • 57 total head of adult cattle plus 45 calves
Assumptions: • Pastures are overstocked and cattle do not receive adequate nutrition, especially in the period November through May. • Calves do not reach their potential because they are not getting all the cow's milk. • Cows give first calf at three years of age. • Oxen are slaughtered at 4 ½ years of age with live weight of about 425kg. • Poor quality breeding bull is used. • Poor animal health practices. • Pasture degradation is widespread. • Native grass hay harvested but is of poor quality and limited amounts fed to cattle in winter/spring. • No "green feed" raised to feed cattle.	Assumptions: • Cows are not milked except for the 5 Alatau cows. • The calves get all the milk from their mothers. • Weaned calves weigh 200 kg at 8-9 months. • All weaned calves (35+5) sold for backgrounding and feedlots except for 5 replacement heifers. • Pastures not overstocked and there is sufficient forage in summer and for winter grazing. • Health of pastures is improving. • Green nutrition is grown and fed in winter. • Cows giving first calf at three years of age. • Proper use of minerals and salt. • Good breeding bulls used. • Proper animal health protocols, good animal husbandry and pasture management.
Winter Management and Feed Requirements: • 55 head of adult cattle (including yearlings) plus 20 calves = 75 cattle	Winter Management and Feed Requirements: • 57 head of adult cattle plus 5 replacement heifers = 62 cattle
• Total sheep units – about 444 Sheep Units to winter (assume 1 cow is 5 sheep units)	• Total sheep units – about 335 sheep units to winter (assume 1 cow is 5 sheep units)
Sales and Revenue: Sell 7 oxen of 425kg @ MNT 3000/kg. Total revenue = MNT 8,925,000.	Sales and Revenue: Sell 40 calves of 200 kg @MNT 3,000/kg. Total revenue from sold calves = MNT 24 million.

Herd restructuring is probably the best and easiest climate-resilient livestock management approach that could be adopted by herders. It would require awareness training and a change in thinking but little

investment. It would result in fewer young livestock that have to be managed through the winter, reducing labor and concerns with young livestock stock succumbing to inclement weather and insufficient forage/fodder in the winter and spring. It would require herders to have access to good beef type of bulls (Hereford, Selenge, Kazakh Whitehead, or Angus breeds. Breeding stock already exist in Mongolia (especialy in Selenge and Bulgan province and to some extent in Dornod).

Many of the actions identified in Table 2 would be important aspects of herd restructuring, which is basically the same as "Improve Herd Composition". The action ranked #4 Improve livestock productivity and quality, #5 Winter feeding and improve animal health, and #6 Find new/better markets, would be key aspects of herd restructuring.

Only when herders start to focus more the on the quality of animals instead of numbers and livestock numbers are reduced will it be possible to start to implement the more specific pasture management/improvement actions identified and ranked in Table 2. (These would be #3 Proper distribution of livestock over the pasture, #7Pasture Monitoring, #8 Pasture Improvement, #9 Rest and Recovery, #10 Proper grazing system, #11 Rotational grazing an #12 Proper timing and intensity of grazing.

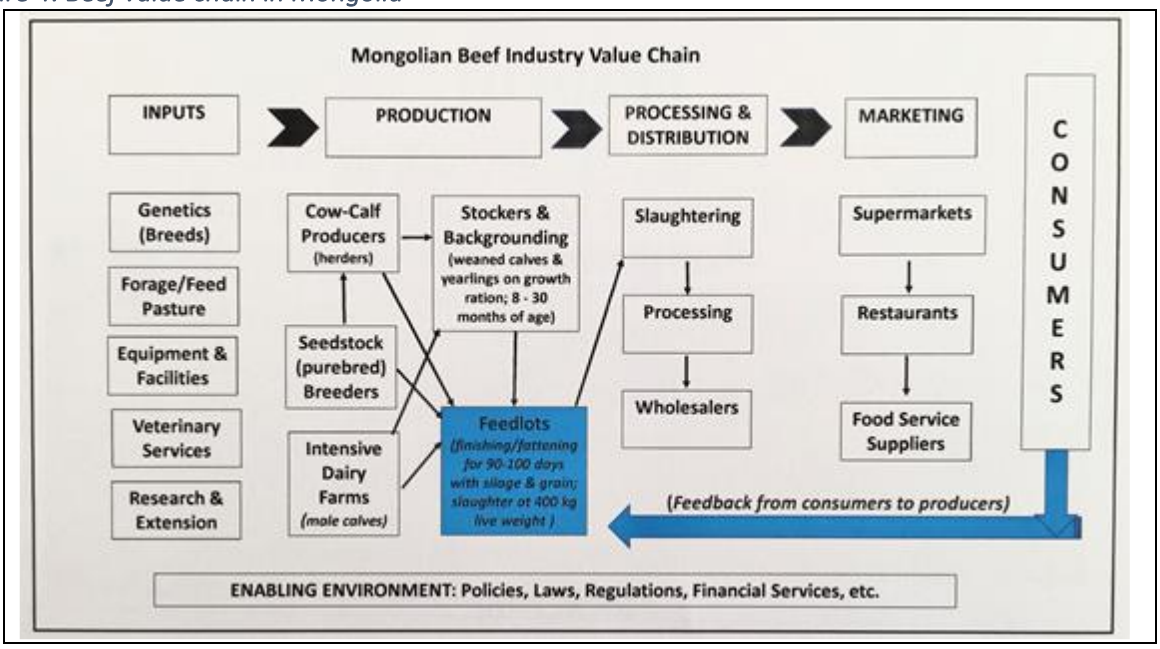
One innovative approach that is now being researched in the United States that could have potential for Mongolia, is virtual fence technology that uses novel GPS features for managing cattle, sheep and other grazing livestock with minimal ecological footprint (https://www.uidaho.edu/news/news-articles/news-releases/2022/072822-rangelandcentergrant). This virtual fence technology could be especially useful to manage pastures along streams and rivers (riparian areas) that are now heavily grazed in the summer.

4.2 Value chain approach to developing to meat sector

Mongolia is seeking to diversify its economy away from its heavy dependence on mining and the livestock sector is seen as having opportunities for economic growth and job creation. Recent assessments confirm a growing demand for quality red meat, both in domestic and export market, but there are numerous challenges that need to be overcome for Mongolia to capitalize on the opportunities.

Mongolians have been raising cattle for thousands of years but current livestock production practices need to be adapted to meet the demands of the market. Developing Mongolia's beef cattle industry requires a holistic approach that considers the entire beef value chain (Figure 4). The value chain illustrated is for beef, but similar value chain principles would apply for lamb in terms of inputs, production, processing and distribution and marketing. An enabling environment with appropriate policies, laws, regulations and financial and business services is also needed to encourage investment in the sector and efficient production. All actors in the value chain (producers or herders, processors and those involved in marketing) must also consider the demands of the final consumer

Figure 4: Beef value chain in Mongolia



Mongolia needs to take the best aspects of traditional nomadic practices and knowledge and incorporate the latest science and best practices about range management and livestock production to fashion more sustainable, climate-resilient ways of raising livestock for the 21st century. Markets will drive changes in livestock production in Mongolia like they have elsewhere in the world. The new mantra for Mongolian herders needs to be "produce to sell" rather than just "sell what you produce." This will require concerted efforts to address constraints in the livestock sector and increase the competitiveness of Mongolian herders while sustaining the rangelands.

4.3 Conclusion

What is the future for the rangelands and herders in Bayantumen soum of Eastern Mongolia? Can new livestock production systems be designed that build on traditional knowledge and age-old practices in order to meet emerging markets for livestock products while sustaining the rangelands? Can rural enterprises be developed to strengthen livestock value chains? What is needed to change herders' thinking and behavior to become better stewards of the rangelands? What opportunities can be created for herders to supplement livestock-based incomes? These are important questions that require serious deliberation. Out-of-the box thinking is needed to devise innovative approaches to better manage some of the last, un-fenced rangelands in the world and to promote more sustainable, climate-resilient livestock farming systems. Improved management of the rangelands, which is the foundation for the livestock sector in Mongolia, will be critical.

With growing domestic market in the neighboring city of Choibalsan and road infrastructure in place to transport livestock and livestock products to Ulaanbaatar and export markets in nearby China and Russia, there is potential for more market-oriented livestock production that is sustainable and climate-resilient. This bodes well for local economic development and improved livelihoods of herders but is hampered by a

number of challenges. Promoting more climate-resilient, sustainable livestock farming systems will require greater integration between the crop and livestock sectors, especially the growing of forage for winter feed and fattening/finishing of cattle and sheep for meat. Animal health needs serious attention, especially if herders want to access export markets. The key to building more climate resilient livestock farming systems in Bayantumen soum will require maintaining and promoting healthy rangelands and healthy livestock. Sustainable production of livestock and livestock products from Mongolia's rangelands can be socially responsible, environmentally sound and economically viable. This requires awareness of the complex relationships among the three pillars of society/culture, environment and economics. It also requires changes in herders' current thinking and approaches to livestock development. Training and education of herders and officials will also be needed to realize these goals.