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Provision of Technical Assistance for Enhancing Climate Resilience and Economic Sustainability of Livestock Farming in a Rural Community of Mongolia

Final Summary Report

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

ABMI	Alberta Biodiversity Monitoring Network
BCK	Bagh's Citizen's Khural
CC	Climate Change
CCP	Critical Control Points
CCSD	Climate Change and Sustainable Development
CCV	Climate Change Vulnerability
CCVA	Climate Change Vulnerability Assessment
CSA	Climate Smart Agriculture
CSO	Civil Society Organizations
CTCN	Climate Technology Centre and Network
DFZ	Disease Free Zones
DSS	Decision Support System
EIA	Environment Impact Assessments
ESD	Ecological Site Description
ESG	Ecological Site Group
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FMD	Foot and Mouth Disease
GCF	Green Climate Fund
GGAHP	Green Gold Animal Health Project
GEF	Global Environment Facility
GHG	Greenhouse Gas
GHP	Good Hygiene Practices
GoM	Government of Mongolia
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis and Critical Control Points
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
ISO	Organization for Standardization
M&E	Monitoring and Evaluation
MCA	Multi-Criteria Analysis
MET	Ministry of Environment and Tourism
MOFALI	Ministry of Food Agriculture and Light Industry
MMA	Mongolian Meat Association
NAMEM	National Agency for Meteorology and Environmental Monitoring
NAPCC	National Action Program on Climate Change
NCGE	National Committee on Gender Equality
NDC	Nationally Determined Contributions
NDE	National Designated Entity

NEARC	North-East Asia Environmental and Agricultural Research Center
NFPUG	National Federation of Pasture User Groups
NSO	National Statistical Office
PESTLE	Political, Economic, Social, Technological, Legal, and Environmental
PPT	Power Point Presentation
PUG	Pasture User Groups
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goals
SOE	State Owned Entities
SPS	Sanitary/Phytosanitary Requirements
STM	State and Transition Models
SU	Sheep Unit
SWOT	Strengths, Weaknesses, Opportunities and Threats
UN	United Nations
UN-CTCN	United Nations Climate Technology Center and Network
UNDP	United Nations Development Program
WWF	World Wide Fund for Nature

1 Objective of the TA

The Climate Technology Centre and Network (CTCN) is the operational arm of the United Nations Framework Convention on Climate Change (UNFCCC) Technology Mechanism and is hosted by the United Nations Environment (UN Environment). It is supported by 11 consortium partner institutions and counts with over 800 Network Members with a wide range of expertise in climate technologies. Its mission is to catalyze the development and transfer of climate technologies for energy-efficient, low-carbon and climate-resilient development in developing countries upon their request. Hence, this project concept was submitted to the CTCN by the National Designated Entity (NDE) of Mongolia.

The support from the CTCN will identify pastureland management measures and develop community-scale business models for enhancing climate-resilient livestock farming in Bayantümen *soum* of Dornod province while contributing to the NDCs and national priorities of Mongolia in the field of climate change adaptation and mitigation.

Outcome: Strengthen the climate-resilient livestock farming while deriving economic sustainability of herding communities in Bayantümen *soum*, Dornod province, Mongolia.

Objectives:

1) Enhance the capacity and knowledge of herding communities on climate-resilient livestock farming and
2) Facilitate decision-making to invest in community-scale sustainable meat processing system to improve the livelihood from livestock farming and enable the vulnerable communities to derive the best value from the livestock farming while dealing with the adverse impacts of the climate change.

Technical Outputs:

- Climate change vulnerability assessment will be conducted on livestock farming in Bayantümen *soum* in a consultative way.
- Pastureland management measures to be implemented for climate-resilient livestock farming in Bayantümen *soum* will be identified.
- Business models will be developed with community-scale meat-processing system for climate-resilient livestock farming in Bayantümen *soum*.
- Capacity of government bodies will be enhanced for climate-resilient livestock farming in Bayantümen *soum*

The TA was carried out between November 2021 and May 2023. Field work was conducted in Bayantumen soum in April, June, September and October of 2022. A final workshop was held in Ulaanbaatar in December of 2022. Project wrap-up and translation of reports was completed from December 2022 to May 2023.

2 Deliverable 2.2 Start-up Mission Summary

2.1 Government and Stakeholder Meetings

2.1.1 Aimag Officials Kick-Off Meeting

Ch.Ganbat, Vice Governor of Dornod aimag:
Dornod aimag has five border ports, an airport and some intensive farmers. Dornod aimag provides about 700 billion tugriks to State budget of which 23 percent is from the animal husbandry industry. Most livestock are raised traditionally causing problems with the pastures, especially with climate change. There has been a constant increase in animal numbers and a decrease in available pasture. Therefore, there is a need for better pasture management and environmental protection. Pasture capacity related risks are increasing year by year and include "steppe mouse" population, fire risk, and immigrants from other soum and aimags and others.

The United Nations-Climate Technology Centre and Network (UN-CTCN) feasibility study is very beneficial to the aimag and the timing is right. The main purpose of the project is in line with the Mongolian government's "New Restoration Policy" and the Billion Trees program. The resulting feasibility study by internationally recognized team will be very valuable in their planning and they expect highly qualified documentation. The aimag has worked with several international projects successfully in the past and expects to work closely with this project as well. He expects the team to work closely with the government specialists and Departments.

This project differs from other international projects because the local ownership is clear. This will be necessary if the resulting project is to be successful. Therefore, we will constantly support it at the aimag, soum and bagh levels. Herders need to jointly collaborate on this small project. We are expecting from this project that herder's income will be constantly increased and that the environment and pasture will be improved and rehabilitated. 50% of herders have more than 200 head of livestock. The project needs to work with these herders and communities to resolve the environmental problem. We also have to think about animal health and food safety issues related to the aimags' 1.4 million sheep and 0.35 million cattle as a main starting point.

Summary agriculture statistics:

- Dornod has 24 intensive farms, although they are not exactly 100 percent intensified farm.
- Dornod has 7 operational slaughterhouses and meat factories.

2.1.2 Veterinary Department

Veterinary Data System: Dornod participates in MOFALI's Integrated veterinary system and track all interactions with herders. Data is gender disaggregated. However, herders use veterinary medications themselves without any veterinarian support (*ed. this use would not be in the system*).

Meat and Food Security/Safety: There is only one veterinary laboratory in Dornod established in 1969 by Russia. It has a capacity of testing 40-50 samples per day, limited by the small staff of four to five lab

technicians. Bayantumen soum has 4 veterinary entities analyzing medical residues in livestock carcasses under the agreement with aimag levels laboratory.

Live Animal Testing: When testing for disease, they isolate 200 animals in a pen and test for various diseases. One carcass sample before the slaughtering process (one sample means under 200 heads of sheep or cattle), cost is 50,000 MNT. Aimag laboratory capacity is 13,000 livestock per year, mostly male breeding stock.

Slaughterhouse inspection: Seven slaughterhouses are inspected once per month. Several slaughterhouses do their own sampling.

The main challenges for the veterinary service are:

- Human resources. The working conditions (*work-life balance*) are challenging and parents who are vets are not encouraging their children to enter the occupation.
- Laboratory capacity, techniques and technology to conduct testing and analyses
- Inventory of drugs
- Establishment of a compartment/quarantine zone for livestock. To establish such a zone, the area must be a disease-free zone for at least three years.

2.1.3 Environment and Tourism Department

Policy and Department Responsibilities: The national climate change policy is for 2018-2024. Dornod has a sub-policy to decrease air pollution. The aimag Environmental Department deals with water, livestock, pollution and environment impact assessments (EIA)s.

EIAs: EIA response is provided within 14 days. According to the Environmental Assessment law, a water use assessment must be done before construction. For small projects like a gas station or meat plant, this is simplified. For large plants and projects, an Environmental General Impact Assessment is required. Assessments are conducted on-site to determine if the project is feasible. A summary of the project has to be submitted to the Department and it is decided what type of assessment is required. Assessments of agricultural projects are simpler than mining projects. Irrigation projects require EIAs. If the water is drawn from a river basin, the Ministry of Environment (Ulaanbaatar) conducts the EIA.

Pasture management: Livestock and related information is collected on soil and pasture. The detailed numbers can be obtained directly from the soum.

Climate Change: They have not done any climate change impact assessments.

Water Use: Any plant using less than 50 m^3 /day can be permitted by the aimag. Wastewater has no specific procedure.

Waste management: Slaughterhouse wastes are to be disposed of at the soum waste collection point. There are no manure management regulations for traditional livestock production. Otherwise, it could be mixed with other waste and go to the landfill.

Composting: Under the Billion Trees program, composting is being established. State Owned Entities (SOEs) will produce compost and work collaboratively with forest companies and professional associations and organizations. Two entities in Dornod will import composting technology in 2022.

2.1.4 Advisor of the Aimag Governor

The aimag government office has started to cooperate effectively with local professional associations including the Associations of Agriculture and Vegetable Plants. Meat slaughterhouses and meat plants can cooperate with the local government office through associations. They are seeking to incorporate the professional associations' suggestions into the aimag's annual socio-economic development direction.

PetroChina Dachin Tamsag LLC spent 300 million MNT for building the bagh's complex center including bagh school and center of production as a part of its social responsibility program in Matad soum. The school would be for the children of bagh employee and herders. This example shows that mining can be fit the local herders' interests.

Livestock of rich Mongolian households prefer to place their horses in Dornod because of pasture degradation in other aimags over the last 10 years. This negatively impacts local households. Those with few livestock are losing their pasture and facing economic challenges. The local herders and soum or bagh administration are protesting against the in-migration but those with influence, including MPs and Minsters, are getting permission from the soum governor to use pasture. In addition to this, pasture rentals are done secretly between local herders and the in-migrated wealthy households. This is leading to increased livestock numbers in Dornod. Because the pasture looks better than other aimags, overgrazing is neglected by herders.

2.1.5 Social Development Department

According to the Law on Promoting Gender Equality in Mongolia, each aimag has a Sub-Committee for gender equality chaired by the aimag Governor. The Specialist of the Social Development Department is Gender Focal Point and Secretary of the Sub-Committee. The Sub-Committee consists of the aimag Deputy Governor, heads of the local agencies and representatives of Civil Society Organizations (CSOs). In addition, there is a Gender Club consisting of gender specialist of the local agencies and soum government officials responsible for the implementation and reporting of activities for gender equality at local level.

The aimag's sub-program to promote gender equality expired in 2021. Recently, the Sub-Committee approved the Annual Action Plan for Gender Equality 2022. However, the Action Plan does not address herders' gender related problems and climate change issues. The forms approved by the National Statistical Office (NSO) limits gender disaggregated data at aimag and soum level.

A restocking program for herders and a program for contracting with herders were approved by the National Council for Employment Promotion but there is no gender disaggregated data on this program at the target soum.

2.1.6 Soum Officials

The following are the key points raised during the meeting with soum officials:

Livestock Breeding

- The soum has a breeding unit with high quality breeding males (goat-14, sheep "barga" and 'uzemchin'-65). Herders like to get those breeders. One breeder "rental" fee is 100,000 MNT per year.
- The Soum Development Fund provided 8 million MNT in 2021 and 15 million MNT in 2022 for high quality breeders. The Soum Agricultural Unit is buying them and renting to herders for improving their livestock quality. Herders are paying money for rental cost to soum agricultural unit. The unit does not have connections with the agricultural university for breeding program information or support.

Livestock Taxes

- Families from other soums and aimags are moving in. We need higher taxes on horses and goats which degrade the pasture more. The maximum allowable tax is 2000 MNT/head. We are charging 1500/horse.
- Herders with less than 200 head of livestock are tax exempt. (note: this means that about 50% of households are not taxed and will dilute the impact of the tax program)
- The Local Development Plan reflects how the livestock taxes will be used.
- The livestock TAX will be spent for the establishment of Dipping Bath for livestock.

Livestock Markets

- Only middleman can buy livestock. Herders are always going to the aimag center because Bayantumen soum is close to the aimag center and selling their livestock to middle mans. Herders do not jointly go to aimag to sell livestock.
- Dornod – average price of a sheep is minimum 150,000 MNT liveweight. The retail price is 10,000 MNT/kg. Herders usually sell to the black-market meat sellers in the aimag center. There is no organized system for selling livestock.

Herder Collaboration

- Herders do not believe each other.
- Herders don't collaborate because they don't trust each other. Therefore, the joint funds are not well used or equitable in their use. Family-based PUGs are actually less active than multi-family PUGs. The MCA land use contracts have not been well implemented.

Feeds and Feedlots

- Herders do not have joint feedlot. They are feeding livestock for themselves, not for the market.

- In the cropland areas, farmers are planting wheat, barley, oats and rapeseed. Very rarely do they plant corn and alfalfa. In the soum, there is no irrigated cropland; all the old irrigation systems are broken. There are no fertilizer factories.
- Machinery is owned by families; nothing is shared. The local flour mill produces flour and some animal fodder. Wheat usually goes to Ulaanbaatar. There are no livestock forage crops produced in the soum and no intensive farming.

2.1.7 Bagh Officials

Herders were asked their perceptions of climate change. Their responses included:

- Pasture condition is getting worse.
- Drought and dzud frequency is increasing
- Livestock productivity is getting worse
- Livestock number is too much
- We do not have any solutions
- When we face the real challenges, we will develop the intensive farming
- We cannot estimate how many grasses have been eaten by livestock. Herders do know how to estimate a grass fee but still consider grass to be a free resource.
- The market cannot buy young livestock.

2.2 Project Meetings

2.2.1 NFPUGs and former Green Gold Project – National Office

There is confusion about the state of rangeland health stemming from the use of different definitions. Decision makers using different methodologies and getting different results and percentage of degradation. Green Gold provided clarification of degradation terminology and worked on standardizing monitoring methodology across Mongolia using long term monitoring on standard plots in baghs. The project developed key concepts and a model around ecological potential.
The monitoring systems is functioning at the national and local level and includes ecological site descriptions. Thirty-three different ecological site groups based on ecological potential and resilience.

Each ecological site has a baseline and productivity information, key species of a healthy site and carrying capacity in sheep units. Three stages of degradation are used: productive (reference state; baseline); grass thinned; degraded. This was developed using Russian info, local knowledge and current research. Reports are prepared in two formats for technical people and for end users.

A recovery class concept for Mongolia has been introduced. Recovery is based on lowered stocking numbers and pasture rest. The classes are:

- Class 1: 1-3 growing seasons for recovery
- Class 2: 3 -5 years
- Class 3: 5 to 10 years

2 Start-up Mission Summary

Rangeland health monitoring systems in Mongolia are at the national level with local land use and impact monitoring. The system was standardized in 2017. Based on findings more than 90% of altered rangelands can be recovered in 10 years.

Herders' mobilization for responsible rangeland management through group management was undertaken. Group management of pastures is based on the Pasture Users Group (PUG) soum level association. PUGs are found in 18 aimags and 180 soums representing 1500 PUGs and 91,000 families. Western Mongolia is fully covered. In Eastern Mongolia, PUGs are found in 4 or 5 soums per aimag.
A Pastureland Use Agreement signed with local government allows for group management of land. It formalizes the traditional user rights of the local area and assigns responsibility to properly manage the rangeland. The agreements are officially recognized by the Government of Mongolia (GoM). To date, 1200 PUGs have this type of agreement registered in the state-level database.

Resilience-based rangeland management starts from community organization into PUGs. Grazing boundary are then created. The carrying capacity is established (mapping of ecological potential) and stocking rate can be set followed by planning with local herders and officials.

Herders are motivated to form PUGs and use pasture agreements for various reasons:

- Access to matching funds. Herder families would contribute 25,000 to 50,000 MNT and Swiss Agency for Development and Cooperation (SDC) would match it. Funds were used for family health needs, school fees etc. It was a revolving fund with very small interest. For some groups, this evolved to credit and savings groups.
- Security of land use: Once herders have a land use agreement, they could not lose their land to mining companies or to other businesses that would exploit their natural resources (water, medicinal plants).
- Responsible nomads branding system: This system for meat and milk provided the opportunity to sell into a stable marketing channel and, sometimes, a premium price. The end users might also pay advances before Tsagaan Sar. Several overseas buyers are sourcing through Responsible Nomads. – certification uses 6 different indicators:
    - Pasture certified by the land agency; can produce
    - Animal health – MOFALI database for vet animal health
    - Animal welfare – MOFALI
    - Environmentally healthy – MET
    - Responsible herder – need to be part of a PUG and PUG has an implemented grazing plan

Herd Reduction: Green Gold worked with PUGs to do herd classification (registry) of existing herds. They would then develop a 5- to 10-year herd reduction plan for to get down to carrying capacity. They recognize the need to work with breeders and animal health specialists to improve productivity when trying to reduce animal numbers. They worked on lamb fattening and castration to get faster growth rates and be able to sell in fall. This has been done in four aimags with good results.

The influence of a slaughterhouse and improved breeding depends on the target market. Without an export market, it is difficult to market premium product in Mongolia. The Chinese were building slaughterhouses to Chinese criteria for export purposes.

Forage and Fodder Production: Green Gold conducted pilots on green forage growing in spring and winter camps. They also made handmade fodder with grass/salt for emergency fodder.

Reserve Pasture: In dry years, have used a fenced reserve pasture to give natural pasture a rest

Water access: Access to water also influences mobility and tendency to overgrazing.

Pilot project in carbon market: One group of herders, through the Mongolian Society for Rangeland Management, have the task of slowing decreasing herd size. Once certified and true, the University of Leicester (UK) would pay a carbon offset to the PUGs common fund.

Dornod: Green Gold had PUGs in Bayantumen, Bulgan, Tsagaan Ova and other soums. Dornod is a distant location with sandy soils that are fragile and erodible. The aimag has limited water supplies. Because Dornod is 700 or 800 km from Ulaanbaatar, sales of hay, meat and fibers are to China versus the rest of Mongolia.

Lots of herders and animals have migrated into Bayantumen soum and are not registered with the local government. Therefore, the official livestock numbers do not reflect the real number of livestock in the soum. Dornod has said they are not allowing in-migration anymore, but this is difficult to enforce.
Recently there is a very big business in hayfield operations in Dornod for hay exports. People see the grass in Dornod as an unlimited resource, but the species make up has changed. Hay companies are cutting the grass very low, making grass recovery more difficult.

2.2.2 AFPUGS and former Green Gold Project – Aimag Office

Green Gold was active in five soums where PUGs were created. Four PUGs were created in Bayantumen soum. The Bayanbulog PUG had 31 member families. Most of the PUG leaders are women. The introduction of PUGs to herders was difficult and some older men opposed them. Establishing a new PUG can be difficult because people tend not to trust each other, and the groups are not active. In contrast to this, Buryat families seem to easily make a team and work together for better results. There is no specific information available regarding the percentage of PUGs that are active/inactive.

Pasture use is based on the Land Use Contracts. PUG pasture user contracts would be with the Land Affairs Agency, which has the contract template. Pasture users' contracts are approved by a Bagh Citizens meeting. The contracts were introduced about two years ago. Several were done but there was no follow-up or photo monitoring because of COVID. They are planning to do the follow-up and monitoring this year as well as conclusions on how well the contracts were fulfilled.

Activities included:

- Forage monitoring in each PUG using six monitoring points/PUG and 24 in total. Data collected usually goes to the Land Affairs Agency. The data could be made available for analysis under this project. Monitoring starts in August each year. Dornod looks green but photo monitoring and site visits show overuse. Green Gold sent a draft manual on pasture management including guidelines and procedures to the government, but it has not been approved, yet.
- Organized a small workshop for women. There no PUGs specifically for women.
- Tsagaan Ovo was selected as model soum having herder-shared funds. They are discussing similar herder-shared funds for another soum that would be used as a revolving fund. There are issues with the size of the funds. A typical fund would have 35 million MNT but there is no impact on pasture quality. The amount is not enough to dig a well or make other investments, so it gets used for social purposes (medical expenses and school fees). If any PUG fund reaches 50 million MNT, they are assisted to form an official credit union (non-bank institution).

Working towards livestock reduction and better pasture management is very challenging. The concept of decreasing animal numbers and increasing quality is very difficult to move from concept to application. Likewise, the concept of carrying capacity and suggested maximum numbers of animals was very difficult. Additional pressures come from large herd owners and newcomers. Horse racers may have 2,000 horses moving freely through the soum and destroying pastures. This makes it very hard on the Land Affairs Agency to speak strictly with herders and enforce the Land Use contracts.

The new Livestock Head Tax is generated at the soum level and remains at the soum for local use. To date, 126 million MNT have been raised in Bayantumen soum. At the aimag level, 1 billion MNT were raised in 2021. The Citizen's Khural at the soum level sets the head tax and decides how the revenues generated will be sued. Some typical tax levels are 1500 MNT/goat and 1800/horse. The tax revenue must be used wisely for the benefit of herders if it is to improve pasture management. Implementation is not transparent, which contributes to overstocking.

Governance capacity needs to be increased. Leaders do not understand pasture management and do not support pasture management, perhaps because they get no direct benefit. Herders also need capacity building. They need to know what technology is available as well as new projects and methods.

In Dornod there are many horse racers and lifestyles have changed in the past five years. Husbands are off racing horses, and the wives are not doing the traditional work. For example, they are not processing dairy products every day. Some even use purchased coffee creamer.

2.2.3 WWF/FAO "Promoting Dryland Sustainable Landscapes and Biodiversity Conservation in the Eastern Steppe of Mongolia" Project

This is a 5-year, USD 5 Million project in 3 aimags and 9 soums which began in July 2021. The project has four components like the CTCN project seeking to decrease erosion. Two components are significant for the UN-CTCN feasibility study:

- Agriculture (livestock and pasture) managed by FAO
- Biodiversity and protected area network managed by WWF

The biodiversity component includes 9 boundary soums in Hentii, Sukhbataar and Dornod.
Land Development Plans of the target soums currently don't address biodiversity. They are trying to include indicator species (e.g., gazelle, Great Bustard, white-naped crane) in peat lands. The project wants to include connectivity areas for migratory species and habitat. To do so, they will overlap the protected areas ad connecting areas and identify gaps.

Protected Areas have management plans and address herders in the area. There are also herders in the buffer zones. Some protected areas have a buffer zone development fund (revolving fund or eco-loan) that are used as incentives to decrease livestock numbers. These loans have low interest rates. They also have breeders (improved genetics) and incentive of information and training. The Nature Conservancy manages the natural reserves which touch on part of Bayantumen soum. Local people in Bayantumen soum knew nothing about the protected area.

Project biodiversity activities include:
1. Protected areas ground survey of wildlife. Will be input to BIOSAN, Mongolia's wildlife database. Only wildlife now but will/should include flora. They muse mobile phones to enter wildlife data.
2. Public Awareness: social media. Competitions. Contracts with T.V. in 3 aimags. They are trying to join all 3 aimags in policy of gazelle protection. There is joint work with stakeholders including Citizens' Khural and Eco-Club students. Stakeholder engagement includes social media, celebrations, competitions, and Eco-clubs for kids.
3. Introducing species in Projected Areas.
4. Supporting eco-friendly business bee farms.
5. Establish plant nurseries to use in the reestablishment of riparian forests. This is for native plants only. The Billion Trees program is very important. Local people have interest in how to establish and sell trees and will expand into fruit and landscape plants.

Their most important approach is stakeholder engagement and discussion

The FAO rangeland specialist is working with herders on pasture rotation. There are 40,000 ha of pasture on rotation in a soum in Hentii. Rotation is initiated through a large stakeholder meeting where the justification for pasture rotation is introduced. Herders know of degradation but do not see what actions they can take and/or do not have space to rotate. Once they decide to do rotation, then they decide how to and where to rotate. Lack of water may be a limitation, so FAO digs a lot of wells to open up pasture areas. PUGs have a written land management agreement with the soum, so it's necessary to work with established PUGs to introduce rotational grazing. To make this successful, PUGs need leadership training and organizational strengthening training.

Bayantumen soum is included in the project. The biodiversity component is working on the rehabilitation of the riparian forest on Kherlen river where there is a species of Salix. The river areas have been heavily eroded by livestock. They already held discussions stakeholders in three aimags (including Bayantumen

soum) about the need to have a "Riparian Forest" day to celebrate and protect these areas. It would be possible to do joint work with WWF on this.

The team consists of six specialists and local coordinators in each soum for a total of 18 people on the project. In addition, the Eastern Branch of WWF is involved. WWF has good management and is very fast. They are good at getting stakeholders doing the work, but the budget is sometimes a problem.
Pasture and biodiversity are very rich in Eastern Steppe but also many disturbers: railway, roads, mines, livestock and crop farmers. The problems are exacerbated by the many rich people, including parliamentarians, who have 1000's of animals. This is very damaging to the eco-system.

2.2.4 United Nations Development Program-Green Climate Fund (UNDP-GCF) Project

The project fund was established in October 2021 and activities began in 2022. The project has three components:

Component 1:	Data management. UNDP HQ would buy a supercomputer to manage big data. Local sites will link into this and use data.
Component 2:	Investment in pasture management and livestock production.
Component 3:	Building the capacity of herders. These are soum-level activities tied to the investment activities.

Some of the core themes for Dornod are tree planting, wells (280 to be drilled) and springs revival. CCVAs are on the list to be done.

To initiate activities in the first year, participating soums were invited to submit project ideas. 256 requests were received and are being prioritized for year 1. Six activities will be done under pasture management:

1. Six (6) springs will be fenced. Selection will be done by the Governor.
2. Three (3) fodder storages will be built.
3. Twenty (20) hectares will be planted with bushes. Location to be based on site visits and need.
4. Three (3) water collection ponds to be constructed. Decision to be made re location.
5. Support one (1) slaughtering unit in Matad soum on the railway to Russia and China. Support is coming from Petro China.
6. Introduce new technology for combing cashmere and shearing wool.

One group has asked for fencing to protect and alfalfa field they intend to plant. Pasture monitoring points are different from Green Gold. Data is received from the National Ecological Agency. They are trying to balance gender roles and bring families together.

2.3 Meat Value Chain Actors

2.3.1 Khaan Foods LLC (Dornod Branch)

Business Structure and Capacity: Khaan Foods (Khaan Group) has multiple locations with head office/factory in Ulaanbaatar and satellite operations in Dornod and Eredenet. The Dornod plant is a branch of the Khaan Group.

- Capacity – currently 1500 mt/year out of a 3,000 mt capacity
- Storage – 450 mt
- Staff – 41 of which 20% are office staff (finance, safety, supply chain management) and two are veterinarians working on meat procurement.

Market share: The plant supplies 10% of the meat product in Dornod. Choibalson uses 6.5 mt meat/day for a population of 46,000. 30 to 40% of the production goes to Ulaanbaatar. The plant purchases carcasses and does deboning prior to the meat being sent to the main factory in Ulaanbaatar. Supply chain 90% is sheep and goat 10% is cattle. The number of beef carcasses is less because of a smaller market and costs. The overall direction for purchasing is set by the head office in Ulaanbaatar.

There are four slaughterhouses in the aimag compared to only one 10 years ago. Open-field slaughtering is no longer allowed but remains a large source of supply. 80% of suppliers are herders. Herders used to bring carcasses with head, feet and guts but have learned to remove these.

Standards and grading: Meat is classified by their own three grades, which the manager noted would probably not match with general grading requirements. The plant operates to the requirements of GASI. They use the basic MNS standards but are aiming for International Organization for Standardization (ISO)-22000 (includes HACCP). They contract the aimag laboratory and send samples 2 to 3 times per month. Sheep carcass standard is no less than 20 kg.

Main problems:

- Seasonality. Shortage in spring so they buy in the fall and freeze carcasses which they may use until June.
- Their standard carcass size is 20 kg, but they have trouble meeting this
- Slaughtering opening areas
- Health of animals. Try to confirm vaccination. Check for residues. Herders don't do inspections because of the costs. The plant tries to provide support to herders by advancing directly payments to the vets for services and then deducting the cost from payment for the carcass.

Growth plans:

- Increase the refrigerator capacity and introduce more technology for automation
- They piloted a higher quality/safe meat product but there was not a large enough market yet to justify the increased costs, so they did not proceed.
- They considered producing chicken feed, but the need for imported inputs was too great
- Raw material supply is not a constraint.

2.3.2 Dornod Meat LLC

The plant is located 10 kms from Choibalsan in bagh 5 of Kherlen soum.

Capacity:

- Large animal (cow and horse) slaughtering lines for 150-200 head/day
- Small animal (sheep and goat) lines for 800-100 head/day using HALAL slaughter methods
- Shop to clean and sort out 5-7 tons of variety meats per day
- Butcher for 10 tons of small and large cattle meats at a time
- Freezer capacity of 80 tons of carcass and variety meats at -40C
- Six refrigerated warehouses for 1000 tons of carcass, processed and variety meats at -18-22C
- Plan to export 2000-3000 tons of meat and meat products on an annual basis

Standards: The website states that the company is "working to produce meat and meat products that comply with MNS, ISO 22000, HACCP and HALAL standards, as well as other applicable health and safety requirements".

They are involved in slaughtering meat for the GoM's meat reserve system. Meat exports from Mongolia have been closed for several months because of an active Foot and Mouth Disease (FMD) outbreak covering most of the country. They purchase animals directly from herders.

2.3.3 Traditional Meat Outlet, Choibalsan

On April 5, the team visited a tradition meat market in Choibalsan. Meat is cut in the back room without any special facilities or equipment. Storage is mostly at room temperature and without any hygiene measures. Prices are 10,000 MNT/kg for mutton.

2.3.4 Dairy Cluster, Bayandelger soum, Tov aimag

A brief visit was made to a recently formed dairy cluster in Bayandelger soum of Tov aimag, 93 km east of Ulaanbaatar. The cluster was developed by the APU company, which uses the fresh milk in its dairy product lines. The cluster consists of 10 individual dairy farms of 40 cows each. Each unit has 15 ha of pasture and an additional 5 ha of land fronting the barns.

Dual-purpose (milk-meat) breeds were imported for the units. Holstein-type are also used. Pasture per cow and pasture productivity are very low. Silage and concentrates (imported and local) are fed. The silage appeared dry, long-cut and not well packed and in limited supply. Water in the barns is available free choice. The farms are not yet reaching their production targets (l/cow/day) and hence are not yet profitable. The farm owners feel that a local milk processing unit would allow them to capture value-added and improve the chance of profitability.

2.3.5 Bayandelger Khuns LLC (Tov)

This vertically integrated company is based 93 km from Ulaanbaatar in Bayandelger soum of Tov aimag where it has a meat plant, feedlot and crop production. From there, it provides fresh meat to Emart and

other clients in Ulaanbaatar. They are also piloting their own retail outlet. MCS and Tovan Bogd are also in this market segment with vertically integrated systems.

Market Specifications: This year, they will have ISO 19001 and ISO 22000 which includes HACCP standards. Emart carcass weight requirements are based on Korean standards:

- Cattle carcass – 130 to 160 or 180 maximum
- Sheep – 18 to 20 kg.

Pricing: Price varies depending on the general market price but Emart charges a premium based on cut classification and other product specifications and standards (ISO, HACCP, traceability, cold chain etc).

Market Demand: Some customers are willing to pay for specific cuts, quality, safe-food and eco-food, but this is a very small niche market. A survey with Emart customers indicated that they would pay up to 20% more for "safe, fresh" food, which is the reason they shop for meat at Emart.

Business Model: The company uses a multi-faceted business model focused on partnership, sustainability and traceability:

- Quadro helix partnership model with stakeholders
- Sustainable production through cluster model
- Open platform business model for herders, suppliers, and buyers
- Compliance with world environmental standards
- Traceability – first company to have. They use the Traceability APP developed by MOFALI and SDC which is complete and functioning from herders to customers.

Vertical Integration: The business has, by necessity, become vertically integrated. The farm and feedlot were established in 2014 and the meat plant in 2016. During Covid, they had to find a way to lower their meat price, so they went back to feed production. The operations now consists of:

- Multi-species slaughterhouse: The slaughterhouse has a daily capacity of 50 head of cattle and 100 head of sheep. In early spring, they are running at low capacity. Currently, carcass weights are 190 kg for cattle and 19-20 kg for sheep. The Construction Development Centre approved blueprinting/drawings of slaughterhouse. The initial vision has expanded to include cooling, freezing and cutting rooms.
- Feedlot: The feedlot has a capacity of 200 cattle in 5-6 pens and is located about 2 km from plant. The feedlot functions as a ***quarantine zone*** which adds value by providing healthy meat for competitive advantage. In the summertime, they feed in the quarantine zone (feedlot) for about 21 days and in the winter for up to 180 days from December until July. Feeding throughout the wintertime, with daily offtake, allows them to produce fresh meat everyday. The financial result in winter is always negative but it allows them to maintain their long-term retail contract.
- Cow-calf production: They have their own herd of Selenge cattle and source from livestock suppliers in the eastern aimags. It is necessary to collaborate with herders, which requires building trust by having something to offer. To do so, they provide improved bulls to herders and the herders provide calves based on standards from emart. Cattle should be two to four years old with

two and three-year-olds preferred. In winter, there are a greater number of four-year-olds. Only cattle are fed.

- Crop production: Feed is vital. To keep the meat price down, they have gone into own feed production. They have their own 200 ha farm is in the same soum within 10 km of the feedlot and plant. They have developed a cluster approach with 4 or 5 other farmers in the area who have 100 ha to 500 ha each. They grow oats, barley, corn, beans and wheat for bales and a small amount of silage. They also have relationships with crop producers in Dornod. Crop production is very risky based on weather conditions and is further challenging because of the lack of human resources.

Employment: The meat plant and feedlot employ 15 staff, not including administration and management.

Comments on the project's feasibility study: Market analysis and selecting the right market and segment is critical. Export markets are an opportunity but require new, high standards, a disease-free zone and/or heat processing of meat. They see Dornod as a strategic point for export and would be open to exploring partnership.

2.3.6 Site Visit to Emart, Ulaanbaatar

Emart charges premium prices for meat based on meat cut classifications, some traceability and handling methods (instore butcher, wrapping, chilling) that are perceived as safe by consumers.

2.4 Gender and Social Issues

2.4.1 Stakeholders' Meetings at the Aimag Government Office

Although seven meat processing plants operate regularly, they do not have a mutual, effective and consistent cooperation with the local herders. Therefore, the promotion of effective bilateral cooperation between the herders and meat factories needs to be addressed. Since more than 50% of the herders 200 head or less, it is necessary to consider introducing new channels for their equal participation and benefits from the interventions.

There is a desire to define the needs of an alternative primary school for herders at *bagh* level. It is crucial to define herders' challenges to educate their children, find alternative solutions and clarify efforts and achievements to solve the problems for community development planning.

The Aimag's sub-program to promote gender equality expired in 2021. Currently, the Sub-Committee approved the Annual Action Plan for Gender Equality. However, the Action Plan 2022 does not address herders' gender related problems and climate change issues. The forms approved by the NSO limits gender disaggregated data at aimag and soum level.

A restocking program for herders and program for contracting with herders have been approved by the National Council for Employment Promotion. Although there is no gender disaggregated data at the target soum, it is needed to consider when doing feasibility study to these issues.

2.4.2 Stakeholders' Meetings at the Soum Government Office

There are 24 herders' groups established in 2012 with the support of the Millennium Challenge Account. There are also two PUGs in each bagh, six PUGs in total. Since the establishment of the herders' groups and PUGs, they do not work effectively. Therefore, in-depth study and analysis is useful to clarify how to build democratically from bottom up a powerful herder's group.

The soum's Citizens' Representative Khural decided to collect a livestock tax from all herders. Decision on the tax was made based on the Survey that herders were participated. But complaints were collected from the households with less than 200 livestock.

The Gender Specialist of the soum has done a Gender Study of the community. Key findings are as below:

a. Household heads (husbands) have authority to spend majority of the household's income.
b. Poor female herders have faced the following challenges:
    i. Due to the small number of livestock, they could not earn income from the dairy products.
    ii. They do not have sufficient money to purchase the necessary equipment to produce dairy products for income security.
    iii. They are not able to get the loan, because the family properties are owned by their husbands.
    iv. Even if they herd other people's livestock and produce dairy products, they cannot go to the marketplace, because they don't have their own car or motorcycle.
c. Revised "A" form for the livestock census gives an opportunity to register herds under each household members' name, if necessary.
d. During the school year, female herders stay with their children in aimag or soum center to educate them. This leads to the separation of the families, but not divorce. There is not a case of divorce because of the family separation.

2.4.3 Stakeholders' Meeting at the Bagh

The key stakeholder's team with 11 members was built from this meeting as a first meeting. The team members divided the *bagh*'s territory into 4 sub-regions and a representative of the sub region is included in the team. Out of 11 stakeholders, there are 4 females and 7 males. Four of them are representatives of the local government offices. To ensure real participation of various groups of herders, they decided to organize information sessions in each sub-region. Team members preferred the outreach meetings so that all members of each households including husband, wife and young members could attend.

2.5 Summary of Findings

The project was well received by all level of government and each stakeholder group. Both the aimag and soum governments pledged their support and participation in the feasibility study activities. There is a strong desire by the members of the Key Stakeholder Group to participate in the feasibility study process and to reach out herders in the bagh to ensure their engagement. There are questions regarding market, product type and ownership, amongst other things, that need to be addressed in the study and related communications programs.

Herders and local leaders alike are aware of the impacts of overgrazing andclimate changerelated to erosion and decreased productivity of pastures. However, they are not confident that they understand what can done to combat these changes or how to implement any measures. Efforts to engage herders in pasture co-management through pasture management agreements and PUGs have had limited results. As a result, many herder groups are inactive and/or are motivated by the indirect benefits of group membership such as low interest revolving funds. There are numerous factors contributing to this including but not limited to:

- The lack of significant and consistent market signals rewarding producers for better quality livestock and underdeveloped auction and joint marketing services
- Limited ability to enforce land and pasture use regulations at the local level
- Lack of transparency in the application of regulations resulting in owners of large herds gaining inappropriate access to pastures
- In-migration of herder families who have no formal access to pasture but nonetheless are grazing their animals
- Entrenched poverty that compels small herd owners to continuously try to grow their herds to attain a minimum standard of living
- Lack of knowledge and skills and resources for intensifying livestock production through improved nutrition, genetics, animal health and forage and fodder production
- Ongoing issues of endemic livestock disease (i.e., Foot and Mouth disease) which make export markets unstable and largely unattainable.

However, as Mongolia enters its second generation of transition to a market economy, there are numerous green shoots of development that bode well forclimate changeadaptation, pasture management and the commercialization of the livestock sector. These have emerged over the past 10 years and, though still nascent, have the potential to support a transition to a more sustainable system. These include:

- A growing market demand for higher quality and safe food based on the restaurant trade and the growing middle-class consumer market, especially in Ulaanbaatar, as evidenced by groups like emart, Bayandelger farms and Razorback/Xanadu.
- Improving systems for animal health and traceability in line with OIE standards and an improved awareness within the industry of the animal health requirements of export markets.
- A small but growing commercial forage, fodder and manufactured livestock feed sector.
- Increased awareness by national, aimag, soum leaders and herders alike regarding pasture degradation andclimate changeissues.
- An improving policy and regulatory environment such as the locally administered animal head tax which is providing local communities the tools and resources to take action on livestock numbers, pasture rehabilitation and climate adaption.
- A robust use of social media and online information sources to promote information sharing between rural stakeholders.
- An ongoing commitment by the GoM and international donors and financiers to supportclimate changeadaptation, natural resource management, the commercialization of the sector and the

ongoing development of the policy environment and supporting institutional services (market infrastructure, animal health, trade, extension, etc).

Translating these developments into a successful plan for Bayantumen will require careful consideration and design related to several key elements:

- Identifying the right market segment and channel for Bayantumen livestock and products that will provide an improved return to herders and provide the incentive for changes to production and marketing practices. This involves examining the market opportunities by i) location (Dornod, rest of Mongolia, export), ii) type of meat (beef, sheep, horse, goat), iii) type of processing and quality standards (basic standards for local market; premium standards for local market; highest standards for export market), iv) the profitability of the feedlot by species and feeding program accounting for seasonality, and v) potential returns to selling improved livestock (genetics, health, youthfulness).
- Identifying the appropriate plant functionality, design, technology, operational and energy efficiency, infrastructure and management systems given the market opportunities, competition, labour availability and other factors.
- Assessing feedlot programs taking into account the availability of feedstocks, water, appropriate mix of animals and the role of the feedlot in managing animal health, end-market contract fulfillment and quality specifications.
- Employing food safety, animal health and traceability throughout the value chain.
- Taking a "whole herd" approach to livestock management that addresses livestock numbers, productivity and pasture pressures related to all species in the herd.
- Developing trust-based relationships with herders supplying livestock through the provision of clear contracting and pricing based on quality specification as well as improved breeding services, animal health services, access to finance and other strategies of mutual benefit.
- Taking a staged approach to development that considers the current baseline of production standards and market opportunities and how to strategically meet a higher level of quality over time.

The engagement of stakeholders, including women, will be critical in developing an approach that herders will support long term. Income generation and access to finance is important to women herders to purchase inputs to improve production levels and quality. They also need better market access to sell their products. Consultations and the strategies developed need to consider the multiple concerns of stakeholders and what motivate them to undertake change in their livestock production and marketing and to make investments in inputs, pasture improvements and climate change adaptation. These motivators include immediate economic returns as well as preserving and improving pasture and biodiversity to secure future income, access to resources and knowledge for new management approaches, the ability to provide education, health and other services to children and other family members, providing an opportunity for future generations to make a decent livelihood in the livestock sector, maintaining rural communities and preserving Mongolia' traditional culture.

3 Deliverable 2.3 Climate Change Vulnerability Assessment

3.1 Background and Objectives

Climate change impacts are happening faster than expected worldwide, particularly in arid and semi-arid regions that play a vital role in global food supply and security. Variability in rainfall patterns and extreme weather events such as recurrent droughts and harsh summers and winters are among the most apparent and disruptive impacts of climate change on local communities and the natural resources and landscapes they rely on for their livelihood.

Climate change is projected to severely impact traditional pastoralism and livestock herding practices. Herder communities and pastoral systems rely highly on accessibility to good quality grazing lands and ecosystem goods and services they provide. Arid and semi-arid grazing lands are generally more sensitive to climate change impacts. It is predicted that the aridity and harshness of the arid and semi-arid grazing lands will be more severe in the future, potentially putting the sustainability of the pastoral and herding livelihood systems in these fragile landscapes at risk. Grazing lands are generally thought to be naturally resilient to climate variability. However, their adaptive capacities have deteriorated over time due to harmful internal and external pressures from both climate change and environmental degradation. Increasing vulnerability to climate change and the scarcity of resources for livestock production could potentially result in severe resource competition and violent conflicts among livestock herding communities in arid and semi-arid grazing lands.

Traditional pastoralism has long been a highly valued livelihood style and socio-cultural nomadic heritage among herding communities in Mongolian arid and semi-arid landscapes. The more recent dynamics of the country's pastoral and herding livelihood systems have mainly been driven by increasing livestock populations and changes in animal husbandry, degradation of forage, soil and water resources, and negative impacts from global warming and climate change. herders are at arguably increasing risk of losing their livelihoods to continuous environmental degradation and recurring extreme climate events.

Natural grazing lands that cover around 80 percent of Mongolia provide critical ecosystem goods and services, including forage for livestock, habitat for biodiversity and well-functioning watersheds for protecting soil and water. However, overgrazing had become a growing challenge across Mongolia since 1990, when the management of grazing lands was changed from a communal socio-economic system into poorly regulated private ownerships or household grazing practices. This widespread overgrazing has caused severe land degradation in more than two-thirds of Mongolia's grazing lands and raised alarming concerns about the sustainability of current livestock herding production systems.

Mongolia is already experiencing significant changes in its typical climate patterns. Recent changes in annual and seasonal patterns of air temperature and precipitation have doubled the frequency and extent of extreme and chronic climate events such as heat waves and droughts. Future climate projections also indicate that the intensity and risks of extreme climate hazards are likely to increase further by the middle of the century. These emerging, unusual climate patterns and increasing grazing pressure due to the rapidly

growing livestock population have already stressed the country's fragile grazing lands and diminished their productivity and grazing capacity. Consequently, the overall household well-being is reducing, and herding communities are becoming more vulnerable to climatic changes.

Individual household members play essential but different roles in herding practices. Women and underrepresented members tend to have fewer resources and significantly lower capacity to cope with and adapt to stresses caused by climate change and the degradation of grazing lands. Therefore, a gender-responsive and socially inclusive assessment of climate change vulnerability and risks are required to determine potential adaptive solutions for impacted herder communities and pastoral systems.

Understanding herders' perception of climate change and local impacts on pastoral livelihood systems is an essential first step to enhancing the resilience of herders and herding households to climate change risks. Typically, station-based meteorological data are analyzed to estimate the rate of change in climate patterns. However, in sparsely populated regions of Mongolia, significant data gaps exist in station-derived climate patterns across space and over time. In addition, predictions of climate change and its impacts based on downscaled climate models are highly uncertain at regional and local levels. Herders' observations of local climate change have the potential to provide more robust, finer resolution information on recent impacts of climate change in such data-spare regions. It holds the potential to provide a more complete picture of the vulnerability of local pastoral livelihood systems to climate change. Herders' observations also allow for a better understanding of the anticipated adaptation measures by the local herding communities to cope with climate change risks.

(a) **Figure 1: The Bayantumen Soum of Dornod Province in eastern Mongolia**

3.2 Assessment Approach

3.2.1 Study Area

Bayantumen Soum sits in the eastern corner of Mongolia, about 650 km from Ulaanbaatar and near Choibalsan, the center of Dornod province (Figure 1 and 2). With an average altitude of about 750 meters above sea level, it is positioned on the gently rolling steppe hills of the Mongolian Plateau.

Only one meteorological station is in the Soum. The annual precipitation in the Soum ranges from about 250-300 mm. The four months of May, June, July and August provide about double the precipitation

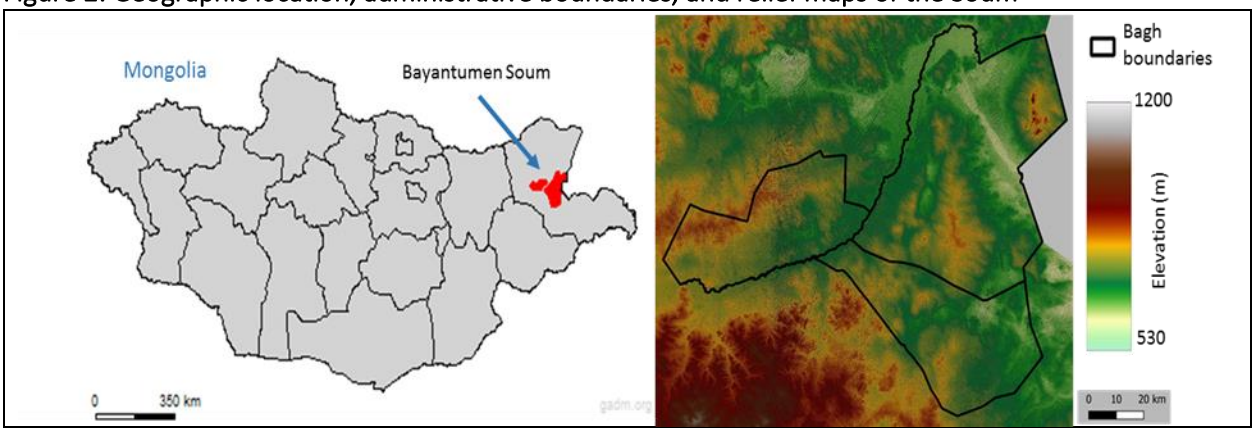
amount compared to the other eight months. The mean annual temperature is about 2 °C, with January and July as the coldest and warmest months, respectively.

The Soum is mainly covered with dry-steppe pastures of turfy grasses or rhizomatous grasses growing on fragile and erodible sandy soils. Fertile riparian and meadow soil suitable for halophyte grasses, subshrubs and shrubs distributed along riverbanks and other lowland areas.

The Kherulen River is the primary source of water, which originates on the eastern slopes of the Khentii Mountains (Figure 2). Due to extremely high evapotranspiration losses (around 90.1% of precipitation), Soum has limited and unevenly distributed water supplies.

Animal husbandry comprises about 24 active herder groups and 250,000 head of livestock, most raised traditionally. Recently, there has been a constant increase in livestock numbers and a decrease in the available pasture. Many herders with their livestock have migrated into the Soum due to severe pasture degradation and climate change impacts in other regions of the country. As a result, river areas and pastures near water resources have been heavily overgrazed and eroded.

Figure 2: Geographic location, administrative boundaries, and relief maps of the Soum



3.2.2 Herder Survey

The Intergovernmental Panel on Climate Change (IPCC) defines CCV as "relative risk or the degree to which a system is susceptible to or unable to cope with adverse effects of climate change and climate extremes". The CCV is, therefore, a function of three main components:

1. Exposure or the magnitude and rate of climate change to which a system is exposed.
2. Sensitivity or innate tolerances of the system to climate change impacts.
3. Adaptive capacity or the system's ability to implement adaptation measures that potentially avert the negative impacts of climate change.

A gender-responsive and socially inclusive CCV assessment of local pastoral and livestock farming systems to potential impacts of climate change was conducted in the Soum. The CCV assessment was based on the

perception and practices of nomadic herders, who have lived and observed changes in local grazing landscapes for generations.

A comprehensive survey questionnaire that included both open- and close-ended questions was prepared. First, a complete list of the recently observed trends in climate variables and predicted near-future climate change impacts on livestock farming systems was compiled from relevant studies and reports in Mongolia and similar pastoral systems. In consultation with local experts, the survey questions were then structured as follows:

1. Specific characteristics of livestock farming systems in the Soum, including information on demographics, livelihood, pasture resources and livestock production management.
2. The perception of climate change and the rate and magnitude of exposure to climate change impacts.
3. The level of concern and sensitivity of local livestock farming operations to observed and anticipated climate change impacts and how they linked to other emerging environmental issues in grazing.
4. The ability and existing capacity of livestock farming systems and herding communities to undertake or continue adaptation actions to address the risks of climate change.
5. Major barriers and challenges limiting the adaptive capacity of local livestock farming operations and herding communities to observed and anticipated impacts of climate change.
6. Gender-specific characteristics of local livestock farming systems and herding communities, including information on ownership, responsibilities, decision-making process, and income.

Across the Soum, a total of 109 herder surveys were completed through direct interviews of herder families during a field visit in June 2022 and with support from local experts and the herders' stakeholder group. The survey interviews included a range of herder household members with diverse demographics, education, pasture, livestock and livelihood characteristics, as detailed in Table 1.

Table 1: Characteristics of herder household members surveyed in the Soum

Characteristic	Detail: Category, Frequency and Percentage (%)
Gender	*Female*: 56 (51.4%); *Male*: 53 (48.6%)
Age (year)	*15-25*: 6 (5.5%); *26-35*: 25 (22.9%); *36-45*: 25 (22.9%); *46-60*: 29 (26.7%); *>60*: 24 (22%)
Marital status	*Unmarried*: 19 (17%); *Married*: 90 (83%)
Education	*Primary*: 54(50%); *Secondary*: 33 (30%); *Post-secondary* 22 (20%)
Household size	*1-3*: 41 (38%); *3-5*: 44 (40%); *>5*: 24 (22%)
Herding history (year)	*<10*: 34 (31.2%); *10-20*: 24 (22%); *> 20*: 51 (46.8%)
Total livestock herded	*<300*: 43 (40%); *300-500*: 22 (20%); *>500*: 44 (40%)
Income from livestock	*<50%*: 26 (24%); *50-75%*: 22 (20%); *>75%*: 61 (56%)

3.2.3 Data Processing and Analysis

Information obtained through the herder survey was analyzed based on the specific characteristics of surveyed herders and their livestock farming systems. The results were then employed to assess the vulnerability or relative risk from CCV to local herding communities and their livestock farming systems.

Figure 3: Survey of herder communities in the Soum

A simple numerical rating approach was used to assign CCV scores to surveyed herders. These quantitative scores were then averaged with equal weight and separately across sub-questions and questions associated with exposure, sensitivity, and adaptive capacity to climate change impacts. The final CCV scores for surveyed herders were calculated as the difference between the standardized, average scores (0-1) of potential exposure and sensitivity and the standardized average scores (0-1) of adaptive capacity. Therefore, the final CCV scores lie between '0' and '1', with '0' indicating no vulnerability and '1' indicating the maximum vulnerability of surveyed herders to climate change impacts.

3.3 Exposure to Climate Change

A total of 109 herder household members were surveyed. Herders identified climate change as one of the main challenges they have faced in recent years and expect to face more in the future. Most of the surveyed herders (about 80%) agreed that climate change is occurring in their area, and extreme weather events are happening more frequently recently due to climate change. They also expected (about 72%) that these unprecedented changes would be more severe in future (e.g., following 20 years).

Herders' perception of exposure to climate change was assessed based on nine climate change indicators identified from the previous climate change studies relevant to the region (Table 2). Overall, about 80% of the surveyed herders indicated some (46%) or big (34%) magnitude of exposure to climate change. However, herder's observations of changes in location, timing, amount, intensity, and form of precipitation (85%), followed by changes in seasonal temperature patterns (78%), were more remarkable. During the interviews, herders highlighted their major observations of recent climate changes such as less snowfall and snow cover during winter; cooler, windier, drier and slower spring season; and relatively drier summer months and more intense droughts. A significant number of surveyed herders already had experience dealing with natural hazards and extreme climate events. However, changes in the intensity and duration of winter storms (dzud) and extreme events such as floods seem to have not been among the primary observations of the herders about the recent climate changes in their area (Table 2).

Assessment of recent climate changes in eastern Mongolia indicates a shorter cold season (October-March) but a longer warm season (April-September). It shows increases in both mean annual maximum (0.6-2.0°C) and minimum daily temperatures (1.0-2.0°C), indicating more intense extreme hot days but less frequent extreme cold periods and generally a milder cold season. It also shows a slight increase in warm season rainfall but more intensified droughts and dryness. Future projections also demonstrate increases in

temperature across all four seasons (on average, 1.3°C) but a minimum change in precipitation except for the summer season (June-August) with an expected decrease of 10-20%.

Table 2. Herders' perception of local climate changes over the last 20 years. Values in this and tables 3–7 indicate the percentage of surveyed herders out of 109 surveys completed.

Table 2: Herders' perception of local climate changes over the last 20 years

Type of Change	Magnitude of Change			NA/DK
	No (1)	Some (2)	Big (3)	
Location and timing of rainfall	5.9	45.1	44.1	4.9
Amounts of seasonal and annual rainfall	4	56	29	11
Amount and intensity (power) of rain in a single rainfall event	9.2	49	32.7	9.2
Amount and intensity of snowfall and duration of snow cover	8	39	45	8
Seasonal and annual temperature	9.1	36.4	41.4	13.1
Number of hot days during summer months	13.1	40.4	34.3	12.1
Number, intensity and duration of winter storms and dzud	18	59	14	9
Number, intensity and duration of droughts, floods and hail events	8	44	33	15
Onset and length of the growing season	23.6	47.2	27	2.2

3.4 Sensitivity to Climate Change

Herders' perception of sensitivity to climate change was assessed using 25 indicators associated with impacts (Table 3) and risks (Table 4) from local climate changes and how they are linked to the emerging environmental issues in the Soum (Table 5).

3.4.1 Herders' Perception of Impacts

About 74% of surveyed herders (Somewhat: 29%; Very much: 45%) raised concern about the six types of climate change impacts that were asked for their perception (Table 3). Among these impacts, herders were most concerned about climate change impacts related to the growing season and summer period. The majority of herders raised concern about the reduced amount of rainfall or relatively drier growing season (81%) and increased frequency of harsher summer periods (80%). This was followed by impacts on onset and length of growing season (74%) which is closely tied to the previous two impacts (Table 3).

Although changes in the absolute volume of rainfall were a primary concern for the herders, they were also worried about the delay in spring and early summer rain in recent years. They are well aware that climate change-induced increases in growing season temperature can potentially improve heat supply for vegetation growth in their area. However, they are highly concerned about the more intense heat stress and severe water supply shortage for vegetation growth and productivity during the optimal growing

period (June-July) in their semi-arid grazing lands. In recent years, the frequency of spring drought events showed an increasing trend in eastern Mongolia.

Table 3: Herders' level of concern about local impacts of recent climate changes

Type of Impact	Concern level			NA/DK
	Not (1)	Somewhat (2)	Very much(3)	
Reduced amounts of rainfall during the growing season	3	26	55	16
Increased number of flood and hailstorm events	13.3	35.7	26.5	24.5
Increased number and duration of harsh (very hot) summers	4	29	51	16
Increased number and duration of harsh (very cold) winters	5	21	50	24
Reduced amount of snowfall and snow cover on the ground	10	31	36	23
Altered onset and length of growing seasons	7	28	46	19

3.4.2 Herders' Perception of Risks

Herders were also asked about the sensitivity of their herding and livestock farming systems to eight major types of risks from local climate changes (Table 4). On average, around 74% of the surveyed herders assigned a moderate to a most level of sensitivity (46%) to the listed risks. As also highlighted during group discussions and interviews, local herders indicated a high sensitivity to risks associated with the productivity (79%) and profitability (72%) of their livestock herds. Based on the survey results, this mainly came from risks to the supply of livestock feed and fodder (81%), pasture forage productivity (75%), and livestock access to water (77%) during harsh summer and winter months, which altogether can potentially increase the rates of livestock health issues (73%).\

Table 4: Herders' perception of their sensitivity level to risks from local climate changes

Type of Risk	Sensitivity: 1 or 'Not Sensitive' to 5 or 'Most Sensitive'					NA/ DK
	1	2	3	4	5	
Increase in the frequency and severity of steppe fires	9.9	4	12.9	5.9	50.4	16.9
Uncertainty in grass available from the pasture	6	7	21	9	45	12
Limited supplemental feed and fodder availability in harsh summers and winters	5	6	16	15	50	8
Uncertainty in access of livestock to water	9.9	4	15.8	10.9	50.5	8.9
Increase in the rates of livestock health issues	14.1	7.1	20.2	10.1	42.4	6.1

Reduction in forage and hay production and a decrease in forage quality and nutrient availability for livestock are expected under a changing precipitation and temperature regime during the growing season. Around 70% of the surveyed herders indicated that they currently have access to enough pasture forage for their livestock. However, a significant percentage of them also indicated a need to buy additional hay and fodder for their livestock, including grass hay (67%), oats (35%), concentrated feed (13%), and wheat barn (91%).

Currently, most herders (90%) either do not own private or shared hayland and cropland or the area of their cultivated land is not sufficient. In addition, more than 70% of their additional hay and fodder

requirements are bought from local animal feed markets in and around the Soum area. Therefore, as climate change impacts intensify in the Soum and surrounding areas, any declines in pasture forage quality and quantity need to be offset by supplementary feed and fodder from other regions. However, this might not be possible anymore for herders with low income and livelihood sustainability levels.

Like similar regions around the world, climate change is projected to reduce surface and groundwater, and thus, livestock access to water in arid and semi-arid grazing lands in Mongolia. Surveyed herders indicated river (38%) and specifically well or groundwater year-round (45%) and during the winter season (74%) as primary water sources for their livestock. However, they were concerned about the risk of a higher rate of variability in river flows and water quality, as well as a decline in groundwater levels in recent years. In herders' opinion, if livestock has no access to water, it does not matter how green pastures are. Herders also indicated that livestock was used to obtain enough water by licking the snow while grazing on pastures in winter. However, with the reducing trend of snowfall and snow cover in recent years, they believe this is no longer an option for their livestock. A few herders were also anxious about the upstream water harvesting and management in the Kherulen river basin and if it can result in water scarcity and conflicts as climate change progresses in their area.

Lastly, most of the herders (90%) thought their livestock shelters were sufficient during harsh winters. Damage to the critical local infrastructures for livestock seems to have not been a major risk to their livestock herding operations in recent years.

3.4.3 Herders' Perception of Environmental Issues

A thorough CCV assessment of herding communities and their livestock farming practices requires a clear understanding of the interactions between impacts from local climate changes and other emerging environmental issues. Therefore, herders were also asked about their perception of the linkage between local climate changes and 11 environmental issues relevant to the Soum (Table 5).

Overall, 74% of surveyed herders thought that the questioned environmental issues had been rooted or intensified due to the recent climate changes in their area (Table 5). Although around 60% of the herders indicated that the number of livestock they herd had increased slightly (47%) or a lot (17%) in the past five years, they were uncertain that local climate changes primarily caused this recent increase in their livestock number. However, herders emphasized the increase in herd size as a coping strategy they had previously taken to avoid a total loss of their livestock during a drought or dzud. Further implementation of such adaptation strategies could contribute significantly to the growing number of livestock in the Soum as climate change impacts worsen and livestock market opportunities expand in the future.

A relatively large percentage of herders (71%) thought that recent climate changes intensified steppe fires in the region. High water deficits and drier and hotter climates generally satisfy fuel flammability during the fire season. However, due to high grazing pressure and frequent spring droughts in recent years, fuel load is minimal, except for small patches of halophyte grasses and subshrubs along the lakes and rivers, as well as rarely grazed pastures with little or no water resources. Therefore, herders seem to have been less worried about the risks of steppe fires in their area in recent years.

Table 5: Herders' perception of the link between environmental issues and local climate changes

Type of Environmental Issue	Link to climate change			NA/DK
	Not(1)	Somewhat(2)	Very much(3)	
Shift in agricultural lands and increase in land cultivation	12.4	26.8	19.6	40.2
Livestock number increases	29	31	28	12
Increasing pressure of trampling and grazing intensity	21	34	38	7
Increasing out of season grazing and livestock movement events	9.2	35.7	49	6.1
Shift in steppe vegetation (e.g., native to invasive plants)	9.1	32.3	50.5	8.1
Increasing frequency and severity of steppe fires	22	28	43	7
Expanded size of bare ground and barren patches	6.9	34.7	50.5	7.9
Increasing runoff and water-related soil erosion events	14	29	43	14
More frequent dust storms and wind-related soil erosion	5	33	53	9
Reductions in crop and forage yield and quality	3	31.5	42.4	23.2
Dropping water level in water resources (e.g., rivers, wells)	7.9	30.7	51.5	9.9

Mongolian herders have migrated across the grazing lands with their livestock for thousands of years. However, their mobility patterns around their seasonal campsites have recently changed, and the distance travelled during the seasonal movements has generally decreased. About 85% of the surveyed herders indicated a linkage between climate change-related increases in drought periods and herders' mobility or livestock movements (Table 5). Traditionally, nomadic herders were used to moving at least four times a year. However, survey results revealed that 23% of herders do not move at all, 30% move once or twice a year, 19% move three times a year, and only 28% move at least four times a year. In addition, the survey results revealed that the seasonal movement of about 77% of the herders is recently limited to a maximum of 10 km, of which 41% move less than 5 km to reach their furthest pastures.

Herders thought this reduced livestock mobility was primarily driven by climate change-induced drop in water resources level (82%) and pasture forage quality and quantity (74%) in their area (Table 5). They highlighted the need to find unconventional water sources. They emphasized that if water is available and the pasture condition is good, they migrate to 3–4 fixed sites, preferably near their winter and spring shelters. However, 87% of them indicated that they do not usually use any sort of otor movement. They also highlighted that their control over access to traditional livestock movement routes and pasture and water resources had been recently diminished by establishing new pasture management boundaries, as well as by pressure from outside herders and livestock moving into or through their area.

Grazing pressure is frequently mentioned as a driver of land degradation in the region. Overall, 72% of the surveyed herders believed that local climate changes had recently intensified grazing pressure in their area, particularly around and close to the remaining water resources (Table 5). They firmly believed that recent climate changes in other parts of the country have also contributed to grazing pressure in their area. Herders stated the recent relocation of a large number of unregistered livestock into the Soum due to severe land degradation and frequent droughts in other regions of the country. They thought this had significantly contributed and will continue to contribute to grazing pressure and pasture degradation in their area. However, a few herders also stated lack of livestock mobility and, therefore, lack of vegetation recovery period in continuously grazed areas as another reason for high grazing pressure.

Climate change-induced shift in steppe vegetation was one of the most quoted (83%) environmental issues by surveyed herders (Table 5). In general, herders were aware of the disappearance or declines in the abundance of specific desirable plant species and increases in the abundance of undesirable and poor-quality plant species in their pastures. They knew how grazing pressure and herd composition or livestock mixture impacts steppe plant species and vegetation cover. They considered horses to damage their pastures compared to other livestock. However, they were uncertain about the extent to which grazing pressure, herd mixture and climate change have contributed to vegetation change and pasture degradation. Basically, they did not say pasture vegetation has degraded only because of climate change.

The expanded size of bare ground and barren patches was another mostly quoted (85%) environmental issue linked to local climate changes (Table 5). Most herders described vegetation cover degradation in the context of increasing soil (86%) and water erosion event (72%) in recent years. Herders indicated more intense wind and sandstorms, possibly driven by the impacts of recent climatic changes in their area. Climate change and overgrazing have been considered the main drivers of pasture degradation in Mongolia. Consistent with this public view, the drivers of degradation most commonly mentioned in recent studies were grazing, followed by changes in precipitation and temperature regimes. A key issue is the concentration of livestock around the few usable wells and water bodies. Overgrazing reduces or eliminates vegetation cover, leading to increased loss of soil moisture and worsens soil erosion by wind and rain. The shallow topsoil in the sandy steppe brown soils of the Soum will be at a high risk as impacts from grazing pressure and climate changes will intensify.

3.5 Adaptive Capacity to Climate Change

Herders' perception of adaptive capacity to climate change was determined using 12 indicators related to different aspects of their livestock farming operations. Specifically, herders were asked to rate their ability (Table 6) and the major barriers (Table 7) to undertaking adaptation actions and addressing the risks of climate changes in their area.

Despite the relatively high exposure and sensitivity to risks from climate changes (Table 4) and in contrast to the expectations and ground observations, 78% of the surveyed herders believed in having a moderate (27%) to high ability (51%) to adapt the questioned aspects of their livestock farming to risks from climate changes (Table 6). Among these aspects, herders perceived to be slightly less capable of dealing with livestock feed shortage (73%), livestock immobility or limited seasonal movement (77%), and risks from steppe fires (74%). Herders also stated a much higher than expected ability to deal with the risks associated with access to water resources and health control services for their livestock under a changing climate (Table 6). However, several herders stated the flexibility in livestock movement and distribution across the landscape as the key determinant of their vulnerability and also ability to cope with risks from climate change impacts. In addition, as expected, most of the herders (84%) indicated a relatively high ability to deal with climate change risks to their basic livestock shelter and other critical infrastructures.

Table 6: Herders' perception of their ability and capacity to adapt to risks from local climate changes

Type of Risk	Ability: 1 or 'No Ability' to 5 or 'High Ability'					NA/ DK
	1	2	3	4	5	
Livestock access to feed/ fodder and feed supplements	20	5	12	14	47	2
Livestock access to water	12.9	6.9	17.8	8.9	53.5	0
Livestock diseases and health control	13	3	19	13	51	1
Livestock protection from steppe fires	13	10	23	10	41	3
Livestock shelters and other critical infrastructures	12.1	3	16.2	8.1	59.6	1
Livestock movements, transportation and retailing	17.2	5.1	11.1	10.1	55.6	1

A total of six indicators (Table 7) related to knowledge, awareness, and technology; the physical environment and biological resources; economic and financial structure; human resources and operational capacity; and governance and institutional capacity were used to assess herders' perception of barriers to adapting to local climate changes.

Unlike the previous indicators, a mixed range of herders' perceptions was obtained for the questioned barriers. Overall, 55% of herders identified these barriers as moderate (3) to major barriers (5), while the remaining 45% characterized them as no or minor barriers to coping with local climate changes (Table 7). The herders' lack of practical knowledge and adaptation technology was the most rated barrier (68%). This was followed by the labor shortage (63%) and lack of financial resources (63%) or herders' limited financial capacity or inability to implement adaptation measures. Lastly, a relatively higher percentage of herders (52%) thought the existing capacity within government institutions and the physical and biological capability of their land and water was no barrier to supporting climate change adaptation measures.

Table 7: Herders' perception of major barriers limiting their capacity to adapt to local climate changes

Type of Barrier	Barrier: 1 or 'No Barrier' to 5 or 'Major Barrier'					NA/DK
	1	2	3	4	5	
Lack of financial means and capacity to cover costs of implementing adaptation strategies	20.2	15.2	27.3	9.1	26.3	2
Lack of practical and technological knowledge of effective adaptation strategies	15.2	13.1	28.3	13.1	26.3	4
Lack of operational capacity to undertake adaptation strategies (e.g., machinery)	28.4	14.7	27.4	12.6	10.5	6.3
Labor shortage	25.5	11.2	17.3	19.4	26.5	0
Lack of or incapacity of government institutions to support the implementation of adaptation strategies	43.3	9.3	15.5	10.3	18.6	3.1
Lack of or incapacity of the land and/or water to support the suggested adaption changes	38.5	13.5	15.6	7.3	20.8	4.2

Improvements in knowledge and information distribution, advancements in technology and infrastructure, and the development of appropriate policy and financial incentives were stated as necessary steps to adapting management to a changing climate. Herders debated that access to pasture and livestock information at relevant spatial and temporal scales promotes their ability to detect and respond

appropriately to the risk of negative feedback from climate changes. Herders also discussed the need to create financial programs and policies (e.g., payment for environmental services) that promote adaptive solutions. Government interventions and programs, such as managing increased livestock numbers by initiating tax penalties for owning over a certain number of livestock, were also highlighted. Herders emphasized that they require higher-level policies and coordination for pasture monitoring and effective seasonal movements of their livestock. From group discussions, it sounded that locals are currently undergoing a competition for increasing the number of livestock and altering herd composition without thinking thoroughly about its outcomes for their pastures and other essential resources.

Figure 4: Livestock herding in the Soum

3.6 Vulnerability and Risks from Climate Change

A simple numerical rating approach based on the standardized (0-1) average scores of the 46 questioned indicators (Table 2 to 7) was used to calculate final scores of exposure, sensitivity, adaptive capacity, and CCV for the surveyed herders. Variation in these scores (Figure 5) was then compared amongst herder groups with different herding history (year), the total number of livestock herded, the percentage of income obtained from livestock herding, and the number of household members (Table 1).

Overall, surveyed herders were characterized with a relatively high exposure to climate changes (Figure 5). The scores showed a tendency towards a higher exposure of herders with a more extended history of livestock herding and a higher dependency on income from livestock (Figures. 5A and 5C). While a tendency toward a lower exposure to climate changes was observed for herders with a larger household size (Figure 5D). Surveyed herders were also characterized with a relatively high sensitivity to climate changes (Figure 5). There was only a small association between herder's scores of exposure and sensitivity to climate changes. However, in contrast to the exposure scores, the results also showed a tendency toward a higher sensitivity of herders with a larger household size to climate changes (Figure 5D). Surprisingly and in contrast to the expectations, surveyed herders were also characterized with a relatively high adaptive capacity to cope with climate changes (Figure 5). Like the exposure scores, the results showed a tendency towards a higher adaptive capacity of herders with a longer history of livestock herding and a higher dependency on income from livestock (Figures 5A and 5C). No association between herder's scores of exposure or sensitivity to climate changes and their adaptive capacity was observed.

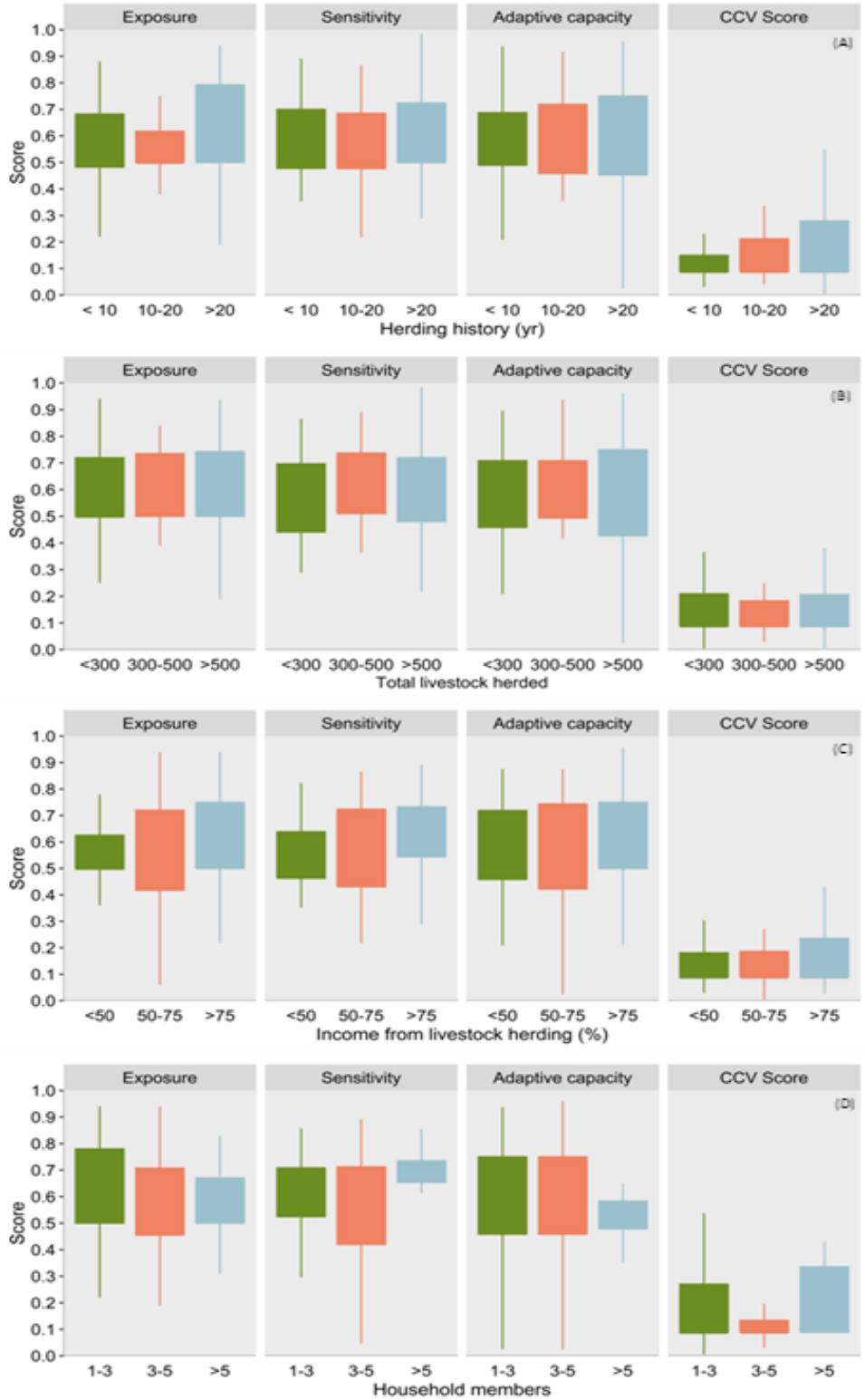
The final CCV scores for surveyed herders were calculated based on the difference in their impacts and risks from climate changes (exposure and sensitivity) and their adaptive capacity. Overall, surveyed herders were characterized with a relatively low and close vulnerability to climate changes (Figure 5). However, the

scores showed a more apparent tendency towards a relatively higher but still low vulnerability of herders with a longer history of herding, a larger herd and household size, and a higher dependency on income from livestock (Figure 5). The results explained here could be well influenced by indicators selected and survey design and sample size. However, from the field observations, it was evident that experienced herders have a deeper understanding of long-term climate changes and how and to what extent these changes can put their herding practices and livelihood at risk. It was evident from herders' feedback that it would be more challenging to feed, move and raise a larger livestock herd as climate change impacts intensify in the region. A higher risk and vulnerability of larger households mainly relying on herding and raising livestock was also observed from discussions with local herders.

Herder's perception of climate changes and risks presented here could likely be mainly related to their perceptions of the changes in pasture condition, which is not only affected by changes in climate but also by changes in pasture management, including livestock grazing pressure. In addition, the divergence observed between herders' perception of their adaptive capacity and the expectations or reality could likely be related to sets of beliefs and concepts through which they live and understand the environment around them and use to solve the problems they face. Mongols' optimistic views and their specific attitude and culture of positivity support a belief that talking about bad things will cause them to happen. Therefore, this assessment might not have captured an accurate picture of herders' adaptive capacity for risk management under a changing climate.

Figure 5 shows the variation in potential exposure, sensitivity, adaptive capacity and CCV of surveyed herders to climate change impacts. Boxplots illustrate the range of variation in standardized, average scores calculated for different groups of surveyed herders (A: herding history; B: total number of livestock herded; C: percentage of income from livestock herding; D: number of herders' household members).

Figure 5: Variation in potential exposure, sensitivity, adaptive capacity and CCV of surveyed herders to climate change impacts



4 Deliverable 2.3 Gender Vulnerability Assessment

4.1 Gender Division of Labour and Gender Gap in Authority

The study used 10 variables for measuring the gender division of labour in livestock production, domestic chores and participation in the community activities. Even though the majority of respondents answered that this is joint work, the results reveal that male members of households are more active in six (6) out of seven (7) livestock herding activities while female members are more active in dairy production and home chores including childcare, cleaning, washing and cooking. Most participants responded that men are more active in community activities such as meeting with officials and participating in meetings, activities and trainings for herders' groups and cooperatives. Male herders are more active in the production and social-community activities while female herders' participation is dominant in the unpaid work or reproductive works and home chores (Table 8). It is important to highlight that there long and repetitive activities under the women's "home chores" even if the table shows that male herders are active in many activities; comparing number of activities is not a measure of total time spent on activities. It is interesting that female participation in income generation activities is lower than male.

A Time Use Survey conducted by the National Statistics Office (NSO) in 2019 reveals that: i) a rural man over 12 years old spends 554 minutes per day for a week for production activities while a rural woman spends 374 minutes; ii) a man spends 68 minutes, but a woman 264 minutes for unpaid home chores; and, iii) a man spends 818 minutes and a woman spends 802 minutes for self-development and private times (NSO, 2019). A rural male spends 1.5 times more than a woman in production activities, but they spend 3.9 times less in home chores, allowing men more time than women for self-development and private time.

This difference was revealed quite uniquely in the difference between men and women living in the capital, in the provinces and soum centers. Specifically, rural women spend the most time on production activities compared to other women, but they spend 71 percent of production activities on household final products for consumption. By comparison, women in the capital spend only about 5% of their time in production on making household products. Therefore, the rural women participants of our study confirm that "men are involved in agricultural production activities, and women are dominantly involved in milk and milk products processing and housework". In addition, it shows that rural women's' unpaid care duties limit the time available to earn income.

The relatively low participation of female herders in agricultural production activities is related to the fact that the herder families are live separately in the soum center and countryside during school. During the Focus Group Discussion (FGD) with female herders, it was explained that living separately has become common among people under 40 years of age and relates to the reduction of the school age to six years. The consequences of this separate living for women include reducing women's participation in livestock production as well as their income and power (or authority) in the family. In addition, in terms of economic impact for the household, when only one member is producing the household products, it limits overall production and income, increases the lack of human resources, and tends to increase household expenses as well, since those products no longer produced in the home must be purchased.

Table 8: Gendered division in livestock farming and house chores (% completed by each)

Task	Man\ Husband (%)	Woman\ Wife (%)	Boy (%)	Girl (%)	No Answer (%)
1. Herding, watching and caring animals	83.3	10.8	5.9		
2. Search for animals	91.0	3.0	6.0		
3. Milking and preparing dairy products	6.1	88.9			4.0
4. Haymaking and harvesting	74.0	3.0	4.0		19.0
5. Fencing pasture	44.9	3.4	1.1	1.1	49.4
6. Plant hay land or cropland	40.4	2.2	1.1		56.2
7. Housework (take care of child, clean houses, wash, cook and etc.)	7.1	84.7	2.0	6.1	
8. Meet with officials for business	70.7	24.2	2.0		3.0
9. Participating in herders' group's activities such as meetings, trainings and etc.,	68.7	26.3	1.0		4.0
10. Treating animals, preventing diseases, washing and tec.	74.2	19.6	5.2	1.0	

Source: Herders' survey in Bayantumen soum, Dornod, June, 2022

The survey identified the gender disparities in eight (8) livestock production activities. Men's participation dominates in livestock production activities (except for cleaning the guts of slaughtered animals), sales, income distribution, and training in animal meat preparation which relates to the traditional division of labour. More than 10 percent of the study participants use a commercial slaughterhouse, so they do not perform some detailed activities of meat preparation at household level. It was observed that training activities for feeding and meat preparation out of mentioned activities in the study are rare in the local area and that that male participation might be higher in these trainings if the training were organized.

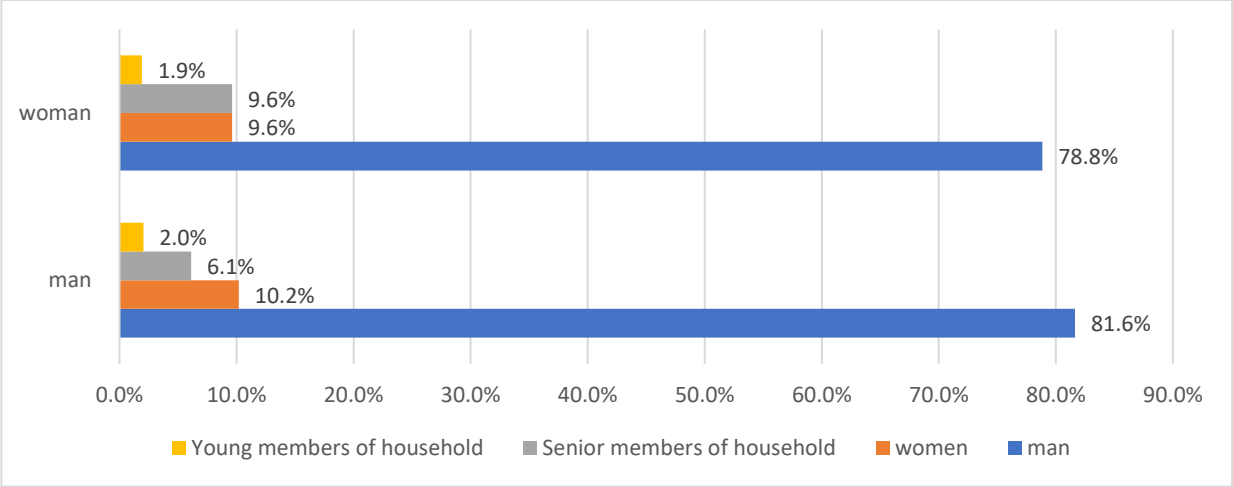
Table 9: Gender division in meat producing

	Male	Female	No Necessary
1. Feeding animals	46.5	18.2	35.4
2. Driving and transporting	90.7	3.1	6.2
3. Slaughtering	88.9	2.0	9.1
2. Breaking, dividing, and classifying	87.9	2.0	10.1
3. Skinning and cleaning the carcass	79.3	7.6	13.0
4. Cleaning intestines	11.1	78.8	10.1
5. Selling animals or meats	79.8	14.1	6.1
6. Communicating with partners and negotiate prices	82.0	13.0	5.0
7. Distribute income from selling livestock or meats	66.0	29.0	5.0
8. Attending at training on feeding and meat preparation and meetings	48.0	12.2	39.8

Table 9 reveals that the participation of men in meat production is dominant across all but one activity. To this extent, 80% of the respondents (78.8% of women and 81.6% of men) say that the power to distribute

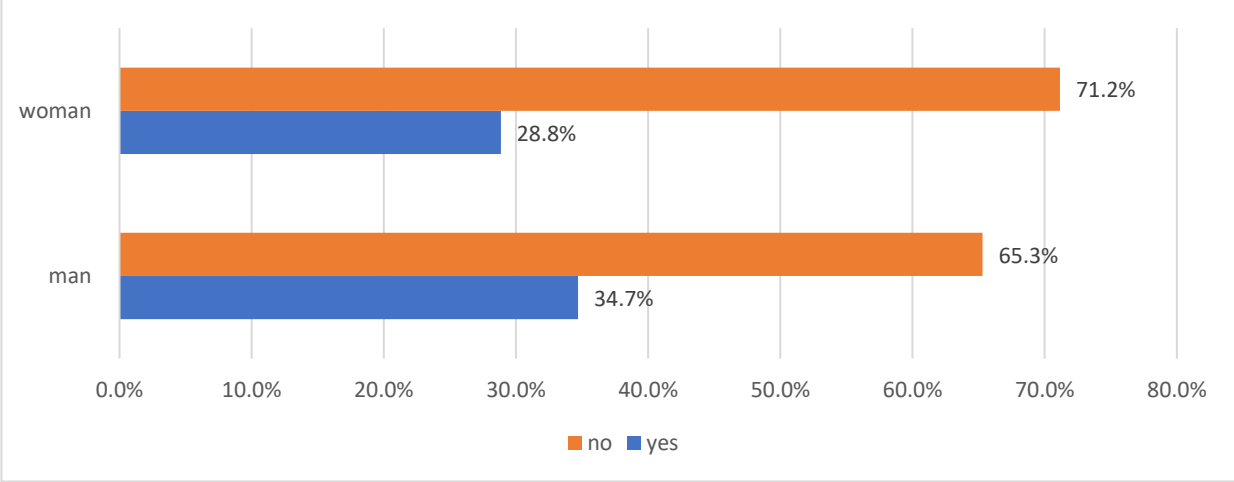
income from meat production and make decisions related to meat production is in the hands of men (Figure 6). In particular, male members of households with 1,000 or more animals make 100% of the decisions related to meat production. This low participation by women in production activities leads to low decision-making power.

Figure 6: Who usually makes meat production decisions? (by sexes)



Survey responses showed that 34.7% of men but only 28.8% of women are able to save money in their own savings account with the income from meat processing activities, a difference of 6 percent. Thus, there is a difference in participation and power between men and women in meat production that leads to different opportunity to share in the income. Low participation leads to disparities in power and income (Figure 7).

Figure 7: Do you save money from meat processing activities (by sexes)



When herders are asked to name the sources of income that can be sold or used without asking for anyone in the family, they named selling livestock or meat, cashmere, and skins and hides, milk and dairy products, and pension and allowances. There is no significant sex difference, but 23% of women and 19% of men answered that they do not have a source of income that they have authority to manage on their own. Although there are women who have the authority to use of the income from the sale of livestock without

asking anyone, there is another category of women who have no source of income to use without asking anyone. Therefore, instead of analyzing by the single category of sex as "women and men", the survey evidence shows that it is better to identify the vulnerability by intersectional analysis including economic position and marital status.

4.2 Gender Gap in Property Ownership

Official government livestock census registration information is recorded in Form A approved by NSO. In our survey, we determined owner of the livestock and 84% of the respondents answered that their herds are registered in the name of the husband as the head of the household, 5.2% registered as their co-owners, and 5.2 registered under the name of the female head of the household (Table 10). There was no significant different by gender or marriage status.

Table 10: Ownership of household livestock according to the official registration Form A

Head of household - husband	Head of household - wife	Co-owned	Children	Parents and relatives	Other people
83.5%	5.2%	5.2%	4.1%	1.0%	1.0%

The number of livestock remains significantly important in determining the livelihood of the herders, while the size of family members plays an important role in nomadic livestock production. The average number of livestock of all herders participating in the survey is 541 while the average number of livestock owned (145) was lowest for 15-25-year-olds. Therefore, vulnerability in terms of livelihood is more evident among the group aged 15-35 (Table 11).

Table 11: Mean of livestock by age group and sex

Age-Interval	Mean	N	Std. Deviation
15-25	145.0	6.0	127.1
26-35	455.0	25.0	369.9
36-45	690.3	25.0	444.7
46-60	575.1	29.0	476.1
over 60s	528.6	17.0	552.4
Total	540.8	102.0	456.6

In terms of marital status, the average number of livestock for people living as couples is 570, while for people living alone or as a single headed household, the average number is 400 (Table 12). Rather than sex, being the head of a household alone results the differences in the livelihood of the herders. Men and women who are single or single heads of households may be more vulnerable to climate change.

Table 12: Mean of livestock by marital status

Marital Status	Mean	N	Std. Deviation
Married	570.0	82.0	435.7
Single or single headed	400.4	26.0	474.7
Total	529.2	108.0	449.0

82% of men who are single heads of households have less than 300 livestock. The small sample size limits detailed statistical analysis. This shows that there may be correlations in both ways, on one hand, being a single household head is key factor to have small number of livestock, and on the other hand, having small number of livestock results to live or head the household alone. The small sample size limits detailed statistical analysis that could be done further.

Although the average number of livestock of female participants was higher according to the result of our survey, it is also revealed that livestock as well as most of the property, assets and tools of families are registered in the name of men, heads of the households. This means that men have a better chance of getting loans from banks and financial institutions.

The study also identified the ownership of the profit, facilities and equipment used in household consumption and production in the official registration. Profit and equipment such as winter and spring camp, wells, trucks, carriages and motorcycles, common in pastoral families, are mostly owned by a man. In addition, more than 40 percent of the herders who participated in the study own fences, houses, apartments, and vegetable fields in central settlements, and almost all of them are owned in the name of men (Table 13). Thus, men are dominant in property ownership in local areas covered by our study.

Table 13: Ownership of properties or facilities

Properties and facilities	Man\husband (%)	Woman\Wife (%)	Father (%)	Mother (%)	No (%)
1. Winter camp	71.4	3.1	2.0		23.5
2. Spring camp	58.1	3.2	3.2		35.5
3. Well	60.0	4.2	3.2		32.6
4. House	44.2	3.2			52.6
5. Apartment in town	36.4	4.5			59.1
6. House with yard in town	33.7	6.0	1.2		59.0
7. Land for crop, vegetable etc.	19.8	3.7			76.5
8. Business premises and facilities	15.8				84.2
9. Truck	64.4	2.2			33.3
10. Sedan car	49.4	6.0	1.2	1.2	42.2
11. Tractor	33.8	5.0	1.3		60.0
12. Motorbike	80.0	2.1			17.9

Winter and spring camp and associated land have significant role in the livestock herding because it allows for the use of pastures. 76.5% of the respondents have winter house, 56.5% spring camp, 59.5% summer camp, and 52.6% fall camp and 66.6% have certificate for winter camp, 60% have certificate for spring camp, 3.1% have certificate for summer house and 1.8 have certificate for fall camp only. In general, an ownership certificate is given for winter camp and spring camp according to the law, the summer and fall camp are used within the public ownership purposes.

Based on the gender analysis, the number of women who have winter, spring, summer and fall camp is 4-7% less than men, while 3-13% less women have ownership certificate (Table 14). So, it is observed that

male herders have a relative advantage in terms of land use compared to women. There are no differences by marital status.

Table 14: Ownership of camps by sex (%)

Camps	Ownership of Camps				It's Certificate			
	Male		Female		Male		Female	
	Yes	No	Yes	No	Yes	No	Yes	No
a. Winter camp	83.0%	17.0%	70.6%	29.4%	73.3%	26.7%	60.4%	29.6%
b. Spring camp	59.1%	40.9%	54.2%	45.8%	63.2%	36.8%	60.0%	40.0%
c. Summer camp	61.5%	38.5%	57.8%	42.1%	3.3%	96.7%	2.9%	97.1%
d. Fall camp	55.3%	44.7%	50.0%	50.0%	3.7%	96.3%	0.0%	100.0%

Analyzing the ownership and possession of winter and summer camps by age group, 40% of young people aged 15-25 have winter camp and 25% have ownership certificate, and 20% have spring camp, but none of them have ownership or possession certificate (Table 15). Obtaining ownership and possession certificates is less of a problem for youth whose parents have winter and spring camps with certificates and demise it to their children, but it is a challenge for youth from herder's family whose two or more children became herders. Furthermore, in an in-depth interview, young people expressed that the most difficult problem they face is obtaining their own winter and spring camps, especially for young herders who recently migrated. The NCGE/ADB gender analysis of young herders showed that a main problem for young herders is to have their own winter and spring camp, and although the percentage of young herders is decreasing, local administrative offices do not pay attention to implement measures to help them get their own land (NCGE, ADB, 2021).

Table 15: Ownership of camps by age groups (%)

Camps\age groups	15-25	26-35	36-45	46-60	Over 61
Winter camp	40.0%	77.3%	73.9%	77.8%	80.0%
Spring camp	20.0%	45.0%	63.6%	61.5%	58.3%
Summer camp	20.0%	60.0%	66.7%	59.1%	63.6%
Fall camp	0.0%	52.6%	60.0%	50.0%	70.0%

... Before I went to South Korea as a worker under the contract, I was a cattle farmer with my grandparents, and after coming to the province center, I couldn't find a job. I stopped having people take care of our herds and became a herder my-self. However, I could not get my own winter and spring camp, and all the wells in my around are owned by other families. I worry about how to herd animals in case of with no land and water? I would like to pay the costs of drilling a well and settle down, but it is difficult to get a permission, because it is a protected area. *From the interview with young herder, 4th bagh*

... We have few herds, but we herd the other family's herds. So far, we have applied for a land for winter camp to the bagh and soum administrative unit, but we don't have an official certificate. Even we do not have a certificate for winter and spring camp, our neighbors do not mistreat. Some get the land certificate of the land we set for winter camp, thus we do not have our own land. *From the interview with the herder with few herds.*

The survey analyzed whether the number of animals owned, or the possession of a winter or spring camp influenced receiving the certificate. The results showed that 58% of herders with less than 300 herds have

winter camp but only 54.5% of those have received their certificate (Table 16) and only 28.6% of them have a fall camp. Thus, it is difficult for herders with a few number herds to have their own winter camp and certificate. Hence, they may face a shortage of pasture due to the increase of movement from other provinces and the trend for herders with huge herds to buy a land. We can see the relevance of the herd size and pasture shortage from the answers of the study; herders with large herds tend to say that there is not enough pasture. It is obvious that rate of pasture usage as a public resource, is directly related to the number of animals. We believe that mutually agreed rules for the pasture management in relation to the number of animals and establishing the appropriate number of animals per household in relation to pasture, will be more suitable to meet the interests of herders with few animals.

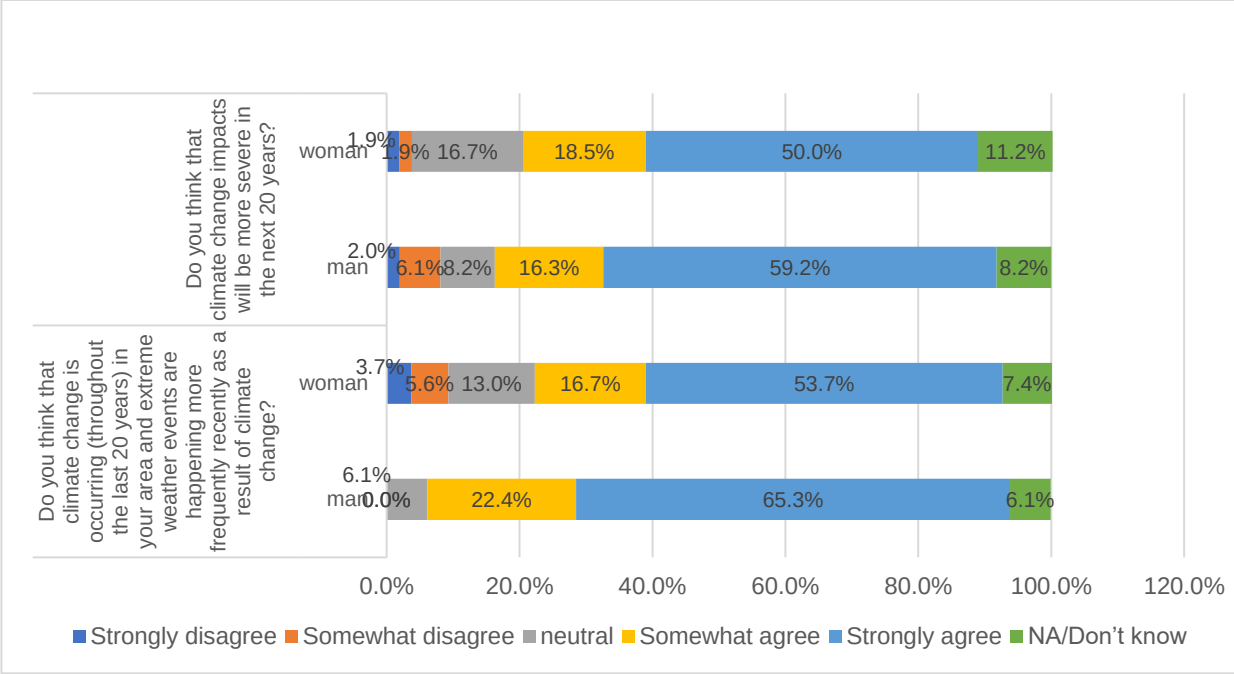
Table 16: Ownership of camps by number of livestock herding (%)

Camps\number of livestock	0-300	301-500	501-999	1,000 and over 1,000
Winter camp	58.3%	80.0%	86.4%	95.0%
Spring camp	28.6%	50.0%	76.2%	94.4%
Summer camp	34.5%	60.0%	70.8%	87.5%
Fall camp	27.6%	61.5%	47.6%	100.0%

4.3 Perception on Climate Change

Nine (9) out of 10 men, and seven (7) out of 10 women agree that climate change is observed in their area compared to 20 years ago. Only a few “disagree” responses were received, and these were from female herders. In terms of sensitivity to climate change and its impact, more male respondents than female say they agree that climate change impacts will be stronger, and they are sensitive to the changes. However, looking at the responses by age groups, respondents agree that climate change is observed (not at the level of statistical significance). The more senior the respondent (at the level of statistical significance), the stronger they agree that climate change will increase in the next 20 years.

Figure 8: Individual perception and evaluation on climate change (by sexes)



Regardless of category of sex, the majority of male and female herders (more than 7 out of 10) agree that the following changes of climate have occurred in their area over the past 20 years as a result of climate change. However, the percentage of women who answered "no change" is higher than that of men, except for seasonal and annual rainfall, but this difference is not statistically significant. Also, the data was analyzed by age and number of livestock, but no significant differences were found.

Table 17: Respondents' assessment on climate change in their area over the last 20 years

	No change		Changed		NA/ Don't know	
	Man	Woman	Man	Woman	Man	Woman
1. Location and timing of rainfall	6.0%	5.8%	90.0%	88.5%	4.0%	5.8%
2. Amounts of seasonal and annual rainfall	6.3%	1.9%	83.4%	86.5%	10.4%	11.5%
3. Amount and intensity (power) of rain on single rainfall event	8.5%	9.8%	83.0%	80.4%	8.5%	9.8%
4. Number, intensity and duration of droughts, floods and/or hail events	6.3%	9.6%	75.0%	78.9%	18.8%	11.5%
5. Seasonal and annual temperature	6.3%	11.8%	79.2%	76.5%	14.6%	11.8%
6. Number of hot days during summer months	10.4%	15.7%	77.1%	72.5%	12.5%	11.8%
7. Number, intensity and duration of winter storms and cold weather (dzud)	16.3%	19.6%	75.5%	70.6%	8.2%	9.8%
8. Amount and intensity of snowfall and duration of snow cover on the ground	6.1%	9.8%	85.7%	82.4%	8.2%	7.8%
9. Onset and length of growing season	23.8%	23.4%	76.2%	72.3%	0.0%	4.3%

The majority of male and female respondents (more than six out of ten) are concerned about the following aspects of climate change. However, 4 out of 6 questions were answered as "Do not know or no answer" by only women, and the percentage of the women, who are not concerned about the "increased number of droughts, floods, hailstorms" and " reduced amount of snowfall and snow cover on the ground", is immediately two times greater than the men. But this difference had no statistical significance. In terms of analysis by age and number of animals, no differences were indicated as well.

The question “Increased number of drought, flood and hailstorm events” has the characteristic of asking the opposite phenomena at the same time in the same question. Thus, it is to note that some female respondents perceived and answered this question as if it asks “Increased number of hailstorm and heavy rains” only. On the other hand, the questions “Reduced amounts of rainfall during the growing season” and “Increased number and duration of harsh summers” were perceived and implicated as “droughts” for Mongolians. Herders believe that there has been increase in heavy and hailstorms, but especially the female herders mentioned during the group interview that "It's good as long as it rains" which they meant it does not matter if it is heavy or hailstorm.

During the group interview with female herders, they said that men are more at risk by the climatic changes as they usually are responsible for daily livestock farming activities taking examples of herding and looking for animals when there is heavy rain, large amount of snow, and wind and storm. Whereas “we (women) stay at home as we are responsible for house chores and dairy products processing, we feel the challenges of the climatic changes less”. Although the herders did not give the exact reason as if it is due to labor shortage, increase in the number of animals, greater efforts on fattening animals, or a change in nature, there is increase in animal husbandry activities per family which result the families stop milking their sheep and goats and milking their cows only once in the morning rather than two times a day. However, elder herders highlighted that it could be true that they stopped milking and producing dairy products because they avoid work and are being lazy. In general, except one woman from the group interview, all of them has doubt that milk and dairy products could be a source of income. Only three (3) of the women interviewed answered that they earn money from milk and dairy products. Herders tend to implicate that less processing and producing of dairy products is caused by firstly, increased number of livestock, secondly, dairy products production itself is physical labor demanding work, third, it negatively effects for fattening of animals.

Table 18: Herders’ assessment of concern about the climatic changes for their livestock farming operations

Question	Unconcerned		Neutral		Concerned		NA/Don’t know	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman
1. Reduced amounts of rainfall during the growing season	2	4	18.4	11.8	79.6	82.4	0	2
2. Increased number of drought, flood and hail storm events	8.5	17.7	27.7	19.6	63.8	60.8	0	2

Question	Unconcerned		Neutral		Concerned		NA/Don't know	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman
3. Increased number and duration of harsh summers	4.1	3.9	16.3	13.7	79.6	80.4	0	2
4. Increased number and duration of harsh winters	4.1	5.9	16.3	17.6	79.5	74.5	0	2
5. Reduced amount of snowfall and snow cover on the ground	6.1	13.7	24.5	17.6	67.3	66.7	2	2
6. Altered onset and length of growing seasons	6.1	7.9	20.4	13.7	71.4	76.4	2	2

The majority of male and female herders participated in the survey believe that the followings are associated with climate change. Particularly, the percentage of male herders who believe that the increase in the number of livestock, increase of out of season grazing events and migrations/ seasonal movements of livestock, increase of frequency and severity of steppe fires are associated with climate change was found to be 4 percent higher than that of women. Whereas the percentage of female herders who believe that shift in steppe vegetation (native, palatable plants to invasive, weedy unpalatable plants), increase of runoff and water-related soil erosion events, reductions in crop and forage yield and quality, and drop of water level of lakes, wetlands, rivers, wells, springs and other water resources was found to be 4 percent higher than that of men. Percentage of female herders believe that increase of out of season grazing events and migrations/ seasonal movements of livestock, and frequency and severity of steppe fires are not related to climate change was found to be 6 percent higher than that of male herders. And, percentage of male herders who believe that increase of runoff and water-related soil erosion events, and drop of water level of lakes, wetlands, rivers, wells, springs and other water resources are not associated with climate change is 6 percent higher than that of female. However, these are the difference shown in sex disaggregated results, the difference did not observe at statistically significance when Chi-square analysis was conducted for verification. It is observed that the more senior the respondent, the higher the tendency that they believe there is association between following issues and climate change (Table 19). For herders with between 300 and 800 animals, it is observed that they believe those issues are associated with climate changes, but no differences were observed at the statistical significance.

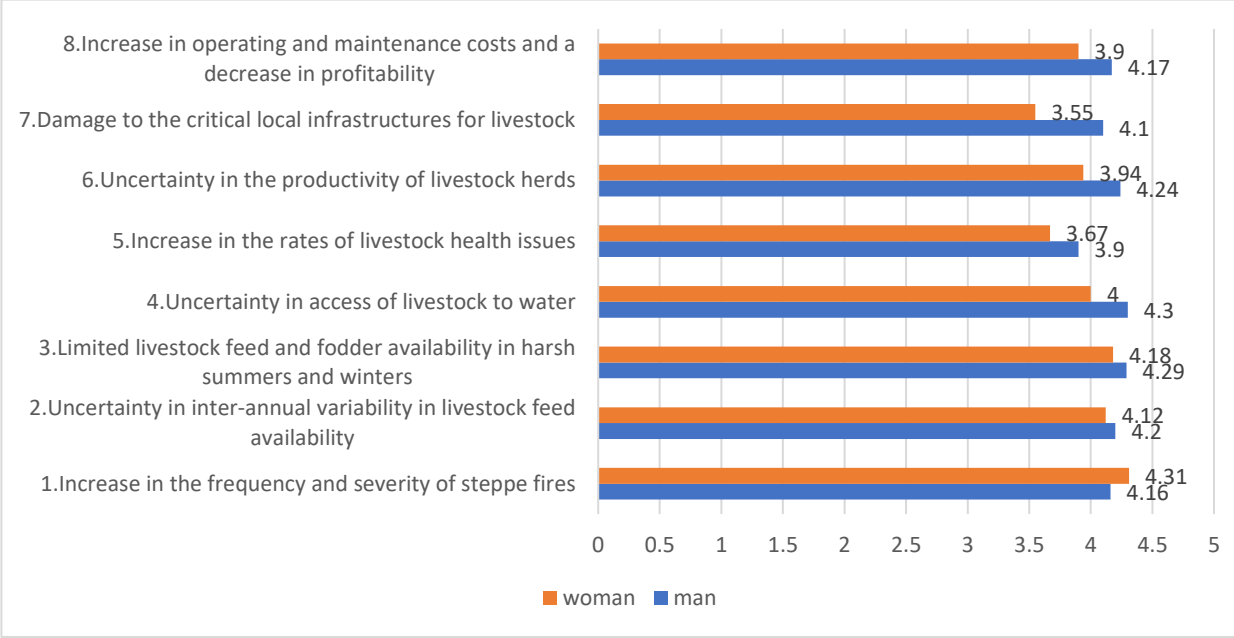
Table 19: Perception on the environmental issues resulted from recent climate changes in their location

Question	Not at all from CC		Somewhat from CC		NA/don't know	
	Man	Woman	Man	Woman	Man	Woman
1. Shift in agricultural lands and increase in land cultivation	13.0%	11.8%	47.9%	45.1%	39.1%	41.2%
2. Livestock number increases	28.6%	29.4%	61.2%	56.9%	10.2%	13.7%
3. Increasing pressure of trampling and grazing intensity	20.4%	21.6%	73.5%	70.6%	6.1%	7.8%
4. Increasing out of season grazing events and migrations/ seasonal movements of livestock	6.3%	12.0%	89.6%	80.0%	4.2%	8.0%

Question	Not at all from CC		Somewhat from CC		NA/don't know	
	Man	Woman	Man	Woman	Man	Woman
5. Shift in steppe vegetation (native, palatable plants to invasive, weedy unpalatable plants)	14.6%	3.9%	77.1%	88.2%	8.3%	7.8%
6. Increasing frequency and severity of steppe fires	16.3%	27.5%	75.5%	66.7%	8.2%	5.9%
7. Expanded size of bare ground and barren patches	8.0%	5.9%	86.0%	84.3%	6.0%	9.8%
8. Increasing runoff and water-related soil erosion events	18.0%	10.0%	66.0%	78.0%	16.0%	12.0%
9. More frequent dust storms and wind-related soil erosion	4.1%	5.9%	87.8%	84.3%	8.2%	9.8%
10. Reductions in crop and forage yield and quality	2.1%	3.9%	70.9%	76.5%	27.1%	19.6%
11. Dropping water level of lakes, wetlands, rivers, wells, springs and other water resources	10.0%	5.9%	80.0%	84.3%	10.0%	9.8%

Male and female herders evaluated the sensitivity of the livestock farming operations to climate change by the Likert scale of 1 (not sensitive at all) to 5 (most sensitive). When the mean is compared by gender, the response of "higher than average sensitivity" was found in all parameters, and except for the "increase in the frequency and severity of steppe fires", men were more sensitive than women. In particular, the biggest difference shown in terms of view of men and women was on the indicator "Damage to the critical local infrastructures for livestock" (the average of women is 3.55, while that of men is 4.1, the difference is 0.55). In general, perceptions of climate change are similar among male and female herders, but male herders have a slightly negative (realistic) perception of climate change-related phenomena and effects than women. This could be related to their higher volume of participation in livestock farming production operations. And this trend is not significant, but there is a potential to increase in parallel with the aging which is related to their life experience. Among the male and female herders with 300-800 animals, it is observed that they were more sensitive and concerned about climate change and its effects, but it was not detected at the level of statistical significance.

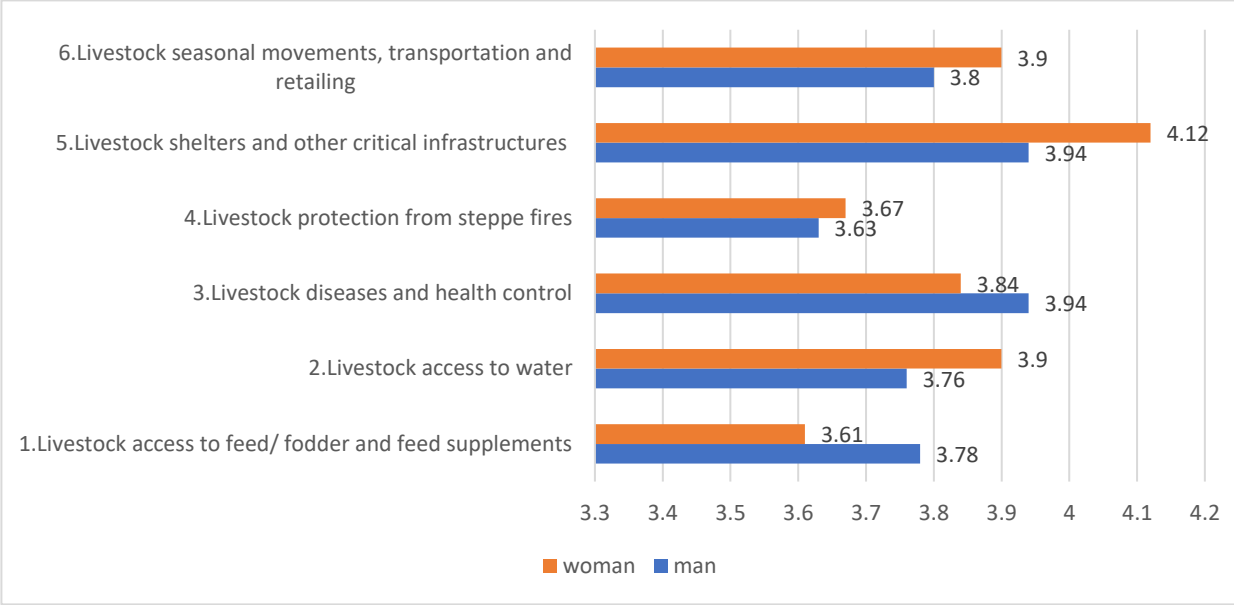
Figure 9: How sensitive do you think your livestock farming operations are to the following climate change effects



Herders participating in the survey evaluated their ability to undertake adaptation actions and capacity to address the risks of climate change associated with the following aspects listed in the table. A very small difference of 0.1-0.18 was found when comparing the answers of men and women. Male and female herders rated their abilities above average. From the aspect, 'livestock protection from steppe fires' and 'livestock access to feed/ fodder and feed supplements' were rated at the lowest level. The female herders rated their ability to provide enough grass and fodder for their livestock at the lowest level. When comparing the rating of this ability with the number of livestock, it is highly rated the ability to obtain enough feed/fodder as the number of livestock increases.

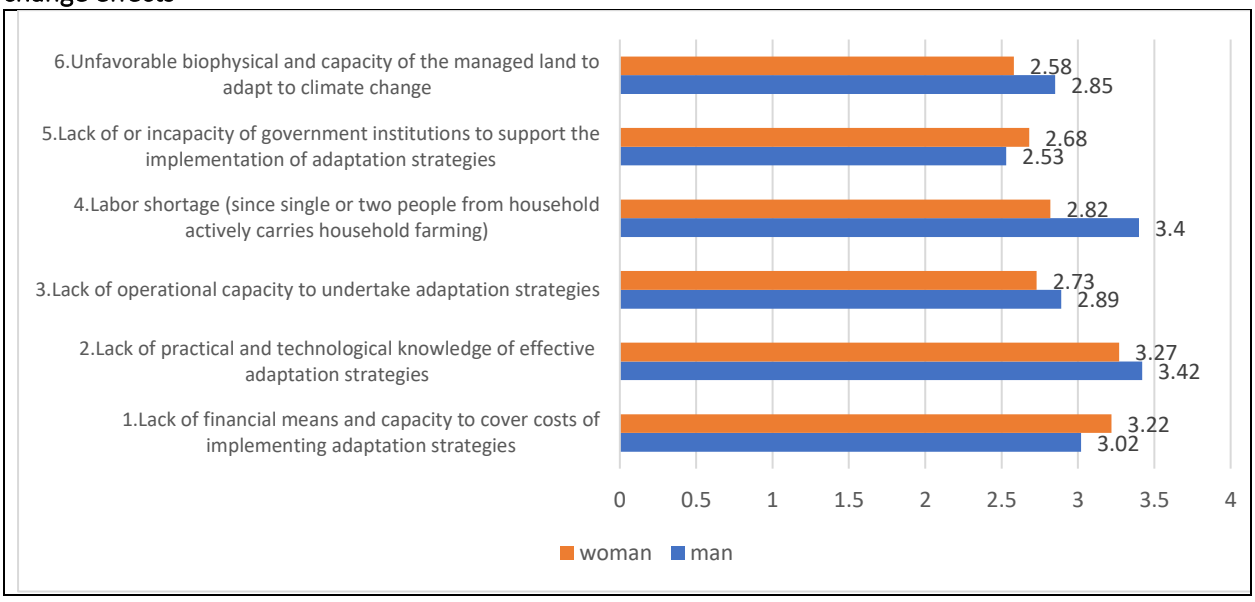
This survey shows that climate change may expose greater risks to women those who financially disadvantaged. To note again that, women and young herders with fewer number of livestock are more vulnerable in terms of their ability to prepare enough fodder for their livestock.

Figure 10: How do you rate your ability and existing capacity to undertake/ continue adaptation actions to address the risks of climate change associated with the following aspects of your livestock farming operation during harsh and extreme seasons



The herders rated major barriers limiting their adaptive capacity to climate change effects. It is observed that lack of financial means for women, lack of practical and technological knowledge as well as labor shortage for men, lack of or incapacity of government institutions for women tend to limit their ability to adapt to the climate change. Differences in socio-economic backgrounds between men and women will create different challenges for men and women in their ability to cope with the impacts of climate change. The findings of this survey show that men and women see problems differently.

Figure 11: Major barriers limiting the adaptive capacity of your livestock farming operation to climate change effects



The study clarified the following impacts of climate change: who is more at risk; whose workload is increasing; and whose income is being reduced. Survey participants answered that both men and women are negatively affected by the climate change but tried to clarify and prioritize effects and risk. According to the answers, more than 62% of the respondents believe that men are more at risk and more affected than women by 6 types of natural phenomena caused by climate change (Table 20). This is related to the high participation of men in the agricultural production activities and the fact that women live in soum centers during school. But women tend to answer that they are more at risk than men based on the gender division of labour. It can be concluded that climate change has gender impacts by increasing the workload of male herders, while reducing women's or household income (even for household consumption) or increasing costs. As mentioned in the gender analysis on the livelihoods of young herders, the impact of climate change and the increase of the frequency and distance of migration (otor) in areas with high pasture degradation has led to men living away from their families for a long time (NCGE, ADB, 2021). Family members living apart for long periods of time can have negative effects on their health and family life.

Table 20: Who is more at risk from the following phenomes of climate changes?

Question	Man (%)	Woman (%)	Boy (%)	Girl (%)	NA/ Don't know (%)	Justification that women affected negatively than men
1.Reduced amounts of rainfall during the growing season	70.7	23.2	2		4	• Difficult to dry dung fuel • Difficult to milk a cow • Difficult to dry curds and dairy products etc.,
2.Increased number of droughts, flood and hailstorm events	61.9	32	2.1		4.1	Low rate of milk
3.Increased number and duration of harsh summers	77	15	3		5	Low rate of milk
4.Increased number and duration of harsh winters	82	11	2	1	4	
5.Reduced amount of snowfall and snow cover on the ground	85	9	2		4	
6.Altered onset and length of growing seasons	73.7	18.2	2	1	5	Low rate of milk

4.4 Next Steps

A participatory gender-responsive and socially inclusive CCV assessment of local livestock herding systems was conducted in the Bayantumen soum. Overall, herders identified climate change as one of the main challenges they have faced in recent years and expect to face more in future in raising livestock and being a herder. However, they believed in being able to adapt their herding practices to climate change risks if major barriers currently limiting their adaptive capacity are appropriately removed. Thus, as climate change progresses, herder communities and local organizations must work together to make decisions encouraging adaptation and promoting resiliency to their new climate and environmental conditions.

Local herders must play a fundamental role in finding appropriate adaptation pathways to cope with the joint effects of increasing grazing pressure and climate changes. Herders deeply understand their surrounding landscapes and the environmental good and services essential to their herding livelihood systems. Effective adaptation of grazing pressure management, including practical livestock movements across the landscapes, requires the ability to accurately monitor environmental changes and properly distribute robust information on the health of essential natural resources for climate-resilient herding practices. High-quality, long-term monitoring data is essential to develop and measure pasture health indicators and provide an early warning system to detect climate change impacts on pasture resources and adapt new pasture management solutions. Thus, herders and emerging community-based pasture management institutions must coordinate and contribute to an empirical and systematic monitoring of the components and functions of their grazing lands under a changing climate and resource depletion.

Financial incentives, in particular programs and high-level policies that actively limit livestock number and promote climate-resilient livestock herding productions based on the proper use of pasture resources, should be a high priority. Local governments and financial institutions must implement payment tools and mechanisms that support local herders and pasture user groups to improve pasture health and productivity and promote the delivery of undervalued regulating and supporting environmental services such as water reserve and purification; soil carbon and nutrient cycling, and storage; and habitat for native species across grazing landscapes.

As frontline decision makers, women play an important role as stewards of natural resources in traditional livestock herding practices. However, they often do not have equal access to the extension services, training, technical support or financing necessary to deploy new, climate-resilient practices. Given women's and men's important but different roles in herding, the new pasture monitoring and restoration programs must set potential adaptive solutions to climate change through a gender lens. Such programs and policies must bring socio-economical and environmental welfare to women and vulnerable groups and leverage women's roles and leadership to mitigate and adapt to risks from climate changes and protect environmental resources and services.

This assessment summarizes existing and possible future impacts and risks from climate change on local herding communities and their livestock herding operations. While acknowledging herders' long history of adapting to environmental change, this assessment sets the stage for communicating the expected impacts and considering strategies and pasture management technologies that help herders maintain climate-resilience pastoral livelihood systems.

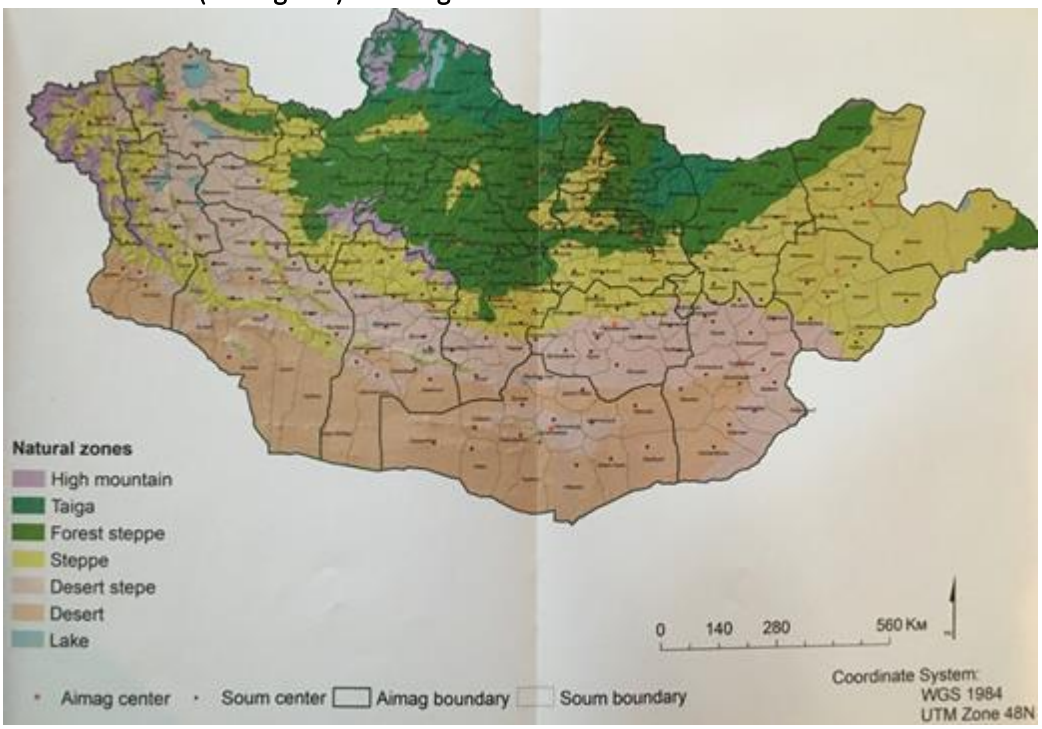
5 Deliverable 3.1 Pasture Assessment

5.1 Mongolian Rangeland Resources and Management Initiatives

5.1.1 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 12).

Figure 12: Natural zones (ecoregions) of Mongolia

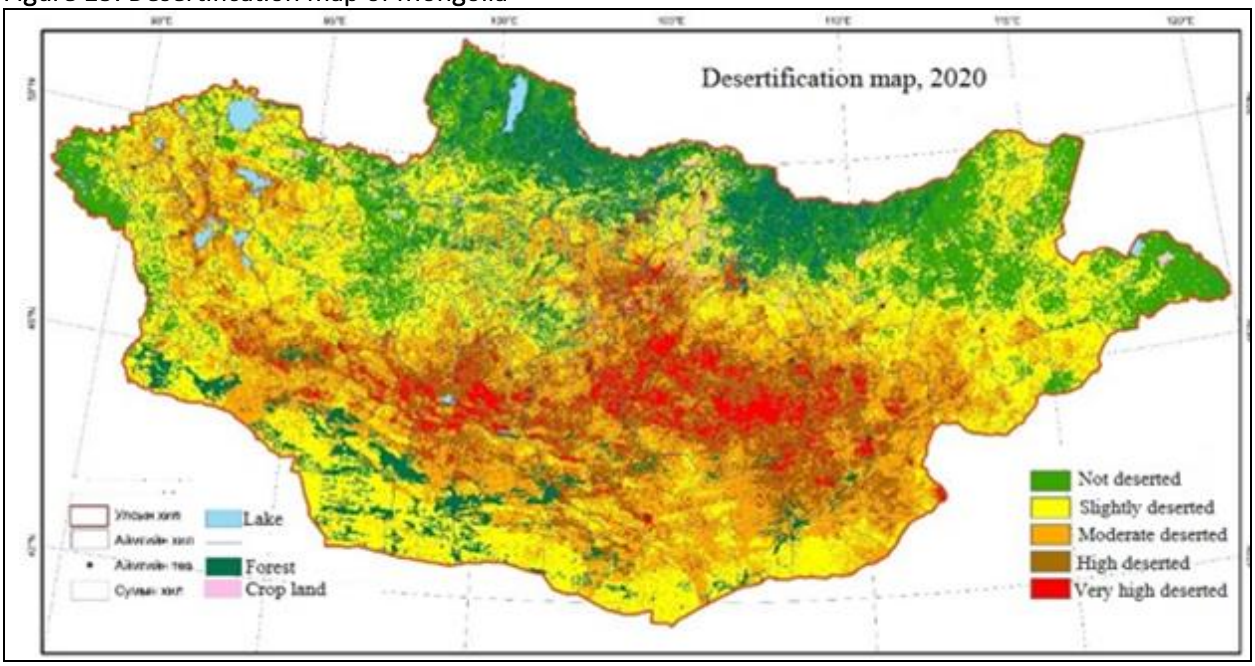


Mongolia has a long history of livestock grazing; large mound graves and “deer stones”, constructed 3,000 years ago by early nomads and found across Mongolia, are evidence of complex social organizations that once existed on the rangelands. Traditional nomadic pastoralism was transformed during the socialist 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 13).

Figure 13: 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 13 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.)

5.1.2 Rangeland Management Initiatives

(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 degradation1. Ecological site descriptions (ESDs) are used for assessment and monitoring and for making management decisions. Following the ESD concept, Mongolian

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

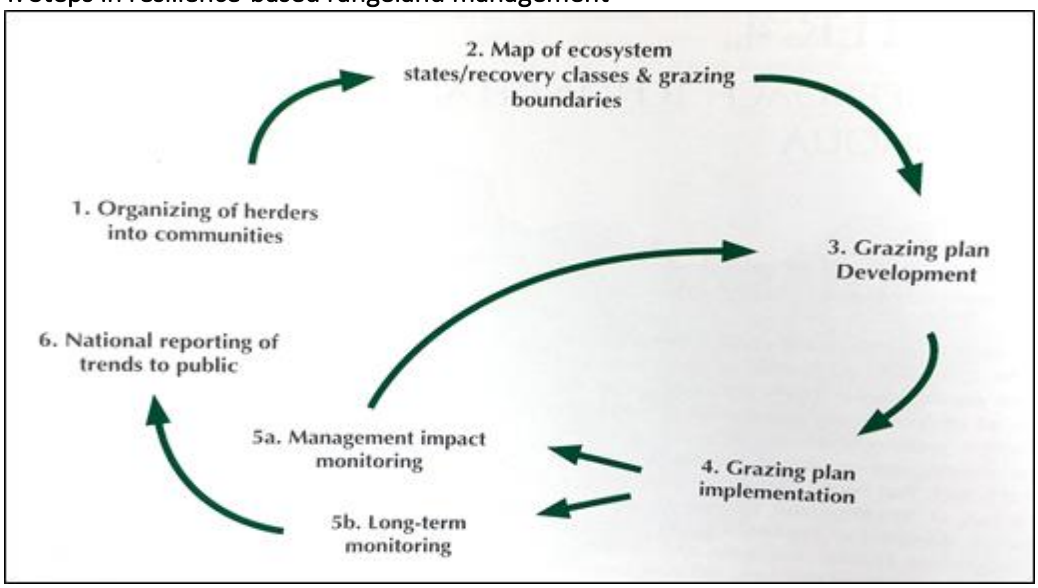
rangelands are classified into 22 ecological site groups (ESG) and each of them have a "state-and-transition model" that describes how rangeland ecosystems have changed and can recover with improved management. The ESD concepts and state and transition models are approved by the Mongolian Academy of 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) 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 14 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 14: Steps in resilience-based rangeland management



5.2 Rangeland and Livestock Production Assessment, Bayantumen Soum

5.2.1 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 below2. 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: 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 in high water table.

Table 21 provides information on the seven ESGs found in Bayantumen, 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 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 Rangeland in Sandy Loam ESG are similar in forage yield and carrying capacity and are 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.

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

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 21: 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)

5.2.2 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.

5.2.3 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 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.

5.2.4 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 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.

5.2.5 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 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 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 emphasize quality 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.

5.2.6 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.

5.2.7 Impact on Climate-Resilient Livestock Production

Several traditional pastureland management and livestock production practices in Bayantumen are climate-resilient or promote sustainable, climate-resilient livestock farming. For example, herders traditionally and 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.

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.

5.3 Innovative Options for Livestock Production in Bayantumen Soum

5.3.1 Climate-smart Pasture Management Options

There are several technologies (or actions) that could be introduced to livestock farming systems in Bayantumen to improve pasture and livestock productivity and enhance climate resilience. Table 22 lists 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 22: 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 carrying capacity), 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 no incentives for herders to reduce livestock numbers to the proper carrying capacity. A "tragedy of the commons" situation is emerging on Mongolian rangelands, especially in 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 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 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 fed and managed in the winter, and lead to increased income from sale of young animals. Table 23 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 versus to 8.9 million MNT in the current herd structure).

Feedlots for finishing beef cattle are being planned for both Dornod and nearby Khentii province, which would provide the markets for weaned calves. Awareness building and training 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 increasingly demand 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 23: 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 (especially in Selenge and Bulgan province and to some extent in Dornod).

Many of the actions identified in Table 22 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 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 22. (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 and #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.

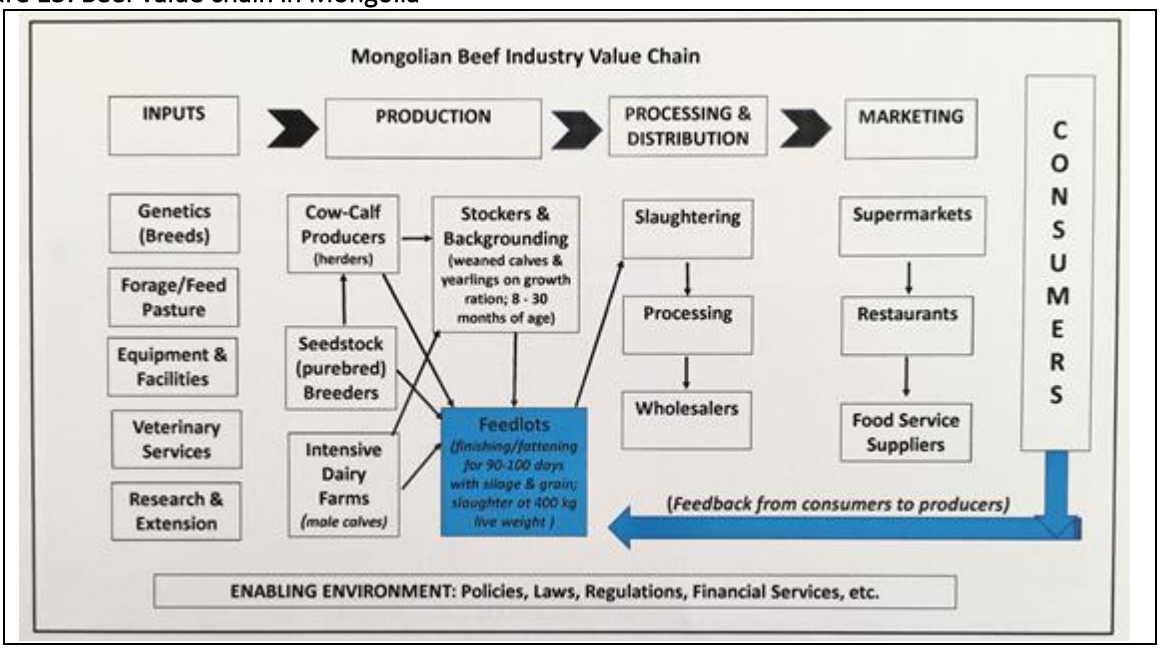
5.4 Value Chain Approach to Developing to Meat Sector

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. 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 15). 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.

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.

Figure 15: Beef value chain in Mongolia



5.5 Conclusion

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 several 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.

6 Deliverable 3.2 Improved Pasture Management and Climate Impacts

A perfect "climate change storm" is confronting Mongolia's vast rangelands and the livestock industry dependent on the rangelands. From 1940 to 2015, annual mean temperatures have increased by 2.24 C, more than double the global average, while annual precipitation decreased by 7 percent. Ten of the warmest years on record have occurred since 1997, while rainfall has decreased, and seasonal weather patterns have shifted. This has exacerbated rangeland degradation, a trend that projections show will intensify in the first half of the 21st century. Twelve percent of rivers and 21 percent of lakes have dried up. Increasing numbers of livestock put additional stress on the land.

Mongolia's livestock sector has seen significant growth in recent decades, but this has mainly been driven by the large increase in livestock numbers. There has been limited improvement in the quality of livestock or livestock products, especially meat. The growth in livestock numbers has been driven by the desire to increase herder household income and was encouraged by subsidies that mainly benefited large livestock and crop producers. The growth in livestock numbers has also resulted in negative environmental consequences, as it has led to increasing rangeland degradation and rising Greenhouse Gas (GHG) emissions, particularly methane. Over the past ten years, the livestock population in Mongolia has more than doubled from 33.1 million in 2010 to 71.8 million in 2019. Overstocking and overgrazing, along with climate change, have resulted in considerable rangeland degradation. Sixty-five percent of Mongolia's rangeland are degraded to some degree and 7 percent are beyond recovery.[3]

Rangeland degradation has decreased forage yields by 30 percent, from 284 kg/ha in 2011 to 198 kg/ha in 2020.[4] With reduced forage, nutritional status and productivity of livestock have declined. During 1990-2016, the carcass weight of sheep decreased by 13.9 percent, while live cattle weight decreased by 30 kg during 2004-2014. Livestock in poor nutrition and health are more vulnerable to diseases and extreme weather events. The lack of resilience to climate hazards (droughts, dzuds, etc.), lack of access to extension services and high-quality inputs (e.g., crop seed/animal breeds with better yields, and resistance to abiotic stress and droughts) remain major constraints. The livestock sector is further constrained by: poor livestock management, leading to rangeland degradation; poor animal health and hygiene; outdated slaughtering and meat processing technologies; weak food safety systems; and inefficient cross-border logistics and customs inspections. Lack of access to finance by herders and private sector further inhibits investments to modernize and adopt green technologies for livestock production. As a result, the competitiveness of livestock products, both locally and for exports has declined.

Mongolia's overall development vision, strategy and agricultural and livestock actions plans are aligned with the agricultural challenges and objectives and emphasize the importance of balanced growth and productivity, sustainability and resilience. However, current policy instruments in the agriculture and livestock sectors are not fully aligned to achieve the Government's vision and strategy. Producer subsidies

[3] https://ieg.worldbankgroup.org/blog/preserving-rangelands-people-and-climate-lessons-mongolia
[4] World Bank. 2022. Green Transformation of Mongolian Agrifood Systems.

are market distortive and result in negative externalities, worsening rather than improving climate and sustainability outcomes. Subsidies have not been effective in creating incentives to improve productivity and competitiveness and in the livestock subsector, had the counter effect of incentivizing a huge increase in the number of poor-quality animals. Lack of extension services has further limited capacity of herders to adopt improved production and range management technologies. Despite a knowledge base about the proper management of rangelands, local governments and herders lack the incentive and capacity to adopt more sustainable and climate-resilient practices.[5]

The National Agency for Meteorology and Environmental Monitoring (NAMEM) estimates the winter and spring carrying capacity of Mongolia's rangeland based on annual rainfall, rangeland productivity and the number of livestock and this year determined that annual precipitation was below the ten-year average in 40 percent of the country. Only 40 percent of the rangelands have sufficient carrying capacity for livestock in the coming winter and spring. In 34.4 percent of the country's rangeland, the number of livestock is 1-3 times higher than the carrying capacity. In 7.7 percent of the rangelands, it is 3-5 times higher than carrying capacity and in 18.4 percent of the rangelands the number of livestock exceed the carrying capacity multiple times.6 This illustrates the dire situation of not enough forage for the number of livestock facing much of the country this coming winter and spring.

The steppes of Eastern Mongolia, which includes Dornod aimag and Bayantumen soum have long been praised for excellent pastures, fast horses and vast herds of Mongolian gazelle migrating across the grasslands. This eastern region of Mongolia has also seen large increases in livestock numbers in recent years with increasing signs of overgrazing. In Bayantumen soum, total livestock numbers increased from 158,980 in 2017 to 249,590 in 2021; a 56.9 percent increase in four years. The number of herder households increased from 470 in 2015 to 757 in 2020; a 61 percent increase in five years. Most of this increase was herders coming into Bayantumen from Central and Western Mongolia. This year, Bayantumen has experienced average and above average rainfall and good grass growth in the rangelands. Because of the lack of rainfall in much of the Central and Western regions there will probably be even more increases in livestock numbers coming into Bayantumen this fall and winter to graze.

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, several challenges impeding this goal. Increasing livestock numbers raised are now placing increasing grazing pressure on the rangeland, 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, placing additional stress on rangeland 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. The number of horses has grown by 53 percent in the four years from 2017 to 2021. In Bayantumen soum, horses only make up 15.3 percent of the total livestock numbers (sheep comprise 43.13 percent, goats 29.03 percent and cattle 12.12 percent) but when converted to

[5] World Bank. 2022. Green Transformation of Mongolian Agrifood Systems.
[6] FAO. 2022. Food Security Update Mongolia. 15 September 2022.

livestock to Sheep Units (SUs), horses comprise 44.72 percent of the SUs on the land. In other words, almost half of the total SU equivalents – and related grazing pressure - on the rangeland is from horses. 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, Ecological Site Groups and the state of health of the rangelands, forage yield, recommended stocking rates, maps of seasonal pastures and rangeland monitoring. However, 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 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) biotic7. 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.8 Sustainable production of livestock and livestock products from the rangelands of Bayantumen soum 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 tackling difficult market and policy issues that hamper the growth of sustainable, climate-resilient livestock farming systems.

A number of rangeland and livestock management practices and technologies have been identified to promote more sustainable, climate-resilient livestock farming systems in Bayantumen soum. There are no easy solutions and any efforts need to take a holistic, integrated approach to tackling the issues. Reducing livestock numbers is going to be critical and to do this, restructuring of cattle herds and sheep flocks should be prioritized. Monitoring of rangelands and rangeland planning using the State and Transition Models already developed for Mongolian rangelands will be a key activity in order to start to balance livestock numbers with carrying capacities of the rangeland. Training of local officials and herders and provision of practical, extension material and advice to support herders in the transformation they need to make to more climate-resilient livestock farming systems will also be essential.

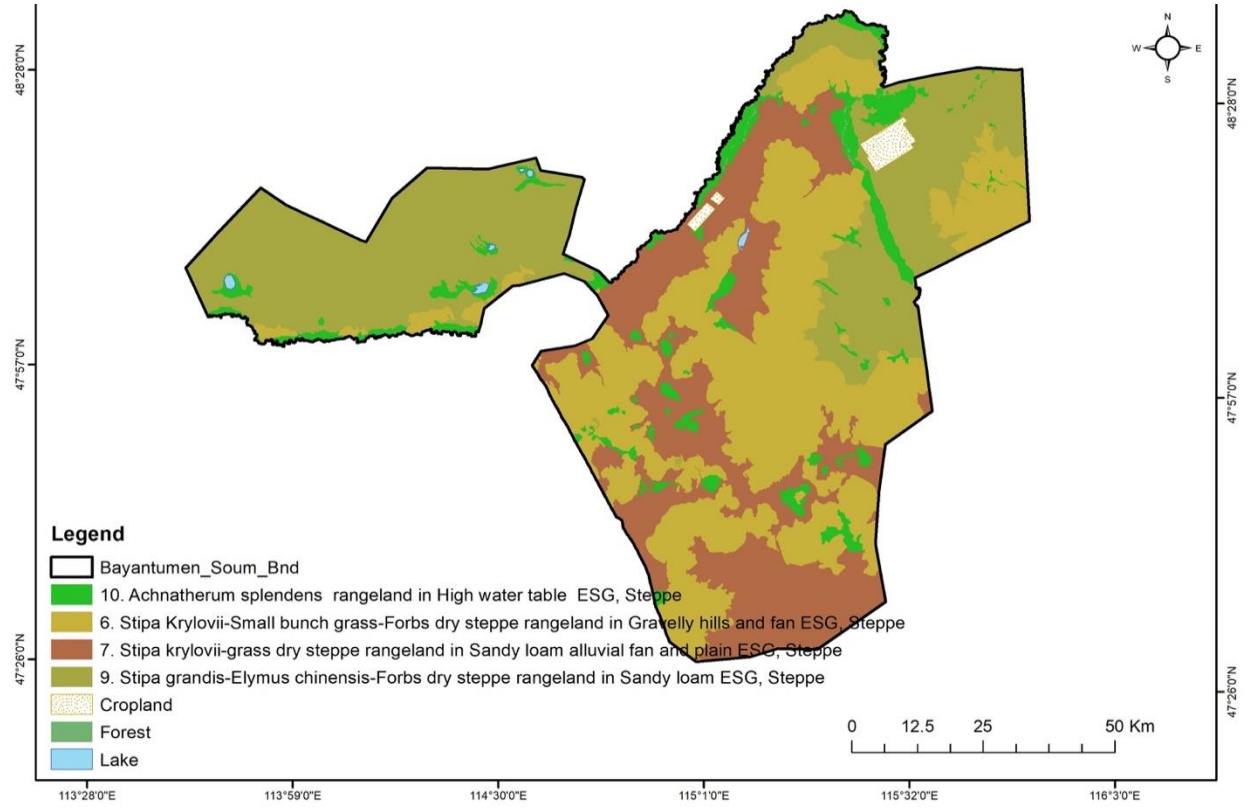
[7] Description. Biotic and abiotic factors are **what make up ecosystems**. Biotic factors are living things within an ecosystem; such as plants, animals, and bacteria, while abiotic are non-living components; such as water, soil and atmosphere.
[8] Concept adapted from: D. Johnson, et.al. 2022. Ratcheting up resilience in the northern Great Basin, Rangelands 44(3): 200-209.

6.1 Rangelands in Bayantumen *Soum*

6.1.1 Ecological Site Groups

The rangelands of Bayantumen are located within one of the largest remaining rangeland ecosystems in the world – the Eastern Steppes of Mongolia. In Bayantumen soum, the rangelands consist of four primary Ecological Site Groups (ESGs) all in the Steppe Zone: 1) Stipa krylovii-grass dry steppe rangeland in Sandy loam alluvial fan and plain ESG, 2) Stipa grandis – Elymus chinensis – forbs dry steppe rangeland sandy loam alluvial plain and fan, 3) Achnatherum splendens rangeland in high water table ESG; and 4) Stipa Krylovii-small bunch grass-forbs dry steppe rangeland in Gravelly hills and fan ESG.

Figure 16: Map of Ecological Site Groups of Rangelands in Bayantumen Soum



Source: NFPUG

Table 24: Area of Ecological Site Groups and other land uses in Bayantumen soum

Ecological Site	Area (ha)	Area (%)
6. Stipa Krylovii-Small bunch grass-Forbs dry steppe rangeland in Gravelly hills and fan ESG. Steppe	301.950	36.1
9. Stipa grandis-Elymus chinensis-Forbs dry steppe rangeland in Sandy loam ESG. Steppe	275.727	33.0
7. Stipa krylovii-grass dry steppe rangeland in Sandy loam alluvial fan and plain ESG. Steppe	192.157	23.0

Ecological Site	Area (ha)	Area (%)
10. Achnatherum splendens rangeland in High water table ESG. Steppe	55.779	6.7
Cropland	7.397	0.9
Lake	1.561	0.2
Forest	1.109	0.1
Total	**835.680**	**100.0**

Source: derived from NFPUG data

Ecoregions are subdivided into classes known as ecological site groups, and separate models of ecosystem dynamics are developed for each class. Models are used to characterize ecosystem dynamics occurring at the site (land unit) scale, with an emphasis on natural and semi-natural ecosystems.

Mongolian rangelands are divided into around 22 ecological site groups, based on their productivity and capacity to endure different intensities of use, and to recover and regrow after being used. In general, Mongolian rangelands have considerably high capacity to recover and regrow. Rangeland ecological capacity data is not only an essential tool used in rangeland management, but also can be an instrument for the establishment of appropriate natural resource use, protection and restoration. The rangeland ecological capacity, including rangeland state, transition patterns can be used as a basic document for regulating relationships between rangeland users and lessee parties.[9]

The concept of classifying any area into ecological sites, according to that area's productivity, based on varying soil, climatic and hydrological conditions, and its capacity to endure different intensities of use and to recover from degradation, and of using this classification as a basis of rational use of natural resources is more and more recognized internationally. Since 2009, the Green Gold Project funded by the Swiss Agency for Development and Cooperation (SDC) has been exploring opportunities to develop the Ecological Site Description (ESD) concept for Mongolian rangelands and use it as an essential tool of rangeland management. Based on soil, vegetation and geomorphological data collected from approximately 500 points representing nationwide environmental zones, the the ESD concept was developed for the Mongolian context. According to this concept, Mongolian rangelands are divided into some 22 zones, representing distinct ecological potentials. Based on these plot data and state and transition models a preliminary conclusion is made that over 65 percent of Mongolian rangeland has, with varying degrees, altered from its reference state, and 80 percent of this area has potential to recover through changes in rangeland management. The main objective of this Green Gold research was to identify, for each environmental zone, the main factors that determine rangeland ecological potential, to develop the ESD concept and to test the possibility of using it in rangeland management. The novelty of this study, as well as its scientific and practical significance, lie in development and testing of a more detailed classification based on ecological potential within Mongolian ecological zones and geo botanical regions. This approach is significant because the classification may be used as an essential tool for rangeland use planning, implementation and monitoring, as well as for regulating rangeland use agreements.

[9] https://warnercnr.colostate.edu/wp-content/uploads/sites/2/2017/09/2015BuildingResilience_of_MongolianRangelands-ENG1-1Bulgamaa_etal.pdf

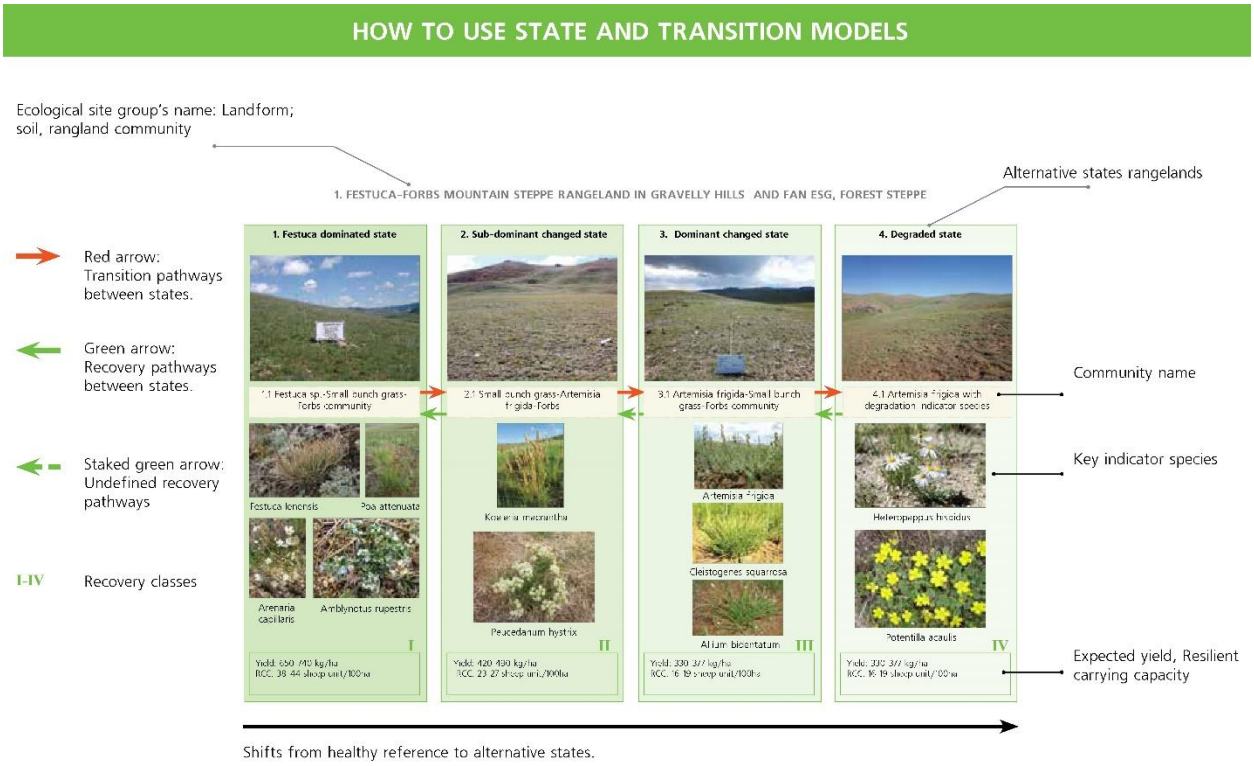
6.1.2 State and Transition Models to Understand Rangeland Ecosystem Changes and Health of the Rangelands

State and Transition Models (STMs) were developed as a means to organize and communicate information regarding rangeland ecosystem change as a basis for management of rangelands. The value of STMs for rangeland management is in fostering a general understanding of how rangelands function and respond to management actions, thereby leading to more efficient and effective allocation of resources and management efforts. STMs allows land managers to link information about rangeland plant community composition collecting during inventories and monitoring with concepts of ecosystem dynamics to develop management plans aimed at long-term stewardship of the rangelands. STMs can help determine management objectives for rangelands and can serve as a guide to maintain and restore rangeland ecosystem services.[10]

STMs for Mongolian rangelands have been developed that describe the reference (healthy) and alternative states (of degradation from reference or healthy state) for specific types of soils within ecoregions of Mongolia. The "states" represent large changes in rangeland conditions that can be difficult to reverse and "community phases" represent more easily reversed changes in vegetation within states. There are transitions between states and community phases interpreted as degradation and restoration that relate to specific management actions that can be used to prevent or reverse degradation over time. The STMs developed for Mongolia consider key plant indicator species and potential productivity, as well as recommended carrying capacity for livestock (expressed as number of SUs/100 ha). The STMs developed for Mongolia can be used for analysis and interpretation of rangeland health, and for monitoring and assessment. They also provide a scientific basis for planning and implementing resilience-based rangeland management and rangeland use agreements.

[10] *Adapted from Bestelmeyer, et al., 2017. State and Transition Models: Theory, Applications, and Challenges. https://link.springer.com/chapter/10.1007/978-3-319-46709-2_9*

Figure 17: How to Use State and Transition Models (taken from State and Transition Models of Mongolian Rangelands 2018)



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

6.1.3 Carrying Capacity of Rangelands in Bayantumen *Soum*

Carrying capacity and stocking rate are often used interchangeably and incorrectly by herders and range and livestock managers. They are actually two very different measures of how things are at a point in time. Stocking rate is how things are, good, bad or ugly. Carrying capacity is how it should be ideally. Stocking rate is a measure of the livestock grazing (per area, per time period, per unit rainfall), while carrying capacity is the ability of the soil and pasture to provide for grazing by livestock and wild grazing animals.

The number of grazing animals a piece of land can support long term while maintaining or improving the rangeland resources (vegetation, soils, and water) is called carrying capacity. The characteristics of the land, soil, and vegetation and prior grazing use determine the carrying capacity, not the land manager. In Mongolia, carrying capacity is expressed as number of SUs (SUs) per 100 hectares.[11]

Carrying capacities have been determined for each state (health condition) of an ESG (Table 25), the Stipa krylovii-Grass dry steppe rangeland in sandy loam alluvial fan and plain ESG, carrying capacities range from 30-34 SUs/100 ha for rangeland in reference (good) condition to 18-21 SUs/100 for degraded range. In the

[11] *In the USA and Canada, Animal Unit Months (AUMs) are frequently used to determine sustainable stocking rates for grazing pasture and rangeland in the west. An AUM is the amount of air-dry forage a 1,000-pound cow and her un-weaned calf will consume (the 'Animal Unit') in one month.*

Stipa krylovii-Grass with Caragana steppe rangeland in deep sandy alluvial plain ESG, carrying capacity ranges from 59-71 SUs/100 ha in good condition to only 7-9 SUs/100 ha in poor condition. For the Achnatherum splendens rangeland in high water table ESG, carrying capacity ranges from 22-24 SUs/100 ha in good condition to 4-7 SUs/100 ha in poor condition. For the Stipa krylovii-small bunch grass forbs dry steppe rangeland in gravelly hills and fan ESG, carrying capacity ranges from 57-62 SUs/100 ha in good condition to 18-34 SUs/ha in poor condition.

Table 25: Forage yield and recommended carrying capacities (SUs/100 ha) for different states (health) for the four key ecological site groups (ESGs) found in Bayantumen Soum

Steppe Zone			
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 SU/100 ha	30-34 SU/100 ha	18-21 SU/100 ha	18-21 SU/100 ha
Stipa grandis – Elymus chinensis – forbs dry steppe rangeland in sandy loam alluvial plan and fan 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 SU/100 ha	41-44 SU/100 ha	34-36 SU/100 ha	17-18 SUs/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 SU/100 ha	8-16 SU/100 ha		4 -7 SU/100 ha
Stipa krylovii-small bunch grass forbs dry steppe rangeland in gravelly hills and fan ESG			
Reference state	Grass-thinned state		Degraded state
970-1030 kg/ha	900-940 kg/ha		362-679 kg/ha
57-62 SU/100 ha	45-52 SU/100 ha		18-34 SU/100 ha

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

6.2 Livestock in Bayantumen *Soum*

In 2021, there were a total of 249,590 head of livestock in Bayantumen soum (Table 26). Forty-three percent of the total number of livestock were sheep; 29 percent goats, 15 percent horses, 12 percent cattle and only 0.35 percent camels. Since 2017, the total number of livestock had increased by 56.9 percent. To really understand the effect of herders' livestock grazing on the rangeland, you cannot just consider total livestock numbers, but need to convert the different livestock species to a standard unit. Mongolia uses a SU where one camel equals 5 SUs, one horse equals 7 SUs, one cow equals 6 SUs, one sheep equals 1 SU and one goat equals 0.9 SU. When you convert all the five different livestock types to SUs, horses made up over 44 percent of the SUs; cattle were almost 29 percent; sheep were 17 percent and goats were only 10 percent. This means that even though horses were only 15 percent of the total animal numbers there make up almost 45 percent of the SUs on the rangeland (e.g., consuming 45 percent of the forage). Table 27 provides information on numbers of livestock and SUs for years 2018-2020 and the total number change and total SU change by year.

Table 26: Livestock Population in Bayantumen Soum 2017 – 2021

	2017	2018	2019	2020	2021	% of total herd in 2020	SUs 2020	SUs 2021	% in SUs 2020	% Increase SUs 2017 to 2021
horse	25,060	27,840	29,690	34,670	38,400	15.32	242,690	268,800	44.72	
cattle	17,560	21,900	23,640	27,430	30,920	12.12	164,580	185,524	28.97	
camel	680	770	750	800	930	0.35	4,000	4.650	0.70	
sheep	70,070	84,030	90,160	97,660	109,820	43.13	97,660	109,820	17.19	
goat	45,610	56,710	61,400	65,700	69,520	29.03	59,130	62,568	10.41	
total	158,980	191,250	205,640	226,260	249,590		568,060	631,388		59.72

Source: derived from NSO data

Table 27: Livestock Numbers and SU Equivalents for in Bayantumen soum for 2018-2020

Livestock Type	Total Number (10^3)			# SUs	Total SUs			Total Number Change (%)			Total SUs Change (%)			Average Annual Change (%)
	2018	2019	2020		2018	2019	2020	2018-2019	2019-2020	2018-2020	2018-2019	2019-2020	2018-2020	
Horse	27.8	29.7	34.7	7	194.9	207.8	242.7	6.6	16.8	24.5	12.5	31.5	24.5	12.3
Cattle	21.9	23.6	27.4	6	131.4	141.8	164.6	7.9	16.0	25.3	14.9	30.1	25.3	12.6
Camel	0.8	0.8	0.80	5	3.8	3.8	4.0	-2.6	6.7	3.9	-4.9	12.5	3.9	1.9
Sheep	84.0	90.2	97.7	1	84.0	90.2	97.7	7.3	8.3	16.2	13.7	15.6	16.2	8.1
Goat	56.7	61.4	65.7	0.9	51.0	55.3	59.1	8.3	7.0	15.9	15.5	13.2	15.9	7.9
Total	**191.3**	**205.6**	**226.3**		**465.2**	**498.8**	**568.1**	-	-	-	-	-	-	-

Source: derived from NSO data

In 2020, there were 757 herder households in Bayantumen soum. This has been an increase of 61 percent in the five-year period 2015 to 2020 (Table 28). The large increase from 2019 to 2020 was reportedly because of many households moving in from other areas.

Table 28: Number of Herder Households and Herders in Bayantumen Soum

	2015	2016	2017	2018	2019	2020
# Herder households	470	512	572	622	644	757
# Herdsmen	525	562	682	548	580	835

Source: NSO

Information on average number of livestock by type per herder shows that the number of all types of animals per herder household has decreased (Table 29). Total number of animals per herder household in 2020 was 298; in 2015 it was 338 head.

Table 29: Data on livestock by type per herder household in Bayantumen

	2017	2018	2019	2020
Horse/herder household	53.3	44.8	46.1	45.8
cattle /herder household	37.3	35.2	36.7	36.2
Camel/herder household	1.4	1.2	1.1	1.0
Sheep/herder household	149.1	135.1	140.0	129.0
Goat/herder household	97.0	91.2	95.3	86.8

Derived from NSO Data

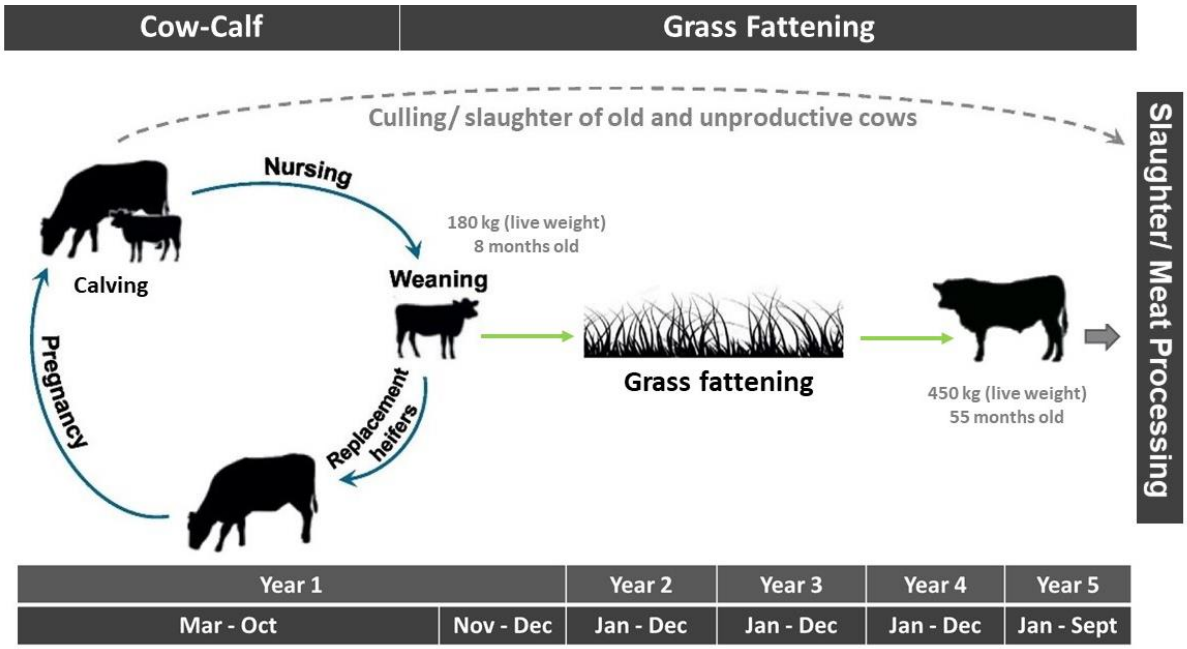
6.3 Life Cycle Analysis for Cattle and Sheep

6.3.1 Current Cattle Production System

A life cycle analysis enables an easy-to-understand “picture” of the life of an animal – cow or sheep.

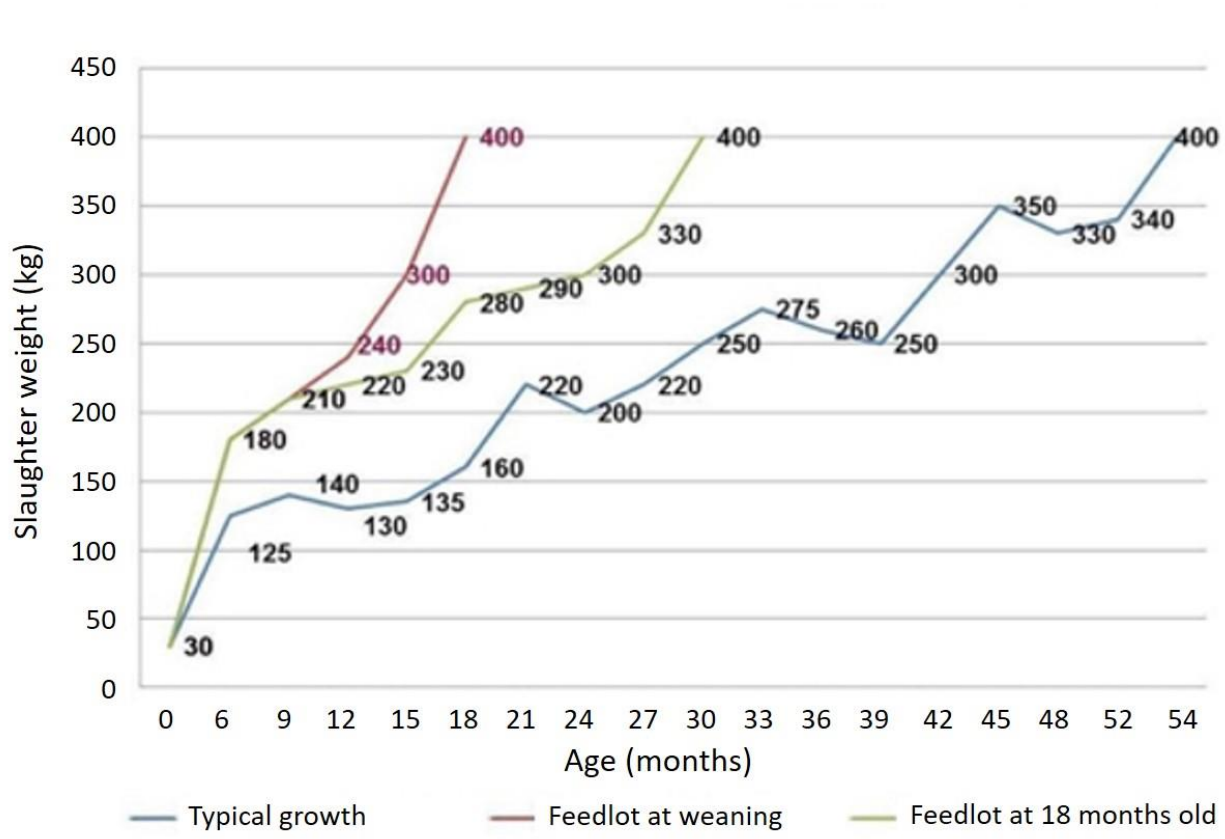
Figure 18 depicts the life cycle for the current cattle production system based on grass fattening. It shows that it takes almost five years for a steer to reach a slaughter weight of 450 kg (see also).

Figure 18: Life Cycle for Current Cattle Production



When cattle eat, the food converts to energy. Part of that energy goes to maintaining the animal's bodily functions while another part fuels any extra exertions they need, whether that is running or reacting to stressful situations. The rest goes to growth. Thus, the more you reduce the amount of energy livestock spend on exertion, the bigger the animal grows. illustrates levels of weight gain in cattle over time under three different management systems. It helps explain the why it takes 4-5 years for a steer in Mongolia to reach slaughter weight.

Figure 19: Cattle Weight Gains under Three Different Management Systems



Source: from data provided by Dan Miller and Jeremy Thiessen

(based on actual data from the Xanadu Razorback LLC feedlot in Hutag-Undur soum of Bulgan aimag.) depicts the weight of cattle over time and shows the impact of different diets. The blue line (bottom line in the graph) shows what happens when cattle follow the typical Mongolian grazing pattern. In this situation, the calf does not get all the milk from its mother, loses weight in the winter as it fights the cold, and does not get a balanced diet. Under these circumstances, it takes about 4 ½ years before a steer reaches a slaughter weight of 400 kg.

The green line (in the middle) shows what happens when the calf gets all the milk from its mother, receives a balanced diet in its first winter, goes to pasture for the following summer, and then goes into the feedlot at about 18-20 months of age. In this case, the steer reaches a slaughter weight of 400 kg at 24-28 months of age.

The red line (on the top) shows what happens when the calf gets all the milk from its mother, then goes directly to a feedlot after weaning, and eats growth rations and then finishing rations for the last 90-100 days. This approach produces the fastest growing cattle, with steer reaching a slaughter weight of about 400 kg at 18-20 months of age. Using the full feedlot approach can save more than two years in fattening cattle for slaughter compared to traditional methods. That is two years sooner that you can receive money for your cattle.

One of the benefits of putting cattle in feedlots is that you can provide them with special diets and an environment which enables them to grow faster and provide higher quality meat than if they were only grazing on pastures. You can also control the amount of extra exertion they do. The goal of a feedlot is to keep the cost per unit of live weight gain as low as possible. To do this, you need to:

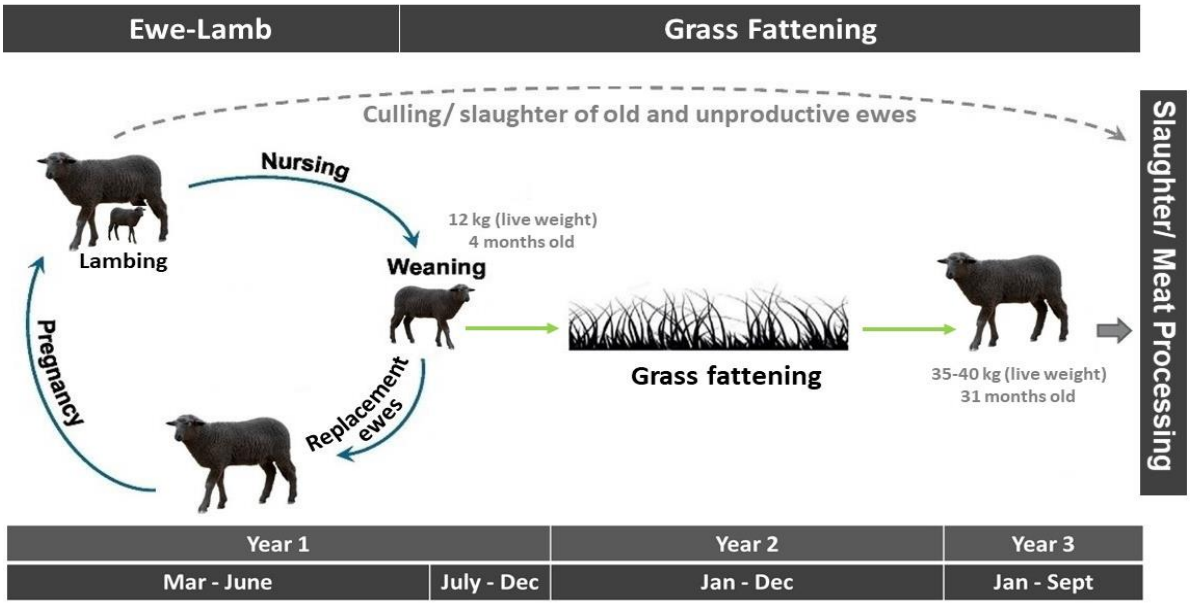
- have a thorough knowledge of the nutritional needs of the cattle
- plan for a consistent supply of all feed ingredients and availability of all nutrients
- be able to continually assess the performance of the cattle in the feedlot.

Good feeding practices are critical to the successful operation of a feedlot. Proper nutrition requires regularly providing feedlot cattle a suitable mix of palatable, digestible, high-quality feed ingredients; clean, fresh water; and adequate mineral supplementation to meet the animals' needs and the feedlot's weight gain goals. Because the animals eat prepared rations and cannot select their own food, it is important to understand the function of the rumen (one of the four stomachs in cattle) and the impact of different types of feed on rumen function and metabolism so that it functions properly.

6.3.2 Current Sheep Production System

The life cycle for sheep under the current production system is illustrated in. Sheep are fattened on grass and are usually not slaughtered until they are 30-31 months old at a live weight of 35-40 kg. Like cattle, sheep also lose weight in the winter because of inadequate nutrition.

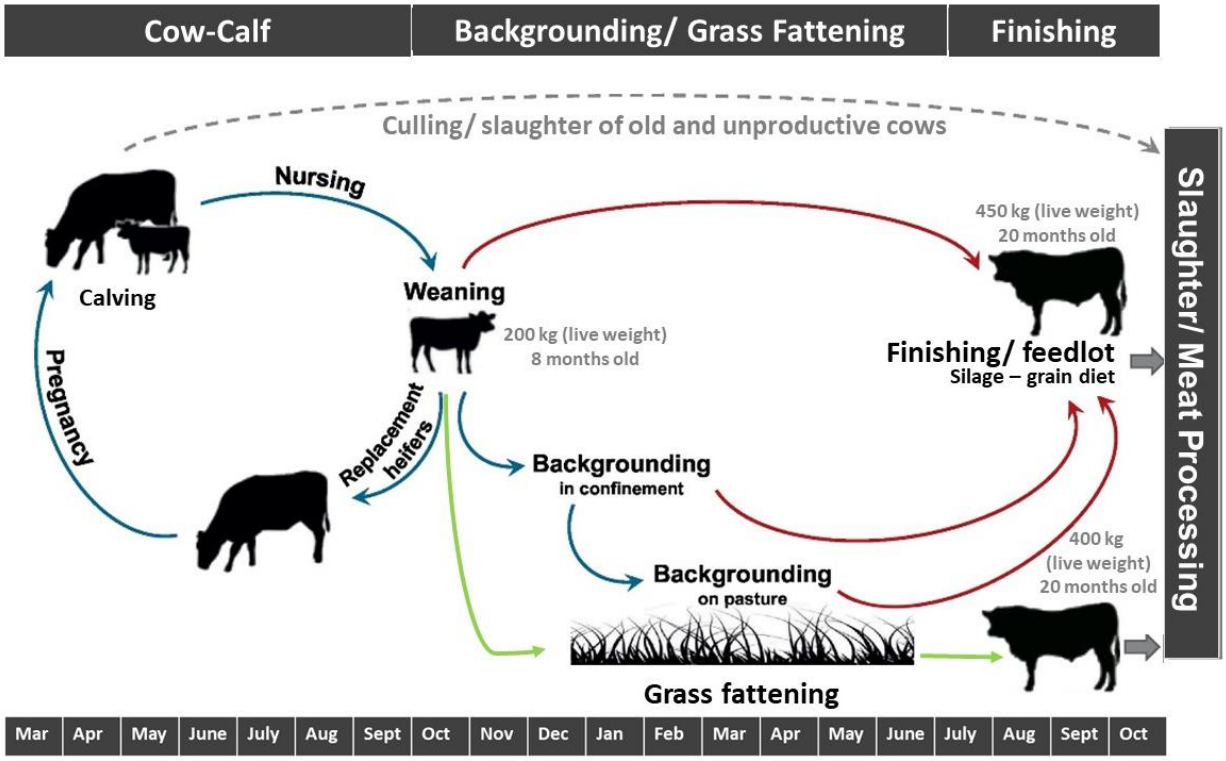
Figure 20: Life Cycle for Current Sheep Production



6.3.3 Life Cycle for Cattle and Sheep Under Improved Management

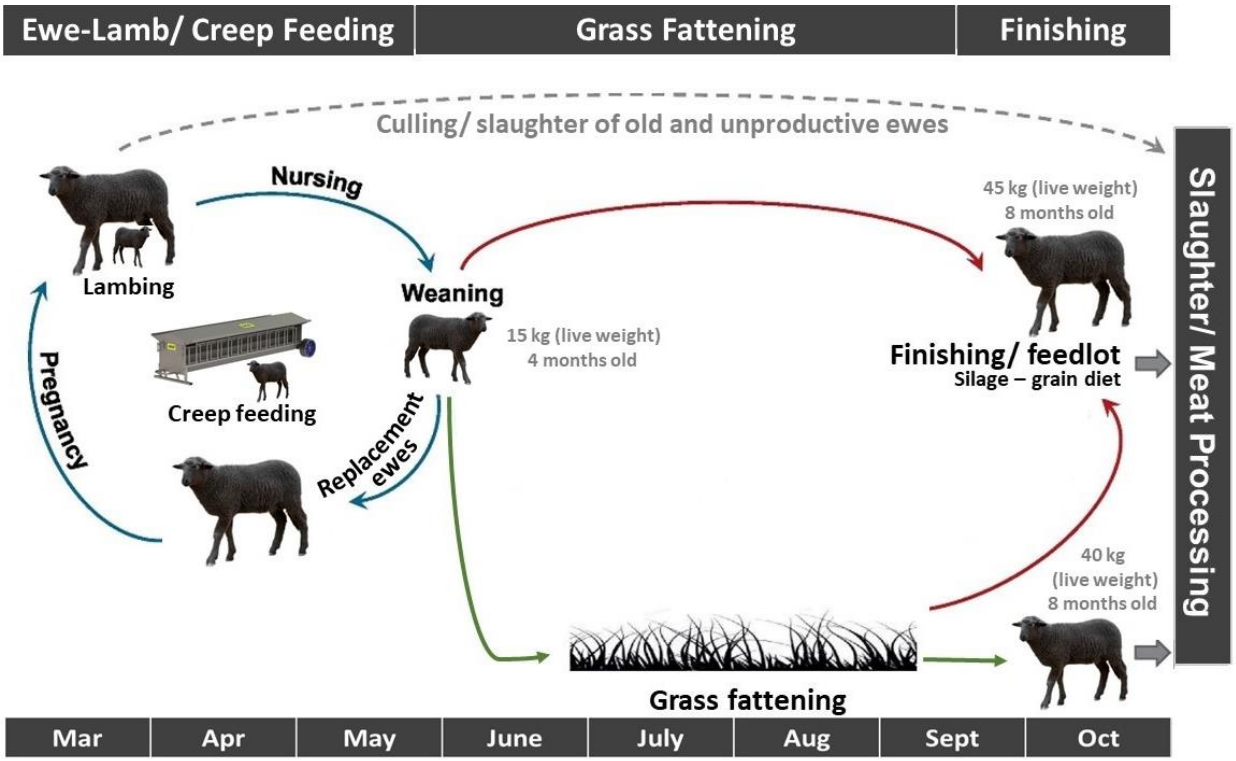
Figure 21 illustrates the life cycle for cattle with improved management by a herder that has adopted restructuring his herd and other recommended practices and technologies. By raising cattle with better genetics (through introduction of good quality Angus or Hereford breeding stock); proper animal health care, and improved nutrition, and with the calf getting all the milk from the cows, calves are weaned in the fall at 8-9 months of age. Castrated male calves (steers) are sent for backgrounding confinement or backgrounding on grazing and supplemental hay and then sent to a feedlot when reach 300 kg live weight for final finishing. In this life cycle, cattle reach slaughter weight of about 450 kg live weight at 18-20 months of age.

Figure 21: Life Cycle for Cattle Under Improved Management



shows the life cycle for sheep under improved management by adopting the recommended practices and technologies (Chapter 8). In this life cycle, improved genetics has resulting in larger lambs and with improved genetics, nutrition and management, ewes are producing more milk, creep feeding of lambs is introduced and lambs are bigger at weaning. After weaning at about four months of age, lambs are grass fattened on pasture until reaching a slaughter weight of 40-45 kg, or they are sent to a feedlot for finishing until reaching a slaughter weight of about 45 kg.

Figure 22: Life Cycle for Sheep Under Improved Management



6.4 Herd Structures

Knowing the structure of herder's livestock herds is critical to understanding their livestock production system and how to go about improving productivity and efficiency. Table 30 depicts and average herder family with 92 total head of cattle. The herder has 20 adult cows that are being milked to supply milk needs for the family. As outlined in the Life Cycle section, the calf does not get all the nutrition it needs to adequately grow, which is the reason it takes 4-5 years to reach slaughter weight. A typical herder then has cattle of numerous ages in his herd because animals are not being sold for slaughter until they are much older. The herder's main income from raising cattle comes when selling 4–5-year-old steers.

Growing markets for quality beef are creating opportunities for feedlot finishing which require younger cattle to be put on feed, ideally weaned calves in the fall or backgrounded cattle. Table 30 depicts a herd structure for a herder who has adopted the recommended technologies of improved cattle production for beef. Restructuring herds enables herders to reduce total livestock numbers on the rangeland, thus giving the opportunity to implement range management practices and allow ranges to rehabilitate.

With a restructured cattle herd, the herder can raise 40 cows, sells steers when weaned and has fewer cattle to maintain over the winter. His system is much more efficient and earns more income. Restructuring herds is a way to reduce livestock numbers on the rangelands. With a 40-cow herd, the herder has a total of 267 SUs at the end of the year compared to 333 SUs under the current system. With a restructured herd, a herder can earn 27.4 million MNT by selling weaned calves compared to only earning 13.5 million MNT under traditional management.

Table 30: Current Cattle Structure for Average Herder Household

Cattle types	Current - 20 Adult Cows							
	Total Aug	Total Dec	SUs Aug^	SUs Dec^	Total Sold	Live weight (kg)	Price (MNT/kg)	Total Value (1000 MNT)
Adult cows (42 months and older) $	20	17*!	120	102	2	450	3000	2700
Calves (born in spring)	19	18*	38	36	0	-	-	0
Yearlings (16-18 months old)	18	17*	54	51	0	-	-	0
Steers (30 months old)	8	7*	48	42	0	-	-	0
Replacement heifers (30 months old)	8	5ā	48	30	0	-	-	0
Non-pregnant replacement heifers (34 months old)	0	3!	0	21	0	-	-	0
Steers (42 months old)	8	7*	48	42	0	-	-	0
Steers (54 months old)	7	0!	42	0	7	450	3000	9450
Bull for breeding	1	1	6	6	0	-	-	0
Open cows (48 months and older)&	3	2!	18	12	1	450	3000	1350
Total	**92**	**77**	**422**	**333**	**10**	**-**	**-**	**13500**

$ Cows have first calf at 3 years old. Local cows that are being milked for the household needs and therefore calves are not getting proper

& Non pregnant cows kept in the herd.

* Cattle head death loss (approx. 5 % of total herd).

! Sold adult cull cows. steers and open cow to the market for meat.

ā Bred heifers calved adding to the adult cows.

^ One adult cow/ steer/ bull considered as 6 sheep units (SUs). 3 calves considered as one adult cow and 2 yearlings considered as one

Table 31: Cattle Herd Structure for a Herder with Improved Management ("with project")

Cattle types	With Project - 40 Adult Cows							
	Total Aug	Total Dec	SUs Aug^	SUs Dec^	Total Sold	Live weight (kg)	Price (MNT/kg)	Total Value (1000 MNT)
Adult beef cows (42 months and older) $¶	35	30*!	210	180	4	450	3000	5400
Adult milk cows (42 months and older) #	5	5	30	30	0	-	-	0
Calves (born in spring)	40	5£!	80	10	35	200	3000	21000
Replacement heifers (18 months old) £	5	5ā	15	15	0	-	-	0
Replacement heifers (30 months old) ā	5	4*	30	24	0	-	-	0

Cattle types	With Project - 40 Adult Cows							
	Total Aug	Total Dec	SUs Aug^	SUs Dec^	Total Sold	Live weight (kg)	Price (MNT/kg)	Total Value (1000 MNT)
Non-pregnant replacement heifers (34 months old)	1	0!	6	0	1	350	3000	1050
Bull for breeding	2	2	12	12	0	-	-	0
Total	**93**	**51**	**383**	**267**	**40**	-	-	**27450**

¶ Beef cows are not being milked. These are Hereford or Angus or crossbred beef cows.

Herders keep 5 good quality milk cows for household milk needs.

* Cattle head death loss (approx. 2-3 % of total herd).

£ Heifer calves kept for replacement. All other calves are sold in the fall after weaning.

$ Cows have first calf at 3 years old.

! Sold adult cull cows and weaned calves to the market for meat for meat.

ã Bred heifers calved adding to the adult cows.

^ One adult cow/ steer/ bull considered as 6 sheep units (SUs). 3 calves considered as one adult cow and 2 yearlings considered as one adult cow. The rest of the herd considered as 1 adult cow.

A similar analysis is done for traditional raising of sheep and a “with-project” scenario where the herder is selling lambs in the fall when they are 8-9 months of age.

Table 32: Current Sheep Flock Structure for a Herder with a 200-ewe flock and a 100 ewe flock

Sheep types	Current - 200 Ewe Flock							
	Total Aug	Total Dec	SUs Aug^	SUs Dec^	Total Sold	Carcass weight (kg)	Price (MNT/kg)	Total Value (1000 MNT)
Adult ewes (30 months and older)$	200	170*!	200	170	20	20	6000	2400
Lambs born in spring	220ϕ	210*	73	70	0	-	-	0
Yearling lambs (18 months old)	200	190*	100	95	0	-	-	0
Sheep (30 months old)	180	40*!ā	180	40	130	20	6000	15600
Breeding rams (24 months and older)	6	6	6	6	0	-	-	0
Total	**806**	**616**	**559**	**381**	**150**	**-**	**-**	**18000**
Sheep types	**Current - 100 Ewe Flock**							
	Total Aug	**Total Dec**	**SUs Aug^**	**SUs Dec^**	**Total Sold**	**Carcass weight (kg)**	**Price (MNT/kg)**	**Total Value (1000 MNT)**
Adult ewes (30 months and older)$	100	85*!	100	85	10	20	6000	1200
Lambs born in spring	110ϕ	105*	37	34	0	-	-	0
Yearling lambs (18 months old)	100	95*	50	48	0	-	-	0
Sheep (30 months old)	90	20*!ā	90	20	65	20	6000	7800
Breeding rams (24 months and older)	3	3	3	3	0	-	-	0
Total	**403**	**308**	**280**	**190**	**75**	**-**	**-**	**9000**

$ Ewes have first lamb at 3 years old.

ϕ Assume 10% of the ewes have twins.

* Sheep head death loss (approx. on average 10 % of total herd).

! Sold adult cull ewes and lambs 15-18 months old to the market for meat.

ā Female lambs (~20-21months old) kept for replacement

^ 3 lambs considered as one SU; 2 yearlings considered as 1 SU; the rest of herd considered as 1 SU.

Table 33: Sheep Flock Structure for a Herder with Improved Management ('with project")

Sheep types	With Project - 200 Ewe Flock							
	Total Aug	Total Dec	SUs Aug^	SUs Dec^	Total Sold	Carcass weight (kg)	Price (MNT/kg)	Total Value (1000 MNT)
Adult ewes (30 months and older) $	200	170*!	200	170	20	20	6000	2400
Lambs born in spring	220ф	210*	70	70	0	-	-	0
Yearling lambs (18-21 months old)	210	35*!ā	105	18	170	20	6000	20400
Breeding rams (24 months and older)	6	6	6	6	0	-	-	0
Total	**636**	**421**	**381**	**264**	**190**	**-**	**-**	**22800**
Sheep types	**With Project - 100 Ewe Flock**							
	Total Aug	**Total Dec**	**Sus Aug^**	**SUs Dec^**	**Total Sold**	**Carcass weight (kg)**	**Price (MNT/kg)**	**Total Value (1000 MNT)**
Adult ewes (30 months and older) $	100	85*!	100	85	10	20	6000	1200
Lambs born in spring	110ф	105*	37	35	0	-	-	0
Yearling lambs (18 months old)	100	20*!ā	50	10	75	20	6000	9000
Breeding rams (24 months and older)	3	3	3	3	0	-	-	0
Total	**313**	**213**	**190**	**133**	**85**	**-**	**-**	**10200**

$ Ewes have first lamb at 3 years old.

ф Assume 10% of the ewes have twins.

* Sheep head death loss (approx. on average 5 % of total herd).

! Sold adult cull ewes and lambs 15-18 months old to the market for meat.

ā Female lambs (~20-21months old) kept for replacement

^ 3 lambs considered as one SU; 2 yearlings considered as 1 SU; the rest of herd considered as 1 SU.

6.5 Influence of Livestock on Environmental Goods and Services

Livestock and rangelands of Bayantumen soum provide numerous ecosystem services including carbon sequestration, biodiversity, improving forage quality and other benefits that are difficult to quantify. Some of the ecosystem services that are more easily quantified are forage production and livestock production. The value of wildlife and biodiversity and "open space" are more difficult to put economic values on. Table 34**Error! Reference source not found.** summarizes some of the influences of livestock on environmental goods and services. The text in green **Error! Reference source not found.**indicates a positive influence; text in red indicates a negative influence.

Table 34: Summary of Influences of Livestock Production System on Environmental Goods and Services

Environmental goods and services (ESGs)	Influence of current livestock herding	Responsiveness to climate-resilient livestock farming		Opportunity to enhance via climate-resilient livestock farming	
		Grass-finished	Feedlot-finished	Grass-finished	Feedlot-finished
Provisioning services					
Meat production	Moderate	Moderate	High	Low	High
Non-meat products	Moderate	Moderate	High	Low	High
Water supply	Large	High	Low	Moderate	Low
Regulating services					
Water quality regulation	Large	High	Low	Moderate	Low
Air quality regulation	Moderate	Moderate	Low	Low	Low
Disease regulation	Moderate	High	High	Moderate	High
Soil quality regulation	Large	High	Low	High	Low
Climate regulation	Large	Moderate	Low	High	Moderate
Cultural services					
Cultural heritage	Slight	Low	*Not relevant*	Low	*Not relevant*
Recreation and tourism	Slight	High	*Not relevant*	Moderate	*Not relevant*
Biodiversity and habitat					
Biodiversity	Large	High	Low	High	Moderate
Habitat maintenance	Large	High	Low	High	Moderate

(Note: The green color indicates positive and red means negative influence)

Livestock farming systems in Mongolia are influenced by a variety of ecosystem properties that fall into two broad categories, 1) abiotic and 2) biotic[12]. 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

[12] 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.

healthy rangelands.[13] Sustainable production of livestock and livestock products from the rangelands of Bayantumen soum 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 tackling difficult market and policy issues that hamper the growth of sustainable, climate-resilient livestock farming systems.

6.6 Multi-Criteria Analysis

A Multi-Criteria Analysis (MCA) was used in assessing recommended pasture and livestock technologies and approaches (Table 35). The MCA used a number of frameworks that included: Political, Economic, Social, Technological, Legal, and Environmental (PESTLE) that has been widely used by UNDP/FAO in recent years. For each framework, there were numerous Criteria and Guiding Questions that were used to determine the appropriateness of each technology/intervention and approach that was being recommended in Chapter 8.

Table 35: Multi-Criteria Analysis Used in Assessing Recommended Practices and Technologies

Framework	Criteria	Guiding Questions
Political	Alignment with Mongolia's Vision 2050 Alignment with Government Action Plan for 2020=2024 for Agriculture, Livestock and Light Industry Alignment with National Livestock Policy Alignment with National Program to Support Intensive Livestock Development Alignment with Atar-4 Campaign for Sustainable Farming Alignment with National Green Development Policy	Is the adaptation intervention in alignment with Mongolia's green economy vision, in terms of aims and objectives? Is the adaptation intervention in alignment with Mongolia's intended development goals, in terms of aims and objectives? Is the adaptation intervention in alignment with the agricultural sector's own climate resilience strategy?
Economic	Cost effectiveness Suitability for resource mobilization Of economic benefit to herders and local communities	How cost-effective is the adaptation intervention, relative to other potential options to reduce the same vulnerability? How strong a candidate is the adaption intervention, in terms of attracting funding from climate adaptation finance sources?
Social	Alignment with Sustainable Development Goals (SDGs) Contribution to food security goals Gender-responsiveness and equity	To what extent is the adaptation intervention in alignment with or reflective of Mongolia's Program to Support Intensive Livestock Development?

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

Framework	Criteria	Guiding Questions
	Ability to support sustainable livelihoods and job-creation	To what extent is the adaptation intervention suitable for gender responsiveness and gender mainstreaming in implementation? To what extent is the adaptation intervention likely to generate and maintain sustainable livelihoods and to create new jobs (economic development co-benefit)?
Technological	Technological ease	How easy is the adaptation intervention to implement, in terms of technological tools and investment needed?
Legal	Suitability for existing institutional arrangements Feasibility within existing legal and regulatory framework.	To what extent is the adaptation intervention implementable effectively within existing institutional architecture, mandates and mechanisms? How feasible is the adaptation intervention within the current legal and regulatory set-up, without requiring legal or regulatory changes?
Environmental	Ability to reduce vulnerability and build adaptive capacity Environmental co-benefits (biodiversity, water, etc.) Mitigation co-benefits Environmental risks	How effective is the adaptation intervention in terms of targeting the major vulnerabilities of the sector, and building adaptive capacity in the sector? To what extent does the adaptation intervention bring co-benefits for environmental protection, management, resource-efficiency, and conservation? To what extent does the adaptation intervention bring co-benefits in terms of reduce GHG emissions, or carbon sequestration and abatement? How minimal are the environmental risks of implementing the adaptation intervention, in terms of unintended consequences?

6.7 Recommended Practices and Technologies

A number of rangeland and livestock management practices and technologies have been identified to promote more sustainable, climate-resilient livestock farming systems in Bayantumen soum. Each practice and technology being considered was analysed using the MCA (Chapter 7) to determine if it met the various criteria and how well it answered the Guiding Questions. Table 36 also illustrates the cost, impact and priority of implementation of each recommended technology.

There are no easy solutions to developing sustainable, climate-resilient livestock farming systems and any efforts need to take a holistic, integrated approach to tackling the issues. Reducing livestock numbers is going to be critical and to do this, restructuring of cattle herds and sheep flocks should be prioritized. Growing markets for better quality beef and lamb that would come from animals fattened in feedlots and slaughtered at a younger age could provide the incentive for herders to change their herd structures. Monitoring of rangelands and rangeland planning using the State and Transition Models already developed for Mongolian rangelands will be a key activity in order to start to balance livestock numbers with carrying capacities of the rangeland. Training of local officials and herders and provision of practical, extension material and advice to support herders in the transformation they need to make to more climate-resilient livestock farming systems will also be essential.

The most appropriate rangeland and livestock management practices and associated technologies for promoting sustainable, climate-resilient livestock farming include the following (key ones are in **bold**):

Pasture related:

- **Rangeland monitoring, using State and Transition Models developed for Mongolian rangelands.**
- **Rangeland planning to identify areas that need improved management which could include: resting from grazing for a year or more, deferred grazing in the spring, identifying *otor* pastures, areas for reseeding pastures, areas for hay cutting, sites for water development, fencing.**
- Determining carrying capacities and recommended stocking rates for the range.
- Rangeland planning for biodiversity conservation (working with nature reserves in Bayantumen *soum* to manage the rangelands for both livestock and wildlife).
- Forage and fodder development (with annual (i.e. oats, wheat, barley and peas for "green nutrition") and perennial forages (alfalfa, etc.))
- **Training for *aimag* and *sum* officials and herders in rangeland monitoring and planning.**
- **Production of rangeland and forage/fodder-related extension material that is practical for herders.**

Livestock related

- Animal health and disease control.
- Training of veterinarians and provision of supplies and equipment.
- Training of herders in animal health and disease control and proper protocols to follow (with special attention to the role of women).
- Genetic improvement of cattle, sheep, and goats through raising and distribution of breeding stock and artificial insemination (AI).

- Herd restructuring to reduce numbers of unproductive animals and increase off-take of younger animals.
- Promoting raising beef cattle as cow-calf producers and selling weaned calves in the fall.
- Herders keep a small number of improved milk cows (i.e., Alatau, Black & White) to provide milk needs for the household.
- Sell lambs in the fall at 8-9 months of age or at 15-18 months of age.
- Improved livestock shelters for winter.
- Training for herders on livestock production and management, with special consideration to training needs of women and children.

Market related:

- Strengthen linkages between herders and markets (direct marketing by herders to buyers, which bypass changers).
- Sale barns where weekly or bi-weekly auctions are held in the fall to market cattle and sheep for meat.
- Strengthen all the links in the meat value chains.
- Promotion of grass-raised beef and lamb.
- Promotion of feedlots (intensive livestock raising).
- Promotion of milk-production and small-scale dairying (intensive and semi-intensive livestock raising).

Policy related:

- Analyze current range, livestock, and market policies that are hindering more sustainable, climate-resilient livestock farming systems.
- Provide policy recommendations that are needed to promote sustainable, climate-resilient livestock farming.

Different actions and technologies have different costs and impacts if implemented. Table 36 illustrates whether the recommended actions/technologies have high, medium or low cost and whether their impact is high, medium or low. Most of the actions/technologies should be implemented in the short-term but some could be done later. This prioritization helps in planning development.

Table 36: Priority actions/technologies for climate-resilient livestock systems with the cost, impact and prioritization

Actions/technologies to promote sustainable, climate-resilient livestock farming system in Bayantumen *soum.*	Cost (High, Medium or Low)	Impact (High, Medium or Low)	Prioritization (Short term or Medium term)
Rangeland and forage/fodder related			
Rangeland monitoring, using State and Transition Models.	M	H	S
Determining carrying capacities for areas used by herders.	H	H	M
Rangeland planning to identify areas for improved management.	L	H	S
Forage and fodder development.	H	H	S

Actions/technologies to promote sustainable, climate-resilient livestock farming system in Bayantumen *soum.*	Cost (High, Medium or Low)	Impact (High, Medium or Low)	Prioritization (Short term or Medium term)
Training for *aimag* and *sum* officials and herders.	M	H	S
Production of rangeland and forage related extension material.	L	H	S
Livestock related			
Animal health and disease control.	H	H	S
Training of veterinarians and provision of supplies and equipment.	H	H	S
Training of herders in animal health and disease control.	L	H	S
Genetic improvement of cattle, sheep, and goats through raising and distribution of breeding stock and artificial insemination (AI).	M	H	S
Herd restructuring to reduce numbers of unproductive animals and increase off-take of younger animals.	L	H	S
Promoting raising beef cattle as cow-calf producers, not milking the cows, and selling weaned calves in the fall to feedlots.	L	H	S
Herders keep a small number of improved milk cows (i.e., Alatau, Black & White) to provide milk needs for the household.	L	H	S
Sell lambs in the fall at 8-9 months old or at 15-18 months old.	L	H	S
Improved livestock shelters for winter.	M	M	M
Training for herders on livestock production and management, with special consideration to training needs of women and children.	L	H	S
Market related			
Strengthen linkages between herders and markets (direct marketing by herders to buyers, which bypass changers).	M	H	S
Establish sale barns where weekly or bi-weekly auctions are held in the fall to market cattle and sheep for meat.	M	H	M
Strengthen all the links in the meat value chains.	M	H	S
Promotion of grass-raised beef and lamb.	L	H	S
Promotion of feedlots (intensive livestock raising).	L	H	S
Promotion of milk-production and small-scale dairying.	L	H	S
Policy related			
Analyze current range, livestock, and market policies that are hindering more sustainable, climate-resilient livestock farming.	L	H	S
Provide policy recommendations that are needed to promote sustainable, climate-resilient livestock farming.	L	H	S

6.8 Potential GHG Emissions and Carbon Sequestration

6.8.1 Background and Objective

The climate change vulnerability assessment of the local livestock herding systems revealed that several emerging environmental issues in the Bayantumen Soum had been rooted or intensified due to the recent changes in local and regional climates. These issues included: an increase in livestock population and herd size; change in livestock herd mixture; reduction in livestock movements or herders' immobility across the landscape; and migration of unregistered livestock into the area. As a result, the number of livestock in the *soum* has exceeded the grazing capacity of the pastures by 2.8 times and plant communities in a reference or non-degraded state have decreased and dominated by annual and less desirable plant communities. These changes have negatively affected the livelihood and livestock farming of local herders and raised environmental concerns over the rising rate of greenhouse gas (GHG) emissions from both livestock and rangeland degradation.

The Mongolian traditional livestock herding, which significantly relies on native rangelands and pastures, plays an important role in GHG emission and mitigation. Livestock in traditional herding systems produce GHGs directly through enteric fermentation during their digestive process (mainly methane or CH4) and decomposing dung and urine deposited by them on pastures (both nitrous oxide or N2O and methane). However, indirect soil carbon dioxide (CO2) and nitrous oxide emissions from grazing intensification and haymaking or production of supplementary livestock feed and fodder are considered relatively larger sources of GHG emissions from livestock farming practices. If well managed, the natural grasslands that livestock grazes on have a large capacity to remove or store those GHGs and prevent them from being emitted into the atmosphere. For example, grasslands are well-recognized as natural carbon sinks, sequestering substantial amounts of atmospheric carbon dioxide in the form of organic carbon in their soils. Therefore, in addition to supporting herders' livelihoods, natural grasslands and rangelands play a vital role in mitigating climate change across Mongolia.

In Mongolian traditional herding systems, livestock is raised on pastures year-round and is mainly grass-fed and finished. Grass-fed livestock raised in pastures typically produce more methane in their lifetime than livestock raised in feedlot operations. Ingestion of grass forage and hay naturally emit more methane than high-quality feed provided to livestock in the feedlot. Also, methane emissions from grass-fed and pasture-based livestock happen over a longer time as they typically reach the market weight more slowly than livestock raised in feedlots (see Fig. 4 in Section 4). However, from a carbon footprint standpoint, this comparison may be misleading as net GHG emissions can be potentially much lower in pasture-based livestock production systems that are sustainably managed. Much of the carbon footprint of feedlot livestock is associated with growing grain and high-quality forages and comes from land cultivation and the use of fossil-fuel-based agricultural inputs like fertilizers and pesticides. Conversely, pasture-based livestock herding systems are multifunctional and deliver multiple environmental services (See Table 34 in Section 6), including mitigating GHG emissions through carbon sequestration services.

Grazing pressure is frequently mentioned as a driver of land degradation across Mongolia. The widespread overgrazing has raised alarming concerns about the environmental sustainability of current livestock herding practices under a changing climate. High grazing intensity shifts pasture vegetation composition

towards less desirable plant communities. This lowers pasture forage availability and quality, reduces livestock productivity and performance, and intensifies GHG emissions per unit of live weight gain by livestock (e.g., through a lower rate of forage intake and digestibility and a higher rate of energy consumption and livestock disease in degraded pastures). In addition, overgrazing limits potential carbon sequestration in pastures and accelerates carbon loss from soil by increasing erosion and deterioration of soil structure, particularly soil aggregates, that physically protect organic matter accumulation in the soil. Therefore, optimizing the stocking rates (e.g., through herd restructuring and removal of less productive livestock) and distribution of livestock grazing (e.g., rotational grazing) is critical to fully benefit from the GHG mitigation capacity of natural grasslands and traditional livestock herding practices in Mongolia.

Several key steps must be taken to reverse rangeland degradation trends and restore the GHG mitigation capacity of traditional livestock herding in Mongolia. Among the recommended mitigation pathways to decrease GHG emissions along the livestock value chain in Mongolia, the primary livestock and pasture management practices include:

- supporting the stocking rates that are in line with pasture carrying capacity
- restructuring livestock herds and improving feeding practices and herd productivity
- promoting seasonal pasture rotations and traditional four-season nomadic rotational grazing
- rehabilitating vegetation and enhancing soil carbon sequestration and GHG mitigation capacity in degraded rangeland.

A preliminary GHG emissions and carbon sequestration assessment was conducted to demonstrate the identification and potential adaption of the above-mentioned livestock and pasture management measures for promoting climate-resilient livestock herding practices in the Bayantumen Soum, a district of Dornod province. Specifically, direct GHG emissions by livestock were compared between the current or traditional livestock herding practices and livestock production under improved life cycles and herd structures. In addition, indirect GHG removal through carbon sequestration in pasture soils was assessed under grazing and pasture management practices resulting from improved livestock life cycles and herd structures. Details of the examined livestock and pasture management practices and their outcomes for GHG emission and removal are explained below.

6.8.2 Potential GHG Emissions

A life cycle assessment approach covering livestock production up to where the cattle and sheep meat products leave the farm (i.e., cradle to farmgate) was used to estimate direct GHG emissions from local livestock farming practices in the *soum*. This mainly included GHG emissions from enteric fermentation and livestock waste. Conservatively, rangeland carbon stores were considered static, and no grazing and haymaking-induced carbon equivalent emission and loss from rangeland soils was assumed. A similar assumption was made for cultivated soil as animal feed and fodder production in the *soum* (i.e., mainly oat, barley, and wheat) is supposed to be limited to the existing cultivated lands (I.e., no land conversion) and typically with minimum use of fossil-fuel-based agricultural inputs.

Primarily, the effects of the alternative life cycle (as illustrated in section 4) and cattle herd and sheep flock restructuring scenarios for an average herder household (as explained in section 5) were investigated. This assessment was then further extended by considering GHG emission reduction effects from improved grazing and pasture management (i.e., reduced grazing pressure, rotated grazing, and rehabilitated pasture vegetation and soil) and livestock productivity practices (i.e., improved feeding efficiency, breeding and mortality rate, and livestock care management). Horses and goats were excluded from this assessment, as currently, there is no working market for their meat products.

The overall GHG emissions were estimated using the reported emission intensity factors for different livestock types and production practices. Relevant previous studies and existing GHG assessment tools (e.g., GLEAM and LEAP) were reviewed to obtain realistic uncertainty ranges (i.e., min and max) of GHG emission intensity or kg of carbon dioxide equivalents (CO2e) per head of adult livestock per year. This included GHG emission intensities for cattle and sheep meat production under grass-fed or grass-finished (i.e., mainly raised and fattened on pastures) and mixed operation (i.e. raised and fattened on a combination of pastures and creep feeding or feedlots), as well as under improved grazing and pasture, and livestock productivity management (see Table B1 in Appendix).

The information on GHG emission intensity was then integrated with information on cattle herds and sheep flocks for an average herder household. This includes herd composition, total herd size based on adult cows and sheep, final live weight of sold livestock, and slaughter age. The rate (kgCO2e/kg live weight) and total annual CO2e emissions (tCO2e/yr) from the current herd and under the proposed cattle and sheep herd restructuring scenarios were then estimated and compared (Table 37). All estimates were obtained by assuming an average climate and livestock-marketing year and based on the best available data from open-access studies and datasets.

Table 37: GHG emissions from current and alternative cattle herd structure and operation scenarios (Note: The green color indicates GHG removal and red means additional GHG emissions)

Cattle Herd Management*	Operation*	GHG Emission							
		Total (tCO2e/yr)		Rate (kgCO2e/kg live weight)		Change in Total (tCO2e/yr)		Change in Rate (kgCO2e/kg live weight)	
		Min	Max	Min	Max	Min	Max	Min	Max
Current (20 adult cows)	Traditional	122	169	27	38	-	-	-	-
Restructured (40 adult cows)	Cow-calf	109	151	12	17	-13	-18	-15	-21
	Grass-finished	161	223	13	18	39	54	-14	-20
	Feedlot-finished	145	201	8	11	23	32	-19	-26
	Cow-calf	76	139	8	15	-46	-30	-19	-22
	Grass-finished	113	205	9	16	-9	36	-18	-21

Cattle Herd Management*	Operation*	GHG Emission							
		Total (tCO2e/yr)		Rate (kgCO2e/kg live weight)		Change in Total (tCO2e/yr)		Change in Rate (kgCO2e/kg live weight)	
		Min	Max	Min	Max	Min	Max	Min	Max
Restructured & grazing/pasture	Feedlot-finished	101	184	6	11	-21	15	-21	-26
Restructured & livestock productivity improved	Cow-calf	94	137	10	15	-28	-32	-17	-23
	Grass-finished	139	203	11	16	17	34	-16	-22
	Feedlot-finished	101	176	6	10	-21	7	-22	-28

** More information in sections 4 & 5*

The results of GHG emissions for the cattle herd and sheep flock of an average herder household is presented in Table 37 and 38. Overall, a relatively high annual rate (on average, 145 and 143 tCO2e) and per unit live weight of GHG emission (32.3 and 23.1 kgCO2e) were respectively estimated for the traditional cattle and sheep herds. Compared to the current herd structure, the annual rate of GHG emission dropped by 43% for the proposed sheep flock. For the restructured cattle herd, it was almost the same for the across the examined life cycle and herd restructuring scenarios, primarily due to a higher rate of GHG emission and the additional cattle finished in the grass-finished operation compared to the traditional operation.

However, when considering the total live weight of sold livestock (as explained in section 5), the GHG emission rate per unit live weight of both cattle and sheep was remarkably dropped across the examined herd restructuring scenarios (64% and 52%, respectively). In addition, improvement in grazing and pasture management and livestock productivity further reduced the GHG emission rate of the restructured cattle herd and sheep flock, particularly under cow-calf and feedlot-finished operations.

Table 38: GHG emissions from current and alternative sheep flock structure and operation scenarios (Note: The green color indicates GHG removal)

Sheep Flock Management*	Operation*	GHG Emission							
		Total (tCO2e/yr)		Rate (kgCO2e/kg live weight)		Change in Total (tCO2e/yr)		Change in Rate (kgCO2e/kg live weight)	
		Min	Max	Min	Max	Min	Max	Min	Max
Current (100 ewes)	Traditional	118	168	17	25	-	-	-	-
Restructured (100 ewes)	Grass-finished	81	115	11	15	-37	-53	-7	-10

Sheep Flock Management*	Operation*	GHG Emission							
		Total (tCO2e/yr)		Rate (kgCO2e/kg live weight)		Change in Total (tCO2e/yr)		Change in Rate (kgCO2e/kg live weight)	
		Min	Max	Min	Max	Min	Max	Min	Max
	Feedlot-finished	73	104	9	12	-45	-64	-9	-13
Restructured & grazing/pasture improved	Grass-finished	56	106	7	14	-61	-62	-10	-11
	Feedlot-finished	51	98	6	11	-67	-70	-12	-14
Restructured & livestock productivity improved	Grass-finished	63	108	8	14	-55	-60	-9	-11
	Feedlot-finished	51	91	6	11	-67	-77	-12	-14

** More information in sections 4 & 5*

The findings of this assessment support life cycle and herd restructuring as an effective GHG mitigation strategy to protect or even promote herders' livelihoods as they potentially end with more livestock production and with a relatively lower direct GHG emission rate (or higher GHG emission efficiency), in particular when improving feeding practices and herd productivity, and promoting appropriate grazing and pasture management practices.

Rotational grazing is considered an effective way to decrease GHG emissions from herding. Currently, livestock herds in the *soum* are left to graze one area of land continuously, resulting in eating the grass down to the ground, disturbing vegetation and soil carbon stores. If herds are rotated between different areas or seasonal pastures, then carbon stored in the vegetation and soil can remain intact or even enhanced, and further emissions from those sources will be halted. Rotational grazing also drops direct GHG emissions from grazing livestock. The improvements of rangeland vegetation will reflect a reduction in livestock energy use and the proportion of fresh grass in livestock diet due to increased quantity and quality of pasture forage, thus reducing GHG emissions associated with feed and livestock grazing activities.

6.8.3 Potential Carbon Sequestration

The cattle herd and sheep flock restructuring examples (see section 5) indicated that in the short-term (i.e., 3-5 growing seasons), the number of grazing cattle and sheep for an average herder household in the *soum* could potentially drop by 20% (333 to 267 SUs) and 30% (381 to 264 SUs), respectively under favorable climate conditions. Based on the vegetation plot data and state and transition models (explained in section 2), the majority of vegetation communities within the *soum* area have the potential to recover in the short-term through optimized grazing and pasture management. It was, therefore, assumed that improved grazing management through the livestock life cycle and herd restructuring (i.e., more intensive to less intensive grazing pressure) and promoting seasonal pasture rotations will potentially result in the

rehabilitation of vegetation in degraded rangeland and, consequently, enhancement of rangeland soil carbon sequestration and GHG mitigation capacity in the short-term.

The overall carbon sequestration potential of improved rangelands was estimated based on the reported carbon sequestration rates for the relevant vegetation types and grazing or pasture management practices. Relevant studies and reports were reviewed to obtain realistic uncertainty ranges (i.e., min and max) of carbon sequestration rates (tC/ha/yr) for both rangeland vegetation and soil. This included carbon sequestration rates for different levels of vegetation degradation (heavily vs. moderately degraded), grazing pressures (i.e., high vs. moderate) and grazing system (i.e., continues vs. rotational) practices (see Table B2 in Appendix).

Reasonable carbon sequestration uncertainty ranges were then assigned to the four main ESGs that characterize dominant vegetation communities and soil types in the *soum* area (Table 39; More information in section 2). The assignment of carbon sequestration uncertainty ranges was done by considering coarse estimates of the current state of vegetation and soil and rough estimates of the distribution and area proportion of seasonal pasture types across different ESGs. Finally, the area of different ESGs was used to estimate the total annual potential carbon sequestration of *soum*'s rangeland under improved grazing and pasture management in average climate conditions.

The estimated potential carbon sequestration of improved soil and vegetation across the *soum*'s rangelands is presented in Table 39. Overall, applying carbon sequestration coefficients to the major ESGs in the *soum* area led to an annual sequestration estimate of 99.8 to 224.3 thousand tons of carbon or 366.1 to 897.1 thousand tons of CO2e from rangeland vegetation and soil, of which 86.8% to 93% originated from carbon sequestration in rangeland soil and the remains from carbon sequestered in improved rangeland vegetation. Accordingly, the corresponding annual sequestration rate across different ESGs was 0.12 to 0.27 tons carbon per hectare per year or 0.44 to 1.07 tons CO2e per hectare per year.

Considering annual conservative GHG emission rates of 1814 and 234 kg CO2e per head of cattle and sheep respectively (see Table B1 in Appendix), the carbon sequestration potential of improved rangeland can annually mitigate direct GHG emissions from 202 to 495 thousand cattle heads or 1,570 to 3800 thousand sheep heads. Also, considering an annual conservative carbon removal of 20 kg from the air through photosynthesis by a typical young tree, the carbon removal potential of improved rangeland can annually be equal to carbon removal by 18.3 to 44.8 thousand trees.

Table 39: Potential carbon (C) sequestration of different ecological site groups under improved grazing and pasture managements

Ecological Site (ESGs)*	Area (10^3 ha)	Vegetation C Sequestration				Soil C Sequestration			
		Total C (10^3t/yr)**		Total CO2e (10^3t/yr)!		Total C (10^3t/yr)		Total CO2e (10^3t/yr)	
		Min	Max	Min	Max	Min	Max	Min	Max
6. *Stipa Krylovii*-Small bunch grass-Forbs dry steppe rangeland	302.0	5.7	6.8	20.9	24.8	45.3	102.7	166.1	442.9
9. *Stipa grandis-Elymus chinensis*-Forbs dry steppe rangeland	275.7	4.3	5.1	15.9	18.8	13.8	41.4	50.5	151.6
7. *Stipa krylovii*-grass dry steppe rangeland	192.2	2.8	3.3	10.3	11.9	19.2	48.0	70.5	176.1
10. *Achnatherum splendens* rangeland	55.8	0.3	0.4	1.2	1.4	8.4	16.7	30.7	69.5
Total	**835.7**	**13.2**	**15.5**	**48.3**	**56.9**	**86.7**	**208.8**	**317.8**	**840.2**

* More information in section 2; Fig. x & Table 21.
** Carbon sequestration rates across ESGs ranged from 0.006 to 0.022 and 0.05 to 0.34 tC/ha/yr for vegetation and soil, respectively (see Table B2 in Appendix).
! A conversion factor of 44/12 or 3.67 was used to calculate the CO2e of the carbon sequestration estimates.

6.8.4 GHG Emission and Removal Impact

The analysis of the historic livestock population statistics indicated an overall increase of 57% in livestock population size between 2017 and 2021 (Table 40). Considering this historical rate of change, by 2025, the total livestock population in the *soum* can be potentially increased by 143 thousand heads of livestock, which translates to an estimated total of 91.8 thousand tons of extra CO2e emissions from the livestock sector. While, taking livestock population measures such as restructuring cattle herds and sheep flocks and, for example, preventing further increases in the populations of other livestock types (in particular, horses and goats) can lead to a projected livestock population size between the 2017 and 2021 levels. In other words, if appropriate measures are taken to prevent and remove additional livestock heads from the region, by 2025, a total of 113 thousand tons of extra direct CO2e emissions can potentially be removed from the livestock sector, and the overall GHG emission of the sector can potentially decrease to a level below the 2021 level (Table 40).

Table 40: Historical and projected livestock population and GHG emission (Note: The green color indicates GHG removal or no emission and the red mean additional GHG emissions)

Description	Scenario	Year	Livestock Types					
			Horse	Cattle	Camel	Sheep	Goat	Total
Livestock Population (10^3 heads)	Historic	2017	25.1	17.6	0.7	70.1	45.6	159.0
		2021	38.4	30.9	0.9	109.8	69.5	249.6
	Change (%)	2017-2021	53.2	76.1	36.8	56.7	52.4	57.0
	Projected	2025	58.8	54.4	1.3	172.1	106.0	392.6
	Optimized*	2025	38.4	24.7	0.9	76.9	69.5	210.5
GHG intensity (tCO_2e/head/yr)!			0.91	2.06	1.61	0.26	0.23	-
GHG emission (10^3tCO_2e/yr)	Historic	2017	22.7	36.2	1.1	17.9	10.4	88.3
		2021	34.8	63.8	1.5	28.0	15.9	143.9
	Projected	2025	53.3	112.4	2.1	43.9	24.2	235.7
	Optimized	2025	34.8	51.1	1.5	19.6	15.9	122.8
GHG emission change (10^3tCO_2e/yr)	Historic	2017-2021	12.1	27.6	0.4	10.1	5.5	55.6
	Projected	2021-2025	18.5	48.6	0.6	15.9	8.3	91.8
	Historic - Optimized	2021-2025	0.0	-12.8	0.0	-8.4	0.0	-21.2
	Projected - Optimized	2025-2025	-18.5	-61.3	-0.6	-24.3	-8.3	-113.0

* Based on 20% and 30% reductions for cattle and sheep populations, respectively, due to herd restructuring. For other livestock types, the population was kept at the same size as in 2021.
! Values are based on Shi et al., 2022 (Front. Public Health, 11).

These simple estimates of GHG projections for the year 2025 are based on coarse GHG emission intensities for different livestock types and by considering assumptions like no improvement in livestock productivity and management and no major climate event or market condition that drastically alter livestock number in the *soum*. However, when you put these estimates of direct annual GHG emissions in 2025 together with the annual potential carbon sequestration from rangeland, if no adaptive measures are taken to prevent and remove additional livestock from the landscape and rehabilitate soil and vegetation of degraded rangelands in the *soum*, then in the year 2025 alone, an estimated total GHG emission removal opportunity of 479 to 1010 thousand tons of CO2e from the *soum*'s livestock sector will be missed. This would roughly equal annual carbon removal by 23.9 to 50.5 thousand trees (i.e., 20 kg CO2e/yr removal by a single young tree).

These figures demonstrate the large mitigation potential of GHG emissions from the livestock sector, particularly through carbon sequestration in vast rangeland areas of the *soum* and the country. It also demonstrates the importance of developing effective climate-resilient pasture management measures and policies that, while sustaining herders' livelihoods under a changing climate, promote the provision of undervalued environmental goods and services from rangelands (see section 6), including their carbon sequestration and GHG mitigation capacity. Local herders must play a fundamental role in the development process of new policies, as they deeply understand their surrounding landscapes and the environmental good and services essential to their herding livelihood systems.

6.8.5 Conclusions and Limitations

This preliminary assessment demonstrates the potential GHG emission and removal from the traditional livestock sector in the Bayantumen Soum. It demonstrates how restructuring the existing livestock herds and improvement in grazing and livestock management can potentially increase the GHG emission efficiency of livestock products (i.e., lower CO2e intensity per unit of live weight) while increasing the total production of livestock live weight for an average herder household. Even more remarkably, it demonstrates the considerable opportunity for GHG removal and mitigation through carbon sequestration in the degraded rangeland soil and vegetation that can potentially be restored through improved livestock and grazing practices, as explained in section 8.

Efforts to address livestock related GHG emission risks are likely to require systemic changes in Mongolian livestock management and marketing to sustain herders' incomes over the long term. Community-based rangeland monitoring and management can support local agreement on livestock mobility or seasonal pasture rotation, an adaptive strategy traditionally used by Mongolian herders to prepare for and respond to pasture and climatic conditions. In addition, adaptive measures that reduce livestock mortality and increase livestock productivity are required to minimize the herders' only offset mechanism or increasing their herd size to compensate for possible livestock losses from harsh climate seasons (i.e., like dzud).

Establishing feedlots for mixed livestock production systems (i.e., feedlot-finished) requires further assessment. On the one hand, feedlots get grazing livestock off the pasture, thus contributing to grazing pressure adjustment while raising more livestock in a shorter period and lowering GHG emissions per kg of livestock product compared to grass-finished production systems. On the other hand, feedlots in mixed systems require special diet composition in different stages (e.g., high fibrous ingredients in the growing stage and high-energy grains during the finishing stage). This can potentially lead to increased CO2e emissions related to feed production, processing and transport. Therefore, decision-making should pay much attention to the source and type of feed that will be fed to the livestock. In addition, the concentration of livestock over small areas can lead to challenges in manure management and, eventually, higher GHG emissions and water pollution issues. Legumes as protein-rich and nutritious feed for the livestock can enrich soils with nitrogen, increase forage production, and promote carbon sequestration at a rate that, in some cases, is less achievable through other practices in cultivated lands. Using legume species for livestock feed and fodder production and promoting them in rangeland vegetation composition can be an adaptive measure for mitigating GHG emissions and climate change impacts.

Reports about GHG emissions and carbon sequestration rates are particularly rare for Mongolia. While great care has been taken to ensure that the input data and the results were of the highest quality possible, there remain several limitations in the underlying datasets and therefore projected changes. These results provide a basis for identifying adaptation pasture and livestock management measures that target the mitigation of GHG emissions from the livestock sector. However, they also suggest that more effort needs to be put into a systematic assessment of the sector's potential GHG emissions and removal. This includes considering the IPCC Guidelines Tier 3 methods that require locally appropriate emission factors for different livestock types and practices that can be obtained though direct measurement of GHG emissions from different aspects and stages of the livestock life cycle.

6.9 Gender

6.9.1 Gender and Social Inclusion Considerations

Target groups of promoting gender equality and social inclusion

According to findings of the vulnerability study that was carried out in June 2022, women and young herders, men, single headed-household and households with few livestock are more vulnerable to climate change. Therefore, in terms of provision of gender equally and social inclusive participation we have to consider on the advantages and disadvantages, and opportunity and threats of the above-mentioned target groups.

Table 41: Advantages, disadvantages, opportunity and threats of the target groups in relation to pasture degradation

	Households with small # of livestock	Women		Men single headed household	Young herders
		Married women	Women headed household		
Advantage in relation to pasture degradation	Few livestock	Better condition of investment and human resource for improving livestock production; Better education	Few livestock	Few livestock	Few livestock
Disadvantage	With no land ownership; Low income; Lower owned capital; Lower participation in community decision making	Low income; Lack of participation during school year; Lack of decision-making power; Lower owned capital; Lower participation in community decision making	With no land ownership; Low income; Lower owned capital; Lower participation in community decision making	With no land ownership; Low income; Lower owned capital; Lower participation in community decision making	With no land ownership; Low income; Lower owned capital; Lower participation in community decision making
Risks	Increase number of own and other's livestock	Increase number of own livestock	Increase number of own livestock	Increase number of own and other's livestock	Increase number of own and other's livestock
Opportunity	Increase efficiency of the unit of livestock, Participate in crop farming, feeding and slaughtering	Milk and dairy production; Increase efficiency of the unit of livestock Participate in crop farming, feeding and slaughtering	Increase efficiency of the unit of livestock Participate in crop farming, feeding and slaughtering	Increase efficiency of the unit of livestock Participate in crop farming, feeding and slaughtering	Increase efficiency of the unit of livestock Participate in crop farming, feeding and slaughtering

A community-based approach is generally equitable, sustainable and legitimized strategies for the pasture management. Although, there are several herders' groups and cooperatives that are attempting to create grassroots community-based groups at the target soum, there are significant differences between the goals of such interventions and the reality of these groups. It is often observed that the groups or cooperatives disappear after the project is completed if a rich or powerful person in the community is selected as the leader; and actual participation of the herders with few animals, women, and young herders' in the group or cooperative is not ensured. Therefore, it is necessary to ensure the active participation of all stakeholders as much as possible when creating a group and defining common goals as a group from the beginning.

A herders' group is possible to exist sustainable if all members are able to participate equally in all stages to solve their problems including describing their problems, determining problem solving options, implementing measures, and monitoring and evaluation. Therefore, a key strategy to promote equal participation is provision of gender equality and social inclusion.

In order to ensure gender equality and social inclusion in the selected pasture management methods, it is necessary to pay attention to create a structure that can effectively ensure target groups' real participation. According to the existing statistical information, target groups in Bayantumen *soum* and 4th *bagh* have very limited opportunities to express their voice in the decision-making processes, and it is difficult to benefit equally from the public policies and measures for them (Table 42). One of the reasons of no concerted effort by authorities to support reducing livestock numbers is lacking opportunities of the herders with few livestock to influence on decision making process.

Table 42: Men and women's participation at the decision-making level of the target soum and bagh

	Man	Woman	Total
Chairman of *soum*'s Citizens' Representatives' Khural (CRK)	1		1
Representative of *soum*'s CRK	16	5	21
Herder representative of *soum*'s CRK	3 (1 is from 4th bagh)	1 (with higher education certificate)	4
Soum Governor		1	1
Council of *soum* governor	5	8	13
4th bagh Governor	1	1	
Citizens' council of *bagh*	5	2	7
	Rich herder	Middle	Lower
Herder representative of *soum*'s CRK	2	1	1

The following steps should be taken to create a structure that can effectively ensure target group's real participation:

1. Create sub-groups or councils of women, young people and herders with less than 300 livestock within herders' groups or cooperatives
2. Organize trainings with the aim to develop members' life skills and leadership of the sub councils
3. Update a rule of herders' groups' or cooperatives integrating sub councils' voice
4. Introduce participatory monitoring and evaluation methodology to groups' or cooperatives activity.

It is possible to involve women and young herders in the photo monitoring of the pasture. Young people have better IT and phone skills since they use smart devices, and women are more educated than men of the target *soum.* Therefore, they are able to work on the data analysis by integrating and comparing data and use findings for their pastureland management.

Herder households that used to work in the soum dairy production farm have mainly cattle. A few of them sell milk and dairy products every day in Choibalsan city. Transportation is the main challenge for women headed household and women who have few cattle. If they are engaged and organized as a group, it is possible to solve transportation related problems to sell their products. Thus, group management and trainings to improve financial, business and marketing skills are crucial for them.

We mentioned that officials recognize the need for feed and fodder, and proper animal nutrition through year to meet the meat demand. It requires more use of feed/fodder all year around and crop farmers need to start growing forage/fodder crops in order to improve livestock production in Bayantumen soum. If crop farmers collaborate with the local herders, they need more workers, and it is needed to restructure or organize work force of the target *soum* or *bagh* properly.

On the other hand, when households with a large number of animals decrease number of their livestock for matching to pasture carrying capacity it is important to feed the animals all year round for create more profit for them. In order to feed animal throughout a year, herders need to re- arrange and organize work force at the target *soum* or *bagh*. If households with many livestock hire herders who have few livestock according to the Labour Law of Mongolia, they will mutually be benefited. If they have same knowledge and information on sustainable pastureland use and labour relations and able to negotiate equally, they would mutually benefit from their cooperation. Therefore, trainings on sustainable pasture management with integration of human rights and labour law regulation that training process provides opportunities for equal participation and learning from each other is essential for all parties. In some cases, herders with few livestock find an alternative income source and increase their income and do not want to herd others' livestock for making money. This would be an option to stop livestock migration to this area.

In addition, reducing the separation of the family during schooling will support female herders' participation in livestock herding. The separation creates a lack of human resource of household farming and increases household cost, as well as women are becoming economically independent from their husband or partner. In order to decrease the separation of the households it is crucial to improve accessibility and service quality of the school dormitory. Totally, 155 students study at the Bayantumen's secondary school and 40 students aged between 6 and 18 stay at the school dormitory equipped with toilets and showers. 4-6 students share a dormitory room. It is observed that households who have close

relatives in a soum or aimag center or have their own houses do not prefer to send their children, especially young children aged between 6 and 8 years old, to the dormitory. Most parents are not satisfied with dormitory's condition, safety and child protection service. Therefore, two options to improve dormitory condition and child protection service or to create a bagh school with alternative program of elementary education for herders are both significant.

Youth, especially young women are moving to the urban area of Mongolia. Therefore, preparation of young herders is one of the problems faced by herders. Local authorities do not pay attention on policies and measures to encourage young people, especially young women, to work at the livestock production. Although, secondary schools provide a career counseling service to students, the local authority do not participate in this service and do not concern on this issue. The gender responsive career counseling is essential for preparation to young generation of the herders.

Legislation Framework for Promotion of Gender Equality

The first ever Constitution of Mongolia, adopted in 1924, guaranteed the equal rights for men and women under the concept of "no person may be discriminated on the basis of ethnic origin, sex, or religion" which remained throughout the adoption of the Constitutions in 1940 and 1960.

According to the Constitution of Mongolia (1992), "no one shall be discriminated against because of ethnicity, language, race, age, gender, social origin, or status" along with "equal rights in politics, economics, society, and culture", and everyone has "equal rights in the field of employment, occupation and official position," and "equal rights in education, faith, conscience, conviction, and opinion". Moreover, the adoption of Law on Promotion of Gender Equality (2011) ensured the equal rights for men and women to abolish discrimination on the basis of sex in political, legal, economic, social, cultural and family relations, and regulates its implementation. This law broadly provides the fundamental regulation in political, legal, economic, social, cultural, and family spheres.[14]

Article 19.1.1 of this law mandates of the central and local government agencies to introduce a methodology to incorporate gender considerations in local and sectoral policies, general strategies, programs and projects; to conduct gender analysis of drafts of these documents and review and comment on their reports and to request appropriate funding and budget.

On top of the above-mentioned fundamental laws aligned with gender equality, the following laws guarantees men and women's equal rights as well as providing regulation on discrimination on the basis of sex: Labor Law of Mongolia, Law on Combating Domestic Violence, Special Law on Combatting Human Trafficking, Family Law, Criminal Code, and Civil Law.

Conventions and agreements relating to the gender equality Mongolia has ratified and signed

Mongolia has entered into over 200 multilateral agreements and has concluded over 2,000 bi-lateral agreements as of 2015. [15]. On July 10, 1980, Mongolia signed the Convention on the Elimination of All

[14] Law on Promotion of Gender Equality, 2011
[15] The National Legal Institute of Mongolia, 2015

Forms of Discrimination against Women as well as signed its Additional Protocol, which aims to ensure women's rights and gender equality.

Mongolia ratified a number of conventions, including Discrimination (Employment and Occupation, C111), Equal Remuneration Convention (Equal Pay for Equal Work, C100), Convention on the Rights of Persons with Disabilities, Universal Declaration of Human Rights, Convention on the Rights of Children, and Convention on the Political Rights of Women. In case of conflict with national laws, international agreements and conventions must be complied by the member state. By ratifying these international agreements and conventions, Mongolia shows its strong commitment to ensure women's rights and gender equality at all levels of society.

The SDG 2030 are a set of universal goals adopted by the United Nations General Assembly in 2015 to eradicate poverty, protect the planet, and ensure peace and prosperity for all people by 2030. SDGs have become a milestone not only for UN projects, but also for KFW, the World Bank, and the EBRD. Goal No.5 of the SDG 2030 specifically focuses on "gender equality and empowerment of girls and women", and in this context, "care and unpaid domestic work should be recognized and valued through the provision of public services, infrastructure, social services, and infrastructure and social protection policies, and the promotion of shared responsibilities with the household and the family as nationally appropriate".

Inter-sectoral Strategic Plan on Gender Equality

Currently, the National Committee on Gender Equality (NCGE) is developing the Inter-sectoral Strategic Plan on Promotion of Gender Equality in Mongolia (2022-2031). This strategic plan is pursued for satisfactory implementation and continued implementation of the Law on Promotion of Gender Equality, Mongolia's 2050 Vision-Long term Development Policy and Sustainable Development Goals objectives to introduce gender-responsive policies, planning and budgeting at all levels, and provide equal opportunities for men and women, and girls and boys to participate in social, cultural, economic, political, and family life.

The Strategic Plan consists of five objectives with a total of 20 sub-objectives to ensure adoption of the sectoral gender-responsive policies and strategies. Moreover, the concepts and each objective directly and indirectly relate to herder population. Especially, 5th objective of the strategic plan considered to promote gender equality in climate change adaptation and mitigation and it includes the following sub objectives:

3.5.1. gender sensitization in policy planning and implementation on climate change mitigation and adaptation;
3.5.2. ensure equal gender participation in environment protection, fostering sustainable consumption and increasing green job places;
3.5.3. capacity building of for women, men and social groups to participate in mitigation processes of climate change.

In addition to this, within 1st objective it was considered to improve life condition of rural girls and women. The strategic plan can be used as the policy background for gender mainstreaming in program developing for male and female herders.

Gender related policies and regulations in livestock herding and climate change adaptation and mitigation

The National Action Program on Climate Change (NAPCC) implemented since 2011 with aims to help Mongolia create the capacity to adapt to climate change and establish green economic growth and development. But it was canceled after the approval of Mongolia's 2050 Vision-Long term Development Policy in 2021 within the framework of the implementation of the law on Development Policy, Planning and its Management. Goal 6 of the Mongolia's 2050 Vision-Long term Development Policy considered promoting an environmentally friendly green development and developing climate change mitigation and adaptation capabilities, as well as goal 8.3 focuses on the developing sustainable agriculture that is environmentally friendly, adaptable and resilient to climate change. However, the goals of these policies are not sufficiently integrated with the gender mainstreaming policy.

The Environmental sector Gender Strategy (2014-2030) is one of the gender responsive policy documents at the sectoral level. This policy aims to build capacities to implement gender mainstreaming in policy planning; to implement gender sensitive practice in the environmental sector and its management, and to expand women's and men's participation in green development processes and open up broader avenues for equal access to benefits. Within the framework of third objective of the strategy focuses on ensuring more effective participation of local citizens and groups of communities in the planning, implementation and as well as the evaluation phases of the environmental sectoral policies.

Gender responsive policy in the food, agriculture and light industry sector was approved in 2018. Within the framework of the Objective 2, the following measures for male and female herders will be implemented:

1. Plan and implement socio-economic and culturally comprehensive measures toward providing support to herder-households' development and train future generation herders to keep the continuity of legacy.
2. Encourage agriculture related rational and reasonable skills and practices for female and male herders and crop-farmers based on their differentiated needs and facilitate improving their social responsibilities.
3. Create an accessible network of professional consulting services and business incubators at local areas for women and men engaged in the SMEs and household productions based on their differentiated needs and requirements.

Within the framework of the Objective 3, the following measures for male and female herders will be implemented:

1. Strengthen the capacities towards taking a leadership role in the implementation of the UN Resolution on Achieving Gender Equality and empowering rural women and girls at national and international levels.
2. Strengthen national capacities for encouraging domestic production, sustainable and reasonable consumption, based on differentiated gender roles and responsibilities of users at all levels.
3. Facilitate improving the coherence and efficiency of donor and international organizations' cooperation and coordination towards ensuring gender equality in the food, agriculture and light industry sector.

Evaluation of the findings of the gender responsive policy in the food, agriculture and light industry sector reveals that there are ambitious and a large number of activities were planned the policy and its implementation plan. The policy and its implementation were not introduced to all staffs at the sectoral unit, especially at the soum level and the sectoral sub council does not provide them a detailed guidance to implement the specific activities to achieve its objectives. The coordination within the sector, cross sectors and stakeholders to implement the policy was not satisfied. Some activities had been implemented within the framework of the national and local project with the international, or donor organizations' supports and initiative[16]. Although, clear guidance on the gender mainstreaming in the policy documents is not provided, the projects of international, or donor organizations are supportive to implement this policy.

To conclude, sectoral gender policies have been adopted at the related sectors but their implementation is not sufficient. These policies' objectives and commitments are considered as a gender framework for intended activities of this field, but much more needs to be done to ensure they are actually implemented.

[16] EU, MONES (2022) Evaluation of the Food, Agriculture and Light Industry Sector Gender Responsive Policy. Ulaanbaatar

7 Deliverable 4.1 Slaughterhouse Feasibility Study

7.1 Purpose of the Analysis

The Meat Processing Feasibility Study Mission was carried out between October 1 and 15, 2022 by the Meat Processing Expert Dr. Wolfgang Lutz, a skilled butcher and a veterinarian, Project Manager (Debra Rasmussen) and the National Agriculture Engineer (Mr. Byambadorj). Dr. Lutz was formerly Director of the German Butcher Association where he and his team provided consulting to German butchers in view of business models, food and hygiene regulations, slaughtering equipment and troubleshooting. The Mission included meetings in Ulaanbaatar with stakeholders and site visits in Ulaanbaatar, Khentii aimag and Bayantumen soum in Dornod aimag.

The Objectives of the mission were to:

- Assess the feasibility of a small-scale community-based meat plant in Bayantumen soum
  - considering two potential types of location (soum center and remote)
  - using a criteria-based "checklist" approach that can be used by any soum as a decision-support-system
- Gather information on different meat-business models and discuss problems and opportunities with stakeholders during the site visits.
- Conduct site visits to potential site(s) for establishing a community-based slaughterhouse and meat facility in Bayantumen soum.
- Meet with aimag officials, soum officials, bagh representatives and stakeholders to discuss meat processing options within the local context.
- Present findings, conclusions and recommendations with stakeholders and officials at a Stakeholder meeting/training event.

7.2 Analysis of Present Situation

The precise analysis of the present situation is a prerequisite for the long-term success of a small, community-scale slaughtering and meatpacking and processing centre in Bayantumen soum. To make the right decisions, local conditions and opportunities, different sites, geographical, environmental, and socio-economic conditions of the target area must be considered.

To find out the best conceptual design for the community-scale slaughterhouse, investigations were made regarding competition in the market, the supply chain, technology used, marketing concepts and expectations for the future. In addition, important criteria such as market situation, customer demands, infrastructure issues like land, power, water, feed, roads, electricity, and human resources were considered to find the most effective business-model and the best associated technical options available.

7.2.1 Consultations with Shareholders and Site Visits

To get an impression of the local market situation, various companies were visited, and their strengths and weaknesses analysed. Furthermore, many consultations and discussions were held with organisations, authorities and ministries. The aim was to present the project on the one hand and to find out how the project as a whole and its implementation was assessed on the other.

Site visit to meat processing companies

- Emeelt Market (Agro negtgel LLC), Ulaanbaatar: Director Mr. Nyamsuren
- Meat "Lavai" market (whole and retail sales) Ulaanbaatar: B. Dumee Director
- Rosewood's Butcher Fritz and Emart Butcher shop, Ulaanbaatar
- Jargalant meat processing factory (Erdenet city), UB: J. Ankhbayar (Director)
- Dornod aimag small butchery and local meat markets, Choibalsan
- Nomin supermarket and other, Choibalsan
- Khaan Foods LLC, Choibalsan, Mr. B. Bat-Erdene, Executive Director
- Dornod Meat LLC, branch of Dornod Makh Market, Mr. T. Battur, Factory director

Meetings with representatives of meat companies and consultants

- Meat Processing factory independent consultant Mrs. Enkhtuya, Ulaanbaatar
- Bayandelger foods LLC: Mrs. Gantuya (Consultant), Ulaanbaatar

Meetings with representatives of organisations

- Mongolian meat association (MMA), Ulaanbaatar: Mr. Battogtokh (Manager of MMA)
- WB livestock commercialization project, Ulaanbaatar: Mr. Vanchin (Project Manager)
- Meetings with Representatives of authorities
- Veterinary Medicine Department: Mrs. Ch. Ayushmaa, Head of Department, Choibalsan
- Agriculture and Animal Husbandry Division: Mr. D. Narankhuu, Head of Division, Choibalsan
- Environment and Tourism Department: Mr. A. Gantulga, Head of Department, Choibalsan
- Bayantumen soum officials: E. Narangarav, Governor; D. Tumentsetseg, Specialist of Agriculture Division; M. Battugs, Specialist of Agriculture (cropland); Kh. Enkhkherlen, Environmental Inspector; Gantulga, Bagh Governor

Stakeholder Meeting (Minutes of meeting presented separately in Deliverable 3.3)

- Meeting with Stakeholders, Presentation of project and discussion, Choibalsan

The visits to meat-plants, slaughterhouses and meat-processors, and the consultations and discussions with herders, directors of slaughterhouses, meat-plants, meat processing companies and retailer gave a deep insight into the existing market structures, their business models, and the opportunities for the future. The opportunities and risks were discussed and informed the Conceptual Design of Community-Based Slaughterhouse. The visits to meat-plants, slaughterhouses and retail-shops, as well as the discussions with stakeholders, took place in an open atmosphere and the willingness to cooperate. Technical details, general market conditions, prices, the competition in the meat industry, chances and risks were discussed regarding business models and meat-plant.

7.2.2 Competitive Environment

In general, there are three different business-models recognizable in the Mongolian meat-market. This is important to understand in view of establishing a new community-scaled small slaughterhouse in Bayantumen soum.

(1) Traditional slaughtering

Traditional slaughtering is the most important type of slaughtering and marketing of animals. It is carried out by herders themselves near their pastures (pasture-slaughtering), without any technical equipment. Alternatively, the live animals (mainly sheep and goat) are delivered to small markets. Customers have the possibility to buy a certain animal, and it got slaughtered by butchers for a fee and the customers take the meat at home. Middlemen also buy the animals and deliver the meat to wholesales, meat-companies, markets, and customers. The slaughtering is done in a traditional way with very limited equipment and is a completely manual process. Usually, there is no fresh water, no hygiene-cloth, and no meat-inspection (post- and ante-mortem). Disposal of waste is unclear.

The traditional slaughter approach does not fit the Mongolian requirements, laid down at the *Technical Regulations for Production and Trade of Meat and Meat Products*. Those regulations correspond to international standards, like Codex Alimentarius or European Hygiene Regulations, and are necessary for international trade and export. According to the regulations, abattoirs must have many rooms or in some cases, areas, for different stages of processing such as stunning, bleeding, dehiding, evisceration, suspect carcasses, offal and so on but this is not achievable in the situation and the needs of small slaughter or processing establishments with just local or domestic distribution. Therefore, in Europe, the regulations allow derogations, as long as the aim of the regulations, namely the perfect and unobjectionable hygienic quality of the meat, is achieved. This means, in practice, all activities can be carried out in a single room, if the activities take place at different times or in different places within that room ("one-room-slaughterhouse").

Interview informants said that all slaughterhouses must follow the Mongolian *Technical Regulations for Production and Trade of Meat and Meat Products* as of 2025. To keep small slaughterhouses with traditional slaughtering or pasture-slaughtering by herders in business, customized regulation must be established, similar to what has been done in Europe.

Despite the simple procedure of the traditional slaughtering, when meat is slaughtered and consumed locally, the risk for human health seems to be limited, because of minor contamination of the meat, direct distribution, short storage, simple handling and generations of experience. In addition, customers take care about hygiene transportation to their homes and meat is heated adequately.

Issues with traditional slaughter become more severe when livestock and meat is marketed outside of the local area. There are long transportations with risks of spreading contagious animal diseases and meat which is delivered to wholesalers, meat-processors, butchers, restaurants, or consumers is often in poor hygiene condition because there is no appropriate transportation and a lack of cooling. Therefore, an increase in technology, standard of hygiene, management, transportation and cooling is necessary,

especially because consumers have an increasing understanding and expectation about hygiene and quality.

Another problem in the traditional system is that the prices and incomes of farmers are limited, and that middleman prevents transparency in pricing along the supply chain.

Pictures show decisive steps in traditional slaughtering

(2) Industrialized slaughterhouses

The second business model are industrialized slaughterhouses. They are owned mostly by investors, have professional management and good financial resources. They use modern equipment like electrical stunning, elevators, tubular tracks, lifting platforms and cooling and freezing rooms. Their capacity is up to 1500 sheep and / or 500 cattle per day, but many of them are suffering low utilization. Some have their

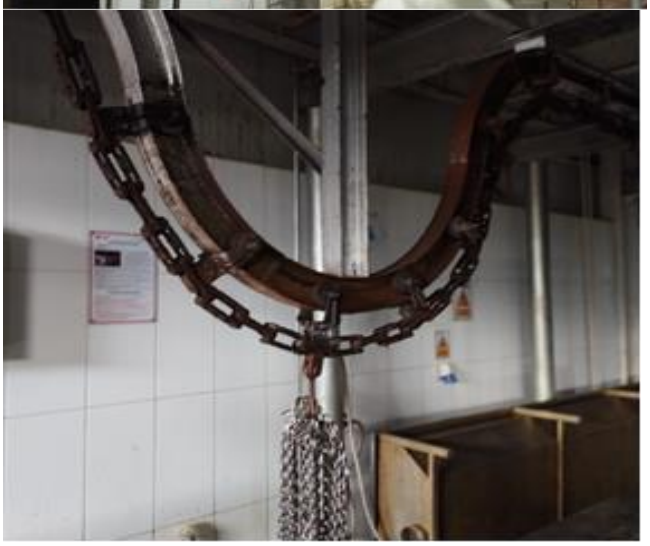
own feedlots to increase weight and fatting the animals. Equipment is mostly from China and in various condition. They also debone and deliver the meat to wholesales, meat-processors, butchers or for export.

It should be mentioned that export markets are very sensitive and risky. Companies exporting meat from Mongolia are dependent on importers and must compete on both price and quality with other exporters from all over the world. At the same time, animal disease outbreaks in Mongolia can lead to an instant import-ban.

It is to be assumed that those slaughterhouses largely fit the Mongolian requirements, laid down at the *Technical Regulations for Production and Trade of Meat and Meat Products*. Meat-inspection (ante- and pot-mortem) is carried out. Animal welfare could not be finally clarified. Sheep are slaughtered usually without stunning (halal-style).





(3) Integrated meat plants and meat-processors

Integrated meat plants are vertically integrated, which means they try to keep the entire value chain in their hand. They run crop production, grassland, breeding, feedlots, slaughterhouses, cutting facilities, and meat-processing. For slaughtering, they use electrical stunning, elevators, tubular tracks, lifting platforms, cooling and freezing rooms. For producing meat-products like dumplings, sausages or ham, they use appropriate machinery. They deliver the meat to butchers, their own shops, domestic super- or hypermarkets as fresh or frozen, unpacked or prepacked. They are also exporting. They have a good management and good systems of training their staff.

Because of their feedlots, they get animals in good condition to produce marbled meat and can slaughter during the whole year.

Some companies limit their business to manufacturing meat-products like dumplings, sausages or ham. They buy the meat from different suppliers.

7.3 Conceptual Design of Community-based Slaughterhouse

As already mentioned, the visits to meat-plants, slaughterhouses and meat-processors, and the consultations and discussions with herders, directors of slaughterhouses, meat-plants, meat processing companies and retailer gave a deep insight into the existing market structures, their business models, and the opportunities for the future.

The traditional slaughtering is carried out without any meat-inspection (post- and ante-mortem) and simple equipment. Despite the simple procedure, the risk for human health may be limited. But the lack of fresh water, hygiene-cloth, unclear disposal of waste and the absence of ante- and postmortem veterinary inspections could mean that this type of traditional slaughtering could no longer be accepted by consumers in the future.

Further unsolved problems are low prices, low income for the farmers, the role of middleman, the lack of transparency and tracing-back, long transportation distances and times with risks of spreading contagious animal diseases. The seasonal slaughtering means that the utilization of the slaughterhouses is low, making economic operation very difficult.

So, the previous traditional slaughter by herders does not appear to be a future-oriented model to ensure the herders' livelihood and income. As described in many publications and reports, incomes and distribution options are limited. Due to the change in climatic conditions and social changes it is to be feared that the herders' economic situation could get even worse in the future.

Based on this information, the design of a community-based slaughterhouse was developed. The aim was to establish a model for a small slaughterhouse with:

- a capacity or 50 sheep (or 40 sheep and 2 cattle) a day
- limited investments

- traditional technology as far as possible but to improvements on the traditional slaughtering
- no expensive, maintenance-intensive equipment like electrical stunning, elevators, tubular tracks, lifting platforms and IT-based controlling-systems
- effective use of electricity and water
- a location close to herders
- distribution on local or domestic market
- lean management
- enhanced hygiene level with better shelf life
- cooling facilities
- a possible feedlot to supply the slaughterhouse over the whole year with animals and to increase weights and conditions

In addition, the income of herders should be increased and the negative impact of animal husbandry on the environment should be limited.

Species and Capacity

At the first step there should be slaughtered about 40 sheep and 2 cattle per day. In the long term, increase should be possible.

Degree of processing

At the first step slaughtering, cutting, deboning, cooling, freezing, packing (vacuum) will be carried out.

Labor requirements

The slaughterhouse could run at capacity with a staff of three to five butchers. Mongolian regulation states that the company must have a veterinarian on staff for inspections. A driver would be required for product delivery. Management and administrative staff would include an operations manager with experience running a meat plant and an accountant/office manager. If the two management/admin staff do not have marketing experience, a marketing person may also be required. Total staff would range from seven minimum to a maximum of ten.

Electrical requirements

The aim is to use as little electrical energy as possible. Therefore, there are no conveyers or lifting platforms. However, the carcasses must be cooled down within 24 hours down to 2 °C. The required energy depends on the outside temperature, the insulation, the opening times of the doors, the cooling technology, and many other things. In comparable slaughterhouses there is an electrical power of 30 to 40 KW specified. But the actual amount of energy must be calculated by a specialist in air conditioning technology. It is critical that the energy is always available without interruption and all over the year.

40 KW solar grids are available for industrial purposes. In the United States, a 40kW solar panel ground mount installation kit system may cost between $63,000 and $79,000 USD excluding labour[17]. China is building renewable capacity faster than any other country and similar units can be obtain at a much lower

[17] https://www.gogreensolar.com/products/40kw-40000w-solar-panel-ground-mount-installation-kit

price, in the range of $12,000 USD before shipping and installation[18]. Similar products available in Mongolia based on Chinese prices plus transport, taxes and mark-ups.

Management requirement

The most important factor is that there is somebody who is responsible for the whole project and takes care about the entire process from beginning to end. This person should have experience in leading and maintaining a meat-company. To ensure the engagement, this person should invest their own money and must be reliable. A business plan and financial calculation about the necessary investments are essential.

It is essential that financial resources are available for construction, start-up and ongoing costs. The needs must be calculated during the planning stage.

Regulatory requirements

Regulations on environmental protection, occupational safety, working hours and approval procedures must be observed.

Hygiene, hygiene and food regulations, food safety

The hygiene requirements for slaughtering, cutting and processing are laid down by the *Technical Regulations for Production and Trade of Meat and Meat Products* (Draft document, Ulaanbaatar 2021). Accordingly, abattoirs must have several rooms, beginning with a crowding pen, animal stunning and bleeding room/area, rooms for de-hiding, pelting, scalding, storage of skins, evisceration, a room for suspect carcasses, edible offal, laundry, and workers changing and break rooms. There are further rooms necessary for meat processing establishments. These requirements correspond to international standards like the Codex Alimentarius or hygiene regulations issued by European Community.

Those requirements may be necessary to avoid risks in slaughterhouse with high throughput and capacity, long shelf life, international trade, export and different levels of trade, but for the slaughtering by herders themselves, or the slaughtering in small establishments with low throughput and capacity, using mainly manpower and local distribution, those far-reaching requirements are not necessary. Local meat plants have short transports, are located near the farmers to support local consumers, focus on domestic or local market and do not want to take part in international trade or export. For small or medium-sized establishments the responsibility for all operations by single person, trained staff, ongoing monitoring, and compliance with good hygiene practices is much more important.

Therefore, the slaughtering of a limited number of animals in an effective and hygiene way can be carried out in one room, possibly in different places or animal by animal at different times. Therefore, customized regulations for small slaughterhouse must be established. This question is particularly for small slaughterhouse very important.

Additional discussions with meat industry specialists in December 2022 provided information on the regulatory environment with specific information for small slaughterhouses:

[18] https://www.alibaba.com/product-detail/Greensun-Complete-Off-Grid-Solar-System_1600132957148.html

- As of January 2023, all soums will have to use meat from the industrial meat plants or from small soum meat plants for all their local institutional uses (schools, hospitals etc). As of January 2025, all markets in the country will have to do this.
- According to the law on ensuring the safety of food products, there is no license to operate in the food sector, only registration with the inspection body is required. In the case of meat and meat product producers, it is required that the supervisory body issues a conclusion within 30 days on whether the requirements specified in the Law on Food and the Law on Ensuring Food Safety are met.
- HACCP is not required for a small slaughterhouse but GMPs must be followed. However, since there is no program for its introduction and no monitoring system has been established, it has not been determined which factories have introduced it and which have not. There are guidelines issued by regulatory bodies but implementation has not been done.
- It is not necessary to have a resident veterinarian. It is recommended to have a contracted veterinarian.

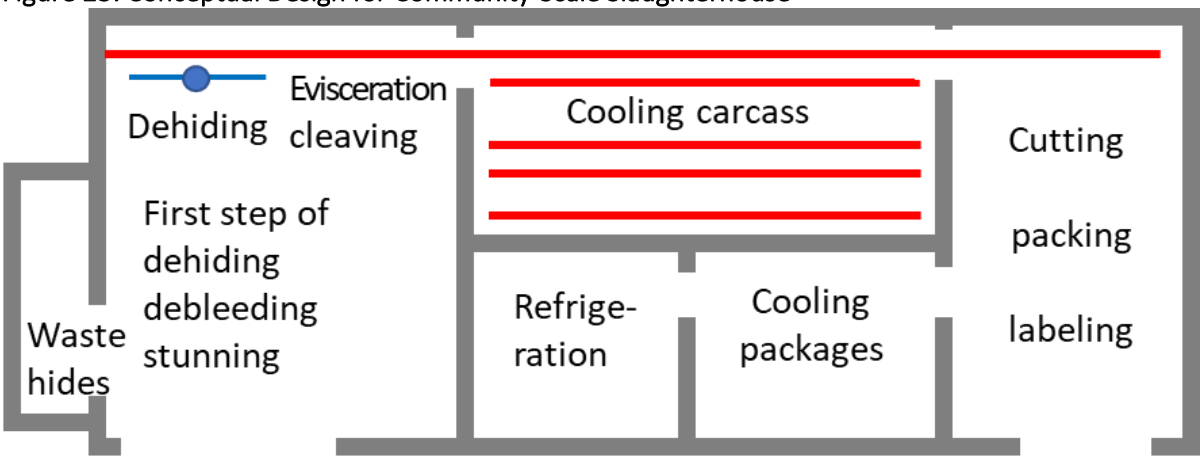
Building requirements, slaughtering facilities

To save investments and other expenditures, and to make the process effective, the small-scale slaughterhouse consists just of three rooms: slaughterhouse, cooling room and a room for cutting, packing and labelling.

With this design, it is possible to slaughter one or two cattle at the same time. When the first carcass is on the tubular track for evisceration, the next one is brought into the slaughter room to get stunned. In the case of sheep, three sheep can be processed at the same time, but the different steps like stunning, bleeding, de-hiding and evisceration are carried out at different places within the slaughter room. In that case no contamination is possible, and slaughtering is going continuously and fast.

When animals come in, they are stunned and bled. First step of dehiding can made on ground or on a special device that prevents the cattle from tipping over on their sides. After that, the hind legs of the cattle are fixed on a bar and lifted by elevator. The skin will be removed and the body eviscerated. In the case of sheep, they also will be raised up, dehided and eviscerated. The individual steps are shown schematically in the following Figure 23.

Figure 23: Conceptual Design for Community-Scale Slaughterhouse



Mobile slaughterhouses

For small slaughterhouses there are also mobile units available. They work on the same technology mentioned above. Slaughterhouse, room for cooling the carcasses and cold storage of meat and room for deboning, packing and labeling are housed in a container. This system is very flexible because containers for processing and other functions can be added. The containers are ready for use with everything such as water pipes or electricity installed. The containers are quickly installed and have the advantage that prices are fixed. They can be removed quickly or other modules, like a container for producing meat-products like dumplings, are easily added.

Figure 24: Community-Scale Mobile Slaughterhouse (profile and from above)

Mobile slaughterhouses are available not only for small slaughterhouse, but even for slaughterhouse with an increased capacity (see picture below, IFFA 2022).

Figure 25: Mobile Slaughterhouse

Energy Efficiency Potential in Meat Processing

Meat processing can be divided into four stages: i) slaughter and carcass preparation, ii) deboning and trimming, iii) preservation and storage, and iv) processing, packaging and distribution. Energy savings and GHG reduction can be achieved at each stage using energy efficient technologies and/or using renewable energy sources that replace the use of fossil fuel-based energy. The amount of energy that can be saved at each stage can vary depending on the specific technologies used, the size of the facility, and the level of energy efficiency already in place. Refrigeration is a major use of energy (60% to 70%)[19] in meat processing followed by air conditioning systems, hot water/boiler systems and compressors[20]. Energy savings can be achieved through improved processes, design and maintenance and/or investment in new technologies. The following table summarizes the potential savings at each stage of meat processing.

Table 43: Potential Energy Saving in Meat Processing

	Slaughtering and carcass preparation	Deboning and trimming	Preservation and storage	Processing packaging distribution
A. Energy Efficient Technologies				
High-efficiency lighting systems	x*)	x	x	x
Automated deboning and trimming		xx		
Efficient refrigeration and cooling systems			xxx	xxx
Energy-efficient processing equipment, such as meat grinders and mixers				x
Heat recovery systems (Heat exchanger): waste heat from cooling/heating systems, hot sewage from processing products	xxx	x	x	xxx
Electric stunners and pneumatic systems versus traditional mechanical methods	xx	x		
Disclaim or reduction of air conditioning, cooling, heating and ventilation systems	xx	xx	xx	xx
Regional origin of animals and regional distribution to save fuel in transportation	xxx			xx
Use of natural climate: especially cold winter temperatures for cooling carcasses	xx	x	x	x
B. Renewal Energy Technologies				
Recovery of waste heat from refrigeration systems or hot water	xx	x	xx	xx
Solar power systems to produce electricity	xxx	x	xx	xxx
Wind turbines to produce electricity	?	?	?	?
Biogas plants: use of slaughterhouse and other agricultural waste	xx	x	x	xxx
Combined heat and power plant to produce heat and electricity (co-generation)	xx	x	x	xxx

*Legend: *)* ***x*** *Low impact* ***xx*** *Medium impact* ***xxx*** *High impact*

[19] "Energy Efficiency Opportunities in Meat Processing" by the Australian Government Department of Industry, Science, Energy and Resources

[20] "Saving energy in abattoirs & meat processing facilities", Australian Industry Group

7.4 Feasibility Assessment

7.4.1 Introduction

The aim of the assessment is to determine if a small community-scale slaughterhouse can be realized in Bayantumen soum considering the local situation, the interests of herders and employees, the change in climate, the demands of customers and environment. In addition, food safety and quality are essential components of the assessment.

7.4.2 Preparatory Documents

To carry out the feasibility assessment full information about the project must be available: project location, address of the project implementer, project capacity, introduction, information on amount and source of road, electricity, heating, and water required for the project operation, plus information on classification, recycling, and removal of waste.

(1) Business plans

A complete and believable business plan is a fundamental requirement for any feasibility assessment. No business plans were made available from NEAARC. The alternative site at the soum centre has no project proponent and no business plans exist.

(2) Development permits

The current land designation at NEAARC is for agricultural/pasture use. No development permit has been granted for the proposed slaughterhouse feedlot complex at NEAARC at this time. Variations on land use can be permitted by the Soum Khural based on the review of required documentation submitted by the applicant. Application for a land use variation and development permit needs to be submitted to the Soum Khural in October each year.

The alternative site at the soum center is already located in a zoned industrial area for which a slaughterhouse is pre-approved enterprise. A feedlot is not allowed within this zone and would need to be sited elsewhere.

(3) Environmental impact assessment

According to a paper of the *Governor Office of Dornod Province and Department of Environment and Tourism of Dornod Province*, following documents are required for general environmental impact assessment for slaughterhouses:

1. Official letter by the citizen, enterprise, or organization to request to have general impact assessment conducted /full contact information of address and phone number needs to be clear.
2. Feasibility study and design approved by related authorized organization.
3. Official letter of support from local Governor of the soum.
4. Brief description of the project / project location, address of the project implementer, project capacity, introduction, information on amount and source of road, electricity, heating, and water

required for the project operation, plus information on classification, recycling, and removal of waste of the project is required.

5. Degree of Governor of province and/or soum on land owning and utilizing.
6. Map sketch of the surrounding area where the project will be implemented.
7. Report and Determination/Description of Environmental Status of the area where the project will be implemented.
8. Technology solutions to be used for the project / technologies to be used for the project must be decided after study conducted on environmentally friendly technologies such as efficient use of natural resources and less waste production.
9. Whether included in the land management plan for the related year / land permission or copy of the contract with the renter organization, copy of land cadastral map, license of land use in protected area.
10. Information of suppliers of the raw materials to be used for the project and copy of the contract if concluded a contract must be enclosed.
11. Copy of the license of enterprise and/or organization / notarized.
12. Copy of ID.

7.4.3 Development of Checklist to Assess Small-scale Meat Plant Feasibility

An assessment tool was developed to allow a standardized analysis that would provide transparency when considering the decision to select a preferred project from a range of options. This generic tool can be used to complete a similar analysis in any location.

a) Structure of checklist

The assessment tool is based on a checklist of success factors considered at two levels: current conditions and potential future conditions. The **checklist** consists of 10 categories. **Each category** consists of several sub-categories (e.g., general, business-plan, financial resources). Each **sub-category** consists of several **criteria**.

Criteria must be checked according to the description of project, the supporting documents and, if necessary, by interview with the applicant. The criteria are divided in two parts:

i. current fulfilment of the requirement (fulfilled or not)
ii. if measures to increase the status are possible or not.

b) Gradation of criteria - assessment of criteria

The checklist is constructed on a five-point scale versus a “yes” or “not possible“ approach.

Table 44: Checklist Grading Scale

Requirements currently fulfilled	Potential to improve
⑤ completely	⑤ easily possible
④ mostly	④ possible
③ partially	③ uncertain
② low	② hardly possible
① very low	① at present stage not possible
⓪ none	⓪ not possible

c) Criteria checklist

The full checklist is provided in Table 45.

Table 45: Slaughterhouse Feasibility Checklist

		Requirements Fulfilled	Increasing Measures Possible	Remarks
1	Management			
	General • Is there somebody who is responsible for the whole project? • Does this person have experience in leading and maintaining a meat-company? • Does this person invest their own money? • Is this person reliable?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Business plan • Is the business plan complete and believable? • Is it likely that the project described in business plan or another document will work?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Financial resources • Have investment costs been calculated? • Are the financial resources sufficient? • Is there a calculation about the ongoing costs?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
2	Site			
	Locations • Does the size of the plot allow the construction of the corresponding establishments? • Is that plot intended for a meat plant? • Is there official permission to build a meat-plant? • Is there any opposition against the project? • Is there community acceptance to build a meat-plant? • Will neighbouring residents accept the facility? • Are there any neighbours who might fight against the project? • Are there any other people affected by the meat	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	

		Requirements Fulfilled	Increasing Measures Possible	Remarks
	plant?			
	Infrastructure • Is it ensured that there is enough drinking quality water to run the meat-plan? • Is it ensured that there is enough uninterrupted electricity (amperage, power output) to run the meat-plant? • Is there a road to bring the animals and deliver the products? Is it ensured that there are no damages because of heavy rain etc.)?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
d	**Environmental Management** • Are there suitable plans and conditions for water sanitation? • Are there suitable plans and conditions for the disposal of slaughterhouse waste?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
3	**Staff, employees**			
	Number of employees • Are there enough employees indicated in the plan and available? • Are the employees free of communicable diseases?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Training • Did the employees already work in a meat-facility? • Are they trained in that duties they must do? • Are the employees trained in hygiene issues? • Is the person who trained the employees competent?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
4	**Food health, legislation**			
	Legislation requirements • Is it ensured, that the hygiene requirements, laid down in the *Technical Regulation on Production and Trade of Meat and Meat Products* are respected? • Is there a valid Hazard and Critical Control Point (HACCP) System? • Are critical control points (CCP) defined? • Is the staff trained to work according HAACP / CCP? • Is it ensured, that Good Hygiene Practices (GHP) and GMP are respected?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Veterinary service Veterinary checks • Is ante mortem and post-mortem meat inspection according to Mongolian law ensured? • Is it possible to relocate the ante-mortem-	⑤ ④ ③ ② ①	⑤ ④ ③ ② ①	

		Requirements Fulfilled	Increasing Measures Possible	Remarks
	inspection to the farmers-sites?	⓪	⓪	
	Traceback and labeling • Is the traceback from the meat and the meat-products to the animals and farm of origin ensured? • Is there a system for labelling the packages?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
5	**Energy, water, environmental**			
	Supply • Is the supply of energy sufficient all over the year? • Is renewable energy used? • Has the water drinking water quality and free from Is the water free from bacterial contamination? • Is there hot water for cleaning and disinfection? • Will the sewage be properly deposed?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
1.1	**Safeguards** • Is there an awareness of environmental risks? • Is there a system to protect the environment?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
6	**Animals**			
	Number of animals for slaughtering • Is it ensured that the number of animals to be slaughtered fit the equipment capacity? • Is it ensured that slaughtering in ongoing during all seasons?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Livestock transport • Is it ensured that livestock transportation fit the regulations laid down in Technical Regulation on Production and Trade of Meat and Meat Products, especially in view of space, rest periods, watering and feeding?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	

		Requirements Fulfilled	Increasing Measures Possible	Remarks
	Animal treatment and animal health • Is it ensured that the well-being of the animals is not impaired during unloading and keeping in stall (no hits or kicks)? • Is it ensured that no animals are slaughtered which are sick, weak or suffer from infections disease? • Is it ensured that no animals are delivered to the slaughterhouse with contagious animal diseases? • The well-being of the animals is not impaired during unloading and keeping in stall (no hits or kicks)?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
7	**Slaughtering facilities**			
	Building • Are there sufficient rooms and facilities to run the facility? • Is it ensured that floors, walls and equipment is in good condition and maintained? • Is it ensured that electricity is available in necessary scope (voltage, time) • Are there efforts to use energy efficiently? • Is it ensured, that hot and cold water is available in necessary volumes?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Equipment and handling • Is sufficient electrical or mechanical stunning secured? • Is it ensured that animal do not suffer avoidable pain (animal welfare)? • Is bleeding, removal of stomach and chest organs and animal carcass spitting under hygiene conditions ensured?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Cooling facilities / equipment • Is the size of the cooling room sufficient for the number of animals slaughtered? • Is the cooling performance sufficient to reduce the temperature of the carcases/meat to 2°C within 24 hours? • Is the size and capacity of the freezing room sufficient for intended purpose?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Staff • Is each member of staff provided with adequate protective and hygiene clothing? • Are all staff trained in their duties and trained in hygiene?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Hygiene • Is it ensured, that sufficient cleaning and disinfection are performed?	⑤ ④ ③	⑤ ④ ③	

		Requirements Fulfilled	Increasing Measures Possible	Remarks
	• Is it ensured, that sufficient pest control is performed and that no other animals like dogs can enter the facility? • Is it ensured that all rooms in which food is stored, prepared, treated or processed are well maintained and clean?	② ① ⓪	② ① ⓪	
	Points			
	Score = Points / rated categories			
8	Cutting, Deboning and Packing			
	Building • Are there sufficient rooms and facilities to run the facility? • Is it ensured that floors, walls and equipment is in good condition and maintained? • Is it ensured that electricity is available in necessary scope (voltage, time)? • Are there efforts to use energy efficiently? • Is it ensured, that hot and cold water is available in necessary scope?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Staff • Is each member of staff provided with adequate protective and hygiene clothing? • Are all staff trained in their duties and trained in hygiene?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Hygiene • Is it ensured, that sufficient cleaning and disinfection are performed? • Is it ensured, that sufficient pest control is performed and that no other animals like dogs can enter the facility? • Is it ensured that all rooms in which food is stored, prepared, treated or processed are well maintained and clean?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
9	Processing			
	Building • Are there sufficient rooms and facilities appropriate to produce meat-products? • Is it ensured that floors, walls and equipment is in good condition and maintained? • Is it ensured that electricity is available in necessary scope (voltage, time)? • Are there efforts to use energy efficiently? • Is it ensured, that hot and cold water is available in necessary volume?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	

		Requirements Fulfilled	Increasing Measures Possible	Remarks
	Staff • Is each member of staff provided with adequate protective and hygiene clothing? • Are all staff trained in their duties and trained in hygiene?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Hygiene • Is it ensured, that sufficient cleaning and disinfection are performed? • Is it ensured, that sufficient pest control is performed and that no other animals like dogs can enter the facility? • Is it ensured, that all rooms in which food is stored, prepared, treated or processed are well maintained and clean?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
10	**Selling facilities and selling possibilities**			
	Building • Are there appropriate facilities? • Is it ensured, that floors, walls and equipment is in good condition and maintained?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Staff • Are all staff trained in their duties and trained in hygiene?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Hygiene • Is it ensured, that sufficient cleaning and disinfection are performed? • Is it ensured, that sufficient pest control is performed and that no other animals like dogs can enter the facility? • Is it ensured, that all rooms in which food is stored, prepared, treated or processed are well maintained and clean?	⑤ ④ ③ ② ① ⓪	⑤ ④ ③ ② ① ⓪	
	Points			
	Score = Points / rated categories			
	TOTAL SCORE			
	% Score			

7.4.4 Evaluation and Scoring

Within each category, the number of points is added up and divided by the number of categories that were rated. This produces the "score" for each category. The maximum score possible in any category is 5 points. The total score possible over the 10 categories is 50.

Table 46: Example of Category Scoring using Project Site

	Category	Current score	Potential to Improve	
	Locations • …	4	4	
	Infrastructure • …	4	3	
	Environmental Management • …	5	2	
	Total Points	13	9	
	Score = Points / rated categories	4.3	3	

To get an over-all evaluation, the score from each of the 10 categories are totalled. The maximum possible score over the 10 categories is 50. To convert this to a percentage score, the number is multiplied by 2.

This system makes it possible for a responsible persons, institution, or authority to compare different projects, which differ in the various criteria.

Example:
Maximum possible score over 10 categories = 50
Actual score out of 10 categories = 39
Percentage score: 39 * 2 = 78 %
That means, that the project is scored with 78 % from a maximum of 100.

7.5 Site-specific Analysis

A "site-neutral" approach was used to compare the pros and cons of a central and a remote (bagh) facility location, include the analysis of the on-grid and off-grid options, against a set of objective feasibility criteria. The two sites assessed included one at the soum centre and a remote site at NEAARC. Rather than giving a simple "yes/no" answer regarding the feasibility of a specific side, a graduated approach was used that indicated i) feasibility or readiness at the current time, and ii) the potential to achieve feasibility in the future. Recommendations and a pathway to feasibility were provided.

The checklist is best suited for when a slaughterhouse is already in operation or when a detailed business plan is available for review. Because of a lack of information and data on the proposed sites and business plans, only the potential physical sites (category 2) could be used in the evaluation plus some management criteria (category 1) and information on the supply of animals (category 6). Based on the information available, the following opportunities and challenges facing each of the sites have been identified.

Table 47: Summary Comparison of Opportunities and Challenges for Two Potential Project Sites

Site near NEARC	Site near soum-centre
Positive: • Applicant was very engaged in project and should be responsible • Has experience in slaughtering • Takes care about herders • Site available • Size allows establishing meat plan • Unpaved road must be maintained	Positive: • Energy-supply already available • Site available • Community supports project • Plot intended to build meat plant (Community) • Plot accepted by community to build meat plant • Site was formerly used a slaughtering area

Site near NEARC	Site near soum-centre
	• Residents accept the plant if there are no negative effects (Information by Officials) • Size allows establishing meat plan • Unpaved road must be maintained
Unclear: • Electricity line already established but functionality is unclear • Plot intended to build meat plant (Community) • Plot accepted by community to build meat plant • Chance to get realized • Chance to be successful in future • Own investment • Financial resources • Accessibility to reliable, trained labour force • There is an adequate supply of livestock in the soum, but it is very seasonal. Providing a stable supply of consistent animals all year round will require accessibility to feedlot cattle.	Unclear: • All issues concerning the company running the facility since there is no applicant • There is an adequate supply of livestock in the soum, but it is very season. Providing a stable supply of consistent animals all year round will require accessibility to feedlot cattle. The site at the soum is not approved for feedlot so it would need to be sited in a different location.
Negative: • No specific infrastructure for meat pant at present stage available	Negative: • Water-supply must be established • No specific infrastructure for meat pant at present stage available
Problem • No further information available (business plan, financial resources, marketing, distribution, energy)	Problem • No further information available (business plan, financial resources, marketing, distribution, energy) • No interested applicant yet available

To provide a full illustrative example of how the checklist can be used, the comparative examination of the two sites has been completed and is provided in on the next page in Table 48. As mentioned in the summary, there was limited information available about the business plans, but both sites are basically suited to the physical construction of the plant. The soum site has a slight advantage in terms of infrastructure and access to labour while the remote site has the advantage of an engaged champion for the project.

Both sites face serious challenges regarding: i) access to finance, ii) maintain a steady supply of animals throughout the year, and iii) dealing with quality control issues in terms of the expense of running HACCP systems and the uncertainty related to external factors of animal health (disease outbreaks), the adequacy of veterinary services and the incomplete system of livestock traceability in Mongolia.

Regardless of the size of a slaughterhouse or meat-plant, a valid HACCP-System is essential (development, implementation, verification). In addition, a manual for Good Hygiene Practice GHP must be developed, implemented, and verified and the employees must be trained according to their duties. Implementing HACCP, GHP and training will arise additional costs (one-time and ongoing). In small sized slaughterhouses

or meat-plants those duties could be solved by the vet (depending on knowledge) or must be done by external consultants.

Conclusion

Both sites are basically suitable to establish a meat plan. However, because there is a lack of data and documented business plans, a complete scoring could not be carried out. To complete an assessment of either project to a degree usable to seek financing, further information is necessary.

In the accompanying report, “4.2 Business Models”, projections of product flows, revenue and expenses and investment requirements are provided, which provide additional information about the feasibility and challenges of the proposed plant. However, these models provide a generalized analysis and are not directly representative of one or the other specific sites.

Table 48: Slaughterhouse Feasibility Checklist Comparing Two Potential Project Sites, Current and Future Potential Scores

		Site 1 – Soum Center			Site 2 – Remote Location		
		Req Fulfilled	Improv. Possible	Remarks	Req Fulfilled	Improv. Possible	Remarks
1	Management						
	General	0	4	No person identified.	4	4	Person identified but has not run a meat plant. No plan shared. Finance required.
	Business plan	0	4	No plan.	0	4	
	Financial resources	0	4	Will need finance.	2	4	
	Points	0	12		6	12	
	Score = Points / rated categories	0	4		2	4	
2	Site						
	Location	5	5	Size adequate. Already approved in soum plan. Needs water.	3	5	Land size adequate but not yet approved. Grid uncertain. Water unknown. Poor road.
	Infrastructure	4	5		3	4	
	Environmental Management	3	5		3	5	
	Points	12	15		9	14	
	Score = Points / rated categories	4	5		3	4.7	
3	Staff, employees						
	Number of employees	0	5	Staff available in town. Training required.	0	4	Staff would have to drive. Training required.
	Training	0	5		0	5	
	Points	0	10		0	9	
	Score = Points / rated categories	0	5		0	4.5	
4	Food health, legislation						
	Legislation requirements	0	5	Possible with conceptual design. Management critical. HACCP is costly. Vet/traceback weak.	0	5	Possible with conceptual design. Management critical. HACCP is costly. Vet/traceback weak.
	Veterinary service Veterinary checks	0	4		0	4	
	Traceback and labeling	0	4		0	4	
	Points	0	13		0	13	
	Score = Points / rated categories	0	4.3		0	4.3	
5	Energy, water, environmental						
	Supply	3	5	Power in place. Water well required. Safeguards can be met.	2	4	Power unreliable. Water well required. Safeguards can be met.
	Safeguards	0	5		0	5	
	Points	3	10		3	9	
	Score = Points / rated categories	1.5	5		1.5	4.5	
6	Animals						
	Number of animals for slaughtering	3	4	Adequate number of animals in the soum. Seasonality a problem.	3	4	Adequate number of animals in the soum. Seasonality a problem.
	Livestock transport	3	4		3	4	
	Animal treatment and animal health	2	4		2	4	
	Points	8	12		8	12	
	Score = Points / rated categories	2.7	4		2.7	4	

		Site 1 – Soum Center			Site 2 – Remote Location		
		Req Fulfilled	Improv. Possible	Remarks	Req Fulfilled	Improv. Possible	Remarks
7	Slaughtering facilities						
	Building	0	4	The conceptual design provided would meet the requirements, given proper management and training.	0	4	The conceptual design provided would meet the requirements, given proper management and training.
	Equipment and handling	0	4		0	4	
	Cooling facilities / equipment	0	4		0	4	
	Staff	0	4		0	4	
	Hygiene	0	4		0	4	
	Points	0	20		0	20	
	Score = Points / rated categories	0	4		0	4	
8	Cutting, Deboning and Packing						
	Building	0	4	The conceptual design provided would meet the requirements, given proper management and training.	0	4	The conceptual design provided would meet the requirements, given proper management and training.
	Staff	0	4		0	4	
	Hygiene	0	4		0	4	
	Points	0	12		0	12	
	Score = Points / rated categories	0	4		0	4	
9	Processing						
	Building	0	4	Not in the current design. Could be added meeting requirements.	0	4	Not in the current design. Could be added meeting requirements.
	Staff	0	4		0	4	
	Hygiene	0	4		0	4	
	Points	0	12		0	12	
	Score = Points / rated categories	0	4		0	4	
10	Selling facilities and selling possibilities						
	Building	0	4	Not in the current design. Could be added meeting requirements.	0	4	Not in the current design. Could be added meeting requirements.
	Staff	0	4		0	4	
	Hygiene	0	4		0	4	
	Points	0	12		0	12	
	Score = Points / rated categories	0	4		0	4	
	TOTAL SCORE OUT OF 50	8.2	43.3		9.2	42.0	
	Percentage score	16.4	86.6		18.4	84.0	

7.6 Summary of Findings and Recommendations

1 Present situation

Mongolia faces challenges throughout the meat value chain. Increasing numbers of animals have a negative impact on vegetation and the sustainability of animal husbandry and cattle grazing. In many cases, there is a strong focus on export. However, strengthening national and regional marketing and economic cycles are crucial for increasing the incomes of the rural population and herders. Transboundary animal diseases are widespread, and the veterinary system has not been able to deal effectively with outbreaks. Food hygiene practices and hygiene standards also fall short of international standards.

To achieve highest possible prices, herders sell their animals preferable in the late autumn and early winter period. Because of lack of feed, suboptimal genetics and ineffective management animals have low weight and are sometimes in poor physical condition. In order to improve the precarious financial situation of the herders, it is necessary to improve national or regional marketing and extend it throughout the year.

2 In general, there are different business-models in the Mongolian meat-market recognizable.

- Traditional slaughtering
- Industrialized slaughterhouses
- Integrated meat plants
- Meat-processors

The traditional way of slaughtering is being surpassed by more industrialized plants due to legislative changes, new investments by companies seeking urban and export markets and greater consumer awareness of food quality and safety concerns. Any new plant will need to be able to meet new industrial and health standards and remain price competitive.

3 A Feasibility assessment-tool was established. Use of a Checklist with categories, sub-categories and criteria.

- Under current conditions, the assessment form could not be fully completed for the two sites due to information shortages. On the criteria that could be evaluated there is little significant difference between the two locations. Each has relative strengths and weaknesses. Both face significant external challenges in the year-round supply of livestock, animal health, veterinary services and traceback systems.
- However, it was possible to consider future potential to meet feasibility requirements:
  Site near NEARC: Advantages for this site appears the long-term engagement of the applicant and owner for the social situation of the herders and his efforts to increase the income of the herders and to enable a good future in their traditional circumstances. In interviews he mentioned that he has experience in slaughtering and was working in slaughterhouses in USA and Germany. His purpose and philosophy are to establish a small slaughterhouse to improve the hygiene and professionalism in slaughtering, to improve the quality of the meat and to

develop new marketing opportunities. Ultimately the income of the herders should be improved and secured. Since he is the owner of the site, it will be possible to start to establish the slaughterhouse soon.

Site near soum-center: very positive support of the Community and the already completed energy-supply.

4 For both sites there are still a lot of challenges for management and ownership. To enable and secure the construction and long-term operation of the slaughterhouse, financial resources must be available. Furthermore, clear specifications and ideas are necessary for the origin of the animals and for the year-round supply in good physical condition and weight. This can only be guaranteed by appropriate feedlots and the associated facilities.

In addition, a stringent, realistic, sustainable and viable concept for marketing is required. Because of the small size of the meat-plant it seems to be risky to sell the meat or meat products only to middleman or wholesalers, because they might have the option to determine the prices and the amount of purchased meat. To reduce dependency on those customers, there is the possibility to establish own marketing chain with direct sales to end customer in the region or perhaps in Ulaanbaatar, preferably in cooperation with a reliable partner. But it must be mentioned that own marketing and own sales facilities are associated with considerable logistical difficulties. Therefore, a detailed business plan including information about financial resources, sales channels, customers, supply chain, suppliers of animals, feedlot (who is running) and feed gain is essential.

Despite all the difficulties, it must be stressed that a smaller meat center can offer many opportunities and advantages for the herders, the local people, the community and local customers. Therefore, it seems reasonable and expedient to pursue the project further. With the appropriate commitment, know-how and engagement, it is very possible to overcome the difficulties mentioned.

5 At present time, competitiveness cannot be verified, because there is no business plan and no concept how slaughterhouse will work and stay in business. With professional management, creative marketing with focus on regional origin, animal welfare and natural rearing, with fresh products in good quality and fair prices, it will be possible to find a market niche and appropriate customers who are willing and able to enjoy the meat.

8 Deliverable 4.2 Business Models

8.1 Overview of the Report

The objectives of the overall United Nations (UN)-Climate Technology Centre and Network (CTCN) technical assistance (TA) is to:

3) Enhance the capacity and knowledge of herding communities on climate-resilient livestock farming and
4) Facilitate decision-making to invest in community-scale sustainable meat processing system to improve the livelihood from livestock farming and enable the vulnerable communities to derive the best value from the livestock farming while dealing with the adverse impacts of the climate change.

Furthermore, the UN-CTCN hopes that the decision-making process used for Bayantumen soum could provide a Decision Support System (DSS) for soums across Mongolia to determine their climate vulnerability, pasture strategies and feasible value chain opportunities.

Developing business models for the meat sector that will sustain the rangelands and livelihoods for rural communities requires a holistic approach that considers the entire value chain. It is not enough to just consider developing a meat-processing center, or to establish a feedlot. Each segment of the meat value chain has specific economic aspects and management issues and market different products, yet they are integrated. For beef, the production segment in Mongolia would include herders acting as seedstock producers (high quality breeding animals), commercial cow-calf producers (to produce cattle that eventually go to a feedlot), yearling/stocker operators that raise young cattle until they are ready to go into a feedlot, and feedlots that fatten cattle. The processing segment would include abattoirs (slaughterhouses) and meat-processing facilities and wholesalers. A major concern for any meat-related business is how meat can be produced, processed, and marketed most efficiently.

This report looks at the technical, financial and market feasibility of developing a new approach to the livestock value chain in Bayantumen soum. The TA Team investigated all aspects of the meat value chain in the target area, including gender and socio-economic dimensions. The analysis was done in a step-wise fashion, examining each segment of the value chain: young stock production, supplementary feeding, meat processing and end markets. It is closely related to the feasibility assessment of the community-scale slaughterhouse provided in Deliverable 4.1, which should be considered a sister report.

8.2 Methodology

Multiple methods were used to conduct the feasibility study and develop the business models. These included:

1. **Literature and Data Review:** Published reports on the meat sector, livestock value chains, business conditions, fodder production and other related topics were reviewed.
2. **Consultations:** Meetings were held with sector actors at the national, aimag and soum level.
3. **Site visits:** Site visits were conducted to all stages of the livestock value chain at various locations between Ulaanbaatar and Bayantumen soum.
4. **Data Analysis:** National data on production, productivity and trade and other pertinent topics were analyzed. Localized and enterprise specific information was collected. Production costs and productivity indicators were reviewed with stakeholders. Livestock and feeding productivity indicators were compared to international standards.
5. **Participatory approaches:** Stakeholder consultations were held with both NEAARC and the soum key stakeholders. This included a review of sites and the feasibility criteria, verification of assumptions and costs, and a review of the results of the analysis. Information on the study was provided in a transparent way through meetings and the sharing of reports.
6. **Development of the Business Models:** Business models were developed based on the analysis. The business models could be scaled up through Green Climate Fund (GCF), Global Environment Facility (GEF), International Finance Corporation (IFC) and/or other programs.

The analysis took a demand-driven, value-chain approach emphasizing new markets for younger, higher-quality cattle and sheep. Within the value-chains for beef and sheep, there various production stages, each which can be undertaken by either private or cooperative activities. The business models examine the overall business strategy and the ownership options for each link of the value chain. Decision criteria focus on:

1. Readiness: are the natural resources, infrastructure, market channels and human resources (skills and knowledge) in place to grasp the opportunity.
2. Gross Margin Analysis: is the activity financially feasible
3. Capital investment: the capital investment is required to start and operate the enterprise as well as the human resources requires (management, marketing, skilled labour)
4. Riskiness: the types and levels of risks facing the enterprise.

Slaughterhouse Site Selection: In Deliverable 4.1, a "site-neutral" approach was used to compare the pros and cons of a central and a remote (bagh) facility location, include the analysis of the on-grid and off-grid options, against a set of objective feasibility criteria. The two sites assessed included one at the soum center and a remote" site at NEAARC. Rather than giving a simple "yes/no" answer regarding the feasibility of a specific side, a graduated approach was used that indicated i) feasibility or readiness at the current time, and ii) the potential to achieve feasibility in the future. Recommendations and a pathway to feasibility were provided.

Site specific, analysis should be completed when investment money has been identified and detailed documentation must be prepared for financing and environmental impact assessment (EIA), which is beyond the scope of the current TA.

The decision support tool for slaughterhouse feasibility is provided in Deliverable 4.1.

Decision Support Tools for Value Chain Assessment: A matrix of feasibility criteria was drafted that includes:

1. Market opportunities: Export, urban (Ulaanbaatar), regional and local.
2. Natural resources: The availability or potential availability for livestock feed (pasture, natural hay, grain, green fodder) and water.
3. Livestock health: Animal health, traceability, disease free zones, sanitary/phytosanitary requirements (SPS), food safety and Hazard Analysis and Critical Control Points (HACCP)
4. Livestock genetics: Improved genetics and breeding management.
5. Infrastructure and equipment: Land, power, water, production/storage facilities, handling equipment, vehicles, roads (on site; to market)
6. Management and human resources: Management, marketing, production (feedlot, plant), food safety and HACCP.
7. Environmental issues: Safeguards and monitoring regarding slaughterhouse and feedlot wastes.
8. Economics: Potential returns.

The general approach to illustrated in Figure 26.

Figure 26: Multi-Criteria Approach to Value Chain Feasibility

Market/Technical	Financial	Business Strategy
MARKET **PRODUCTION SYSTEM** - feed and water - livestock and breeding - animal health, traceability, food safety, HACCP **INFRASTRUCTURE & EQUIPMENT** **HUMAN RESOURCES** - Management, marketing - Production - Food safety/HACCP **ENVIRONMENTAL** - Safeguards, Monitoring	Can the business make a profit? Is there enough investment capital? Is there enough operating credit? Can you manage the financial risks caused by changes in input and market prices?	Type of ownership? (private/coop) Marketing management Value system coordination - distributors, processors, herders and farmers communicate and coordinate Scale - sufficient volume to access markets and compete on price Value-added traits - location ("Dornod meat"), attractive "story" about the product and/or producers, organic certification Production system - "push"– produce then find a buyer - "pull" – find a buyer then produce Relationship with the customer - Need to have a good understanding of your customer base.

A scoring grid was developed to assess readiness and feasibility for each criteria. The 1-5 scoring grid (Table 49) matches the grid used in the slaughterhouse feasibility analysis in Deliverable 4.1.

Table 49: Scoring Grid for Value Chain Feasibility Analysis

Criteria Fulfillment - Current Condition		Criteria Fulfillment - Likelihood of Achieving	
Complete	5	Easily	5
Most	4	Possible	4
Partial	3	Uncertain	3
Low	2	Hardly possible	2
Very Low	1	At present stage not possible	1
None	0	Not possible	0

The complete DSS is shown in Table 50. To illustrate how the scoring system is used, the current conditions for primary production of sheep and cattle by herders is assessed. In Bayantumen soum, the basic resources (pasture, water) and infrastructure (shelters, wells) are in place but there are limitations in the amount of supplementary feed that is produced. Export systems score very low because of market access issues stemming from livestock disease, the absence of disease-free zones and weaknesses in traceability, SPS and HACCP systems. Management and technical knowledge need to be improved, especially regarding the environment and marketing. Overall, returns to herders are low.

In Table 50, the “future possible” scoring has not been completed. This is done in the body of the report where the value chain assessments are reported.

Table 50: Decision Support Tool – Value Chain Development

Criteria	Current System		Young Stock Sales		Backgrounding		Feedlot		Slaughterhouse	By-Product Sales	Further Processing
	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle	Mixed		
MARKET											
Export	1	1									
UB / other provinces	4	4									
Local	5	5									
FEED AND WATER											
Water and water wells	4	4									
Pasture	4	4									
Hay	3	3									
Green fodder – planted	2	2									
Concentrate feed	2	2									
LIVESTOCK HEALTH											
Animal Health	3	3									
Traceability	2	2									
Disease-free zone	0	0									
Sanitary-Phyto Sanitary -export	1	1									
Food Safety Systems/HACCP	1	1									
BREEDING											
Methods	3	3									
Improved genetics	2	2									
INFRASTRUCTURE & EQUIPMENT											
Land	3	3									
Power	2	2									
Water											
Buildings (production, storage)	4	4									
Production & handling equipment	4	4									
Vehicles	4	4									
Roads (onsite, to market)	3	3									
MANAGEMENT & HUMAN RESOURCES											
Management Skills	3	3									

8 Business Models

Criteria	Current System		Young Stock Sales		Backgrounding		Feedlot		Slaughterhouse	By-Product	Further
	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle	Sheep	Cattle	Mixed	Sales	Processing
Marketing Skills	2	2									
Production Skills (feedlot/plant)	3	3									
ENVIRONMENTAL											
Safeguards	2	2									
Monitoring	2	2									
ECONOMICS											
Potential Returns	2	2									

Legend:

Current Likelihood of	Non 0	Very Low 1	Low 2	Partial 3	Most 4	Complete 5
Conditions: Achieving:	Non 0	Not now 1	Hardly 2	Uncertain 3	Possible 4	Easily 5

8.3 Opportunities and Target Market

8.3.1 The Community Based Slaughterhouse Concept

In Deliverable 4.1 Meat Plant Feasibility Study, the design of a community-based slaughterhouse was developed. The design allows for a limited capital investment, the use of traditional technology as far as possible, inexpensive, low-maintenance equipment and efficient use of electricity and water. Cooling facilities are included. While simple in design, it allows for enhanced hygiene level with better product shelf life. Staff and management requirements are minimized. The slaughterhouse is intended to be located close to herders with distribution of product to the local or domestic market. To ensure a year-round supply of livestock for slaughter, a feedlot should be established. This multi-species plant would have the capacity to slaughter 50 sheep or an equivalent mix of sheep and cattle. For this analysis, a mix of 40 sheep and 2 cattle per day was used. The plant could slaughter 10,000 sheep and 500 cattle operating 50 weeks per year. This would produce 200 mt of mutton and 100 mt of beef per year. The feasibility assessment showed that the two proposed locations each had relative strengths and weaknesses but could meet the basic technical requirements for site selection. The critical factor for success rests in ownership and management capacity and capacity to withstand external risks. Detailed analysis is provided in Chapter 4.

8.3.2 Market Analysis

(1) Overview of Supply and Value Chain

The meat supply chain includes a range of stakeholders, territories, and distance: herders (involved in herding, feeding, rangeland, water supply, shelters, vet service, transport and on-foot driving); processors (inspection, processing, freezing, storing, deboning, sorting, and packaging); and logistic suppliers (transport, store sales and serving consumers). Products from processing facilities have the advantage of being able to be sold on the global market and generate income through both domestic and international marketing. Meat of various livestock and animal origin are the main sources of income for herder households. Herders supply meat and live livestock to the centralized markets as follows:

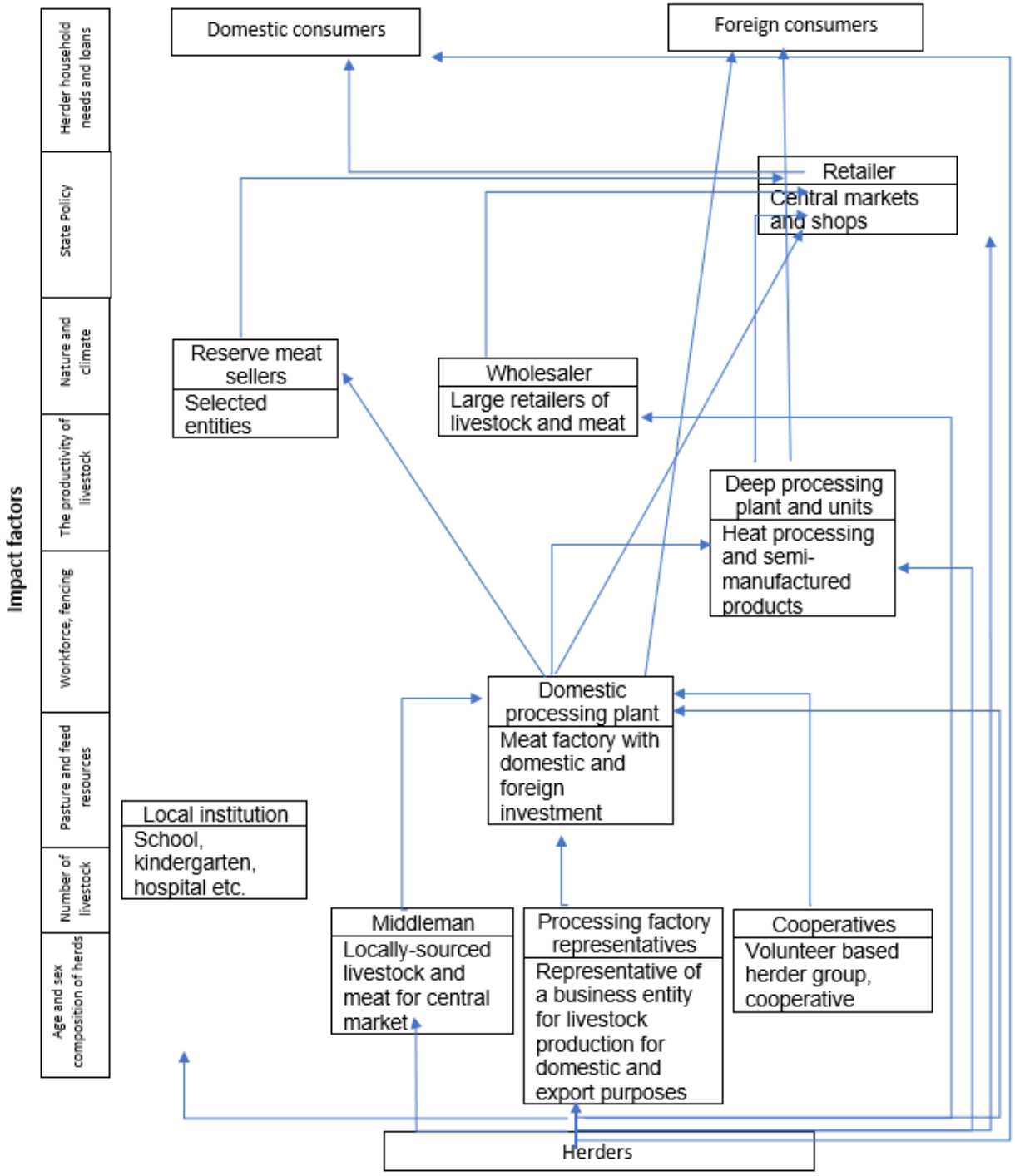
1. Sell live animals: Herders supply fattened livestock to the nearest markets during the fall and winter. Livestock is sorted by their type and ages and sold to intermediaries (middleman) or end users. This method has the advantage of preventing product quality changes during shipping as well as extending its shelf life. However, it can also have negative effects such as reduced prices and slower sales.

2. Traditional slaughter: Most animals are slaughtered by traditional method and carcasses brought to the soum, aimag or other centralized markets. Several problems exist with this method: i) no veterinary and intestinal examinations are carried out on the livestock slaughtered for food; ii) it is not possible to detect its origin or traceability; iii) slaughter locations do not meet modern requirements; iv) meat hygiene is inadequate as there is no washing or cleaning; v) it is not possible to cool, freeze or store the meat according to standards; and vi) it is not possible to meet the requirements for delivery or transportation to urban centres or consumers.

3. **Delivery to slaughterhouses:** A small number of herders have livestock slaughtered and meat processed in the abattoir and then go through many steps to reach end users.

The meat supply chain in Mongolia is illustrated in Figure 27.

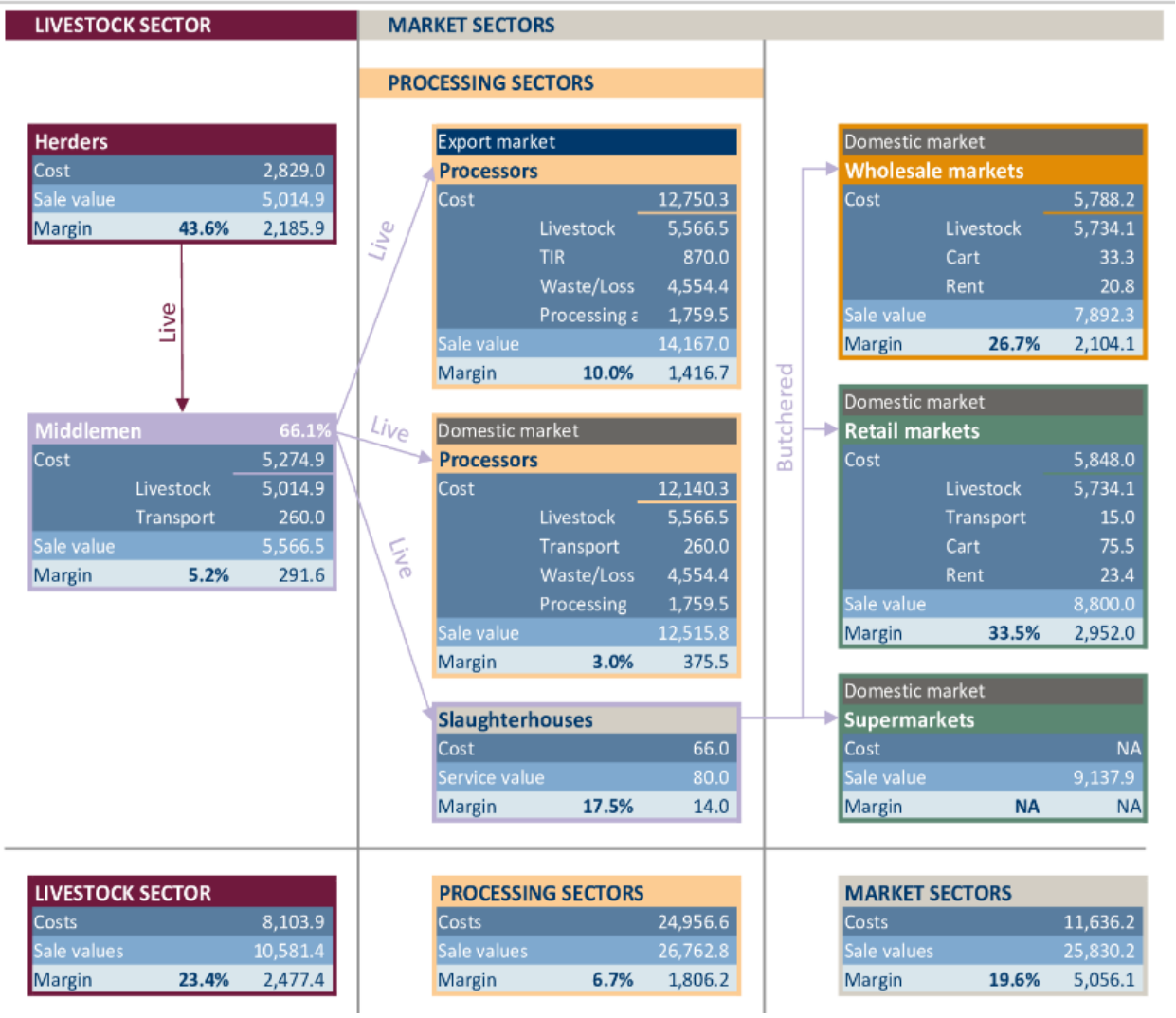
Figure 27: Meat Supply Chain



In the current system, herders receive a small share of the value of meat. Primary production costs include feed, veterinary medicine and service, fencing, hired herders, slaughtering costs (MNT 25,000 for a three-year old male yielding a 160 kg carcass or 156.3 MNT/kg), depreciation and basic living expenses. Costs to the middleman include the cost of the live animal, transportation, loading and unloading and preparing the meat. Wholesaler costs include the cost of the carcass or meat product, in-town shipping, operating permits, loading and unloading charges, weighing costs and parking fees. Retailer costs include the purchase price from the wholesaler, operating permit fees, the rental fee of the counter, the loading and unloading charges and the weighing costs.

Table 51 shows the margins within and between the sheep meat value chain. Processors selling in the domestic market work with a 3 percent margin while slaughterhouses achieve a 17.5 percent margin on slaughter services. The margins between the domestic processing and the wholesale/retail prices average 19.6 percent but the spread can be as much as 33.5 percent.

Table 51: Detailed Value Chain Analysis – Sheep Meat Bone-In (values in MNT)



Source: UNCTAD https://unctad.org/system/files/official-document/ditccominf2021d10_en.pdf

(2) Meat Processing Sector

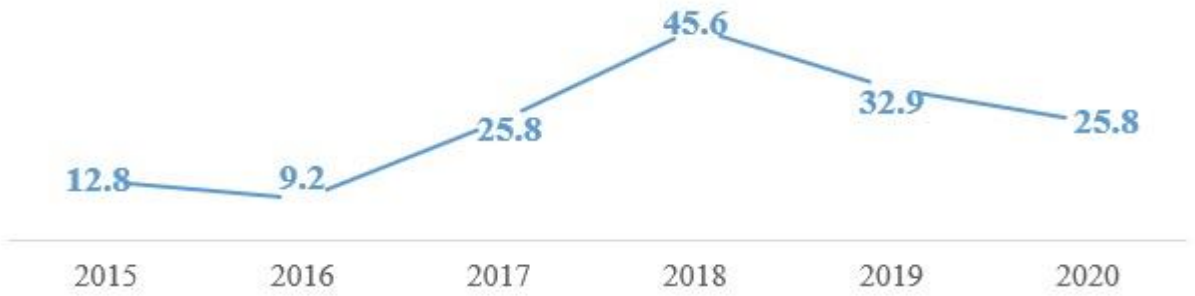
Meat is a strategic staple food for general use in the domestic market and has the potential to be a major export product. Table 52 presents Mongolian meat production levels from 2016-2020[21]. Only a fraction of meat production is carried out in processing factories, as shown in Figure 28. By 2020, 3.4 percent of the total meat production were processed by factories.

Table 52: Meat production, Mongolia 2016-2020

No.	Types of livestock	Unit	2016	2017	2018	2019	2020
1	Cattle	'000 mt	92,4	97,7	126.6	114.7	158,5
2	Sheep, goats	'000 mt	193,1	207,5	236,3	258,1	343,1
3	Goats	'000 mt	0,6	0,5	0,6	0,6	0,3
Total		'000 mt	**400,0**	**426,1**	**515,2**	**545,0**	**744,5**

Source: National Statistical Office (NSO)

Figure 28: Meat Produced in Slaughterhouses, 2015-2020 ('000 mt)



Source: National Statistical Office (NSO)

Industrial slaughtering is important to increase employment in the meat sector and to raise the value of products so they can compete in both domestic and foreign markets. With greater volumes through industrial slaughter, new technologies and innovations can be introduced and the reputation and profits are increased. As of 2016, 48 meat processing factories were formally registered in Mongolia, in the following regions:

- Western: 17 (Khovd 3, Bayan-Ulgii 6, Uvs 3, Zavkhan 4, Gobi-Altai 1).
- Khangai: 10 (1 each in Arkhangai, Bayankhongor, Khuvsgul, Bulgan, Uvurkhangai, Bulgan and Uvurkhangai and 5 in Orkhon).
- Central: 16 (Ulaanbaatar 9, Darkhan 2, Tuv 1, Selenge 2).
- Eastern: 5 (Sukhbaatar 2, Khentii 2, Dornod 1).

[21] Махны үйлдвэрлэл - ХХААХҮЯам (mofa.gov.mn)

Of these 48, one operates at 80% capacity, five at up to 50% capacity and four at up to 30% while 27 operate at only 20% capacity or less. Another 14 are inactive[22]. In recent years there has been an increase in the number of meat processing facilities, especially those designed for the heat treatment/thermal processing required to export to many countries because of Mongolia's livestock disease status.

While there has been a rapid rise in the number of slaughterhouses and meat processing facilities, many do not comply with national and international standards or required equipment, technology and human resources. Table 53 shows the number of factories that meet the requirements of importing countries, as verified by experts, certified as eligible to export meat.

Table 53: Mongolian Slaughterhouses Meeting Export Requirements

№	Type	Number of factories	Operational factories	Certified for export
1.	Slaughterhouses	48	22	31
2.	Thermal processing factories	120	60	4
3.	Sorting and deboning factories	15	6	0

Source: National Value Chain and Finance Expert's report of "Promoting Dryland Sustainable Landscapes and Biodiversity Conservation in the Eastern Steppe of Mongolia" project, 2018

(3) Overstocking and Low Offtake Rates

Mongolia's livestock herd has grown from 26 million in 1990 to 67 million in 2021. Traditional livestock management practices, preferences against consuming young stock, attitudes about livestock as wealth and self-insuring against weather disasters by holding "extra" livestock all contribute rapidly growing livestock numbers. Typically, the herd includes many older, non-breeding animals resulting in a low percentage offtake (slaughter) from the herd annually. Offtake as a percentage of total herd size was estimated (Table 54). There were no region-specific statistics available for this calculation, thus the state data was used. Using 2017 as an example, only 21% of the herd was slaughtered (24% for sheep; 18% for cattle). Because of the lack of supplementary feeding and pasture degradation, carcass weights are low (Table 55) and in decline. By comparison, offtake rates for cattle in Canada and sheep in Australia are typically about 32% (ranging from 30 – 35%) with average carcass weights of 340 kg for beef and 22 kg for sheep.

Table 54: Estimate of Annual Livestock Slaughter as a Percentage of Herd Size, 2017

Livestock Type	Livestock Population ('000 hd)	Annual Slaughter ('000 hd)	Offtake %
Horse	3,939.8	463.4	12
Cattle	4,388.5	802.7	18
Camel	434.1	33.4	8
Sheep	30,109.9	7,091.8	24
Goat	27,346.7	5,714.5	21
Total	66,219.0	14,105.8	21

[22] *National Value Chain and Finance Expert's report of "Promoting Dryland Sustainable Landscapes and Biodiversity Conservation in the Eastern Steppe of Mongolia" project, 2018*

Source: NSO data and consultant's calculations

Table 55: Estimate of Annual Meat Preparation and Unit Yields

Livestock type	Total Meat Production ('000 mt)			Carcass Yield (kg/hd)			
	2015	2016	2017	2015	2016	2017	Average
Cattle	*93,2*	92.4	97.7	128	128	122	126
Sheep	*220.9*	193.1	207.5	16	17	16	16
Goat							
Total	***314.1***	**285.5**	**305.2**				

Source: NSO data and consultant's calculations

The potential for export markets is often projected based on increasing livestock numbers and current, low offtake and carcass yields. This projected meat production growth is shown in Table 56. Livestock numbers to grow to 93 million by 2024 – an unsustainable number on the pastures – producing 548,000 mt of meat annually.

Table 56: Projected Livestock and Meat Production 2019-2024, Current Herd Expansion and Productivity

Type	Livestock ('000 hd)		Offtake Rate (3-year average)	Annual Slaughter ('000 hd)		Carcass Wt. kg/hd	Annual Meat Production ('000 mt)	
	2019	2024		2019	2024		2019	2024
Horse	4,186	5,664	11%	460	623	120	55.2	74.8
Cattle	4,605	5,906	18%	847	1,087	126	106.8	136.9
Camel	495	718	8%	42	60	350	14.6	21.1
Sheep	32,719	46,067	25%	8,212	11,563	16	131.4	185.0
Goat	28,437	36,017	23%	6,427	8,140	16	102.8	130.2
Total	**70,441**	**94,370**		**15,988**	**21,472**		**410.8**	**548.0**

Source: NSO data and consultant's calculations

Mongolia's pastures cannot sustain the current levels of overstocking let alone additional growth in livestock numbers. Changing herd structure to increase offtake numbers and improving herd management to increase carcass yields can have a similar but more sustainable impact on meat production and export market development. Table 57 illustrates the potential impact of increased offtake rates and carcass yields on annual meat production. Improving cattle and sheep/goat productivity such that offtake rates match international standards and increasing carcass yields could result in as much meat production as the baseline projection for 2024 but with an 11% reduction in herd size relative to 2019 (62.8 million versus 70.4 million) and a 33% reduction in comparison to the 2024 projected herd size (62.8 million versus 94.3 million).

Table 57: Livestock Numbers Needed to Match 2024 Meat Projections with Improved Productivity

Type	Livestock ('000 hd)	Offtake Rate (3-year average)	Slaughter ('000 hd)	Carcass Wt. kg/hd	Meat Production ('000 mt)
Horse	5,664	11%	623	120	74.8
Cattle	2,139	32%	685	200	136.9
Camel	718	8%	60	350	21.1

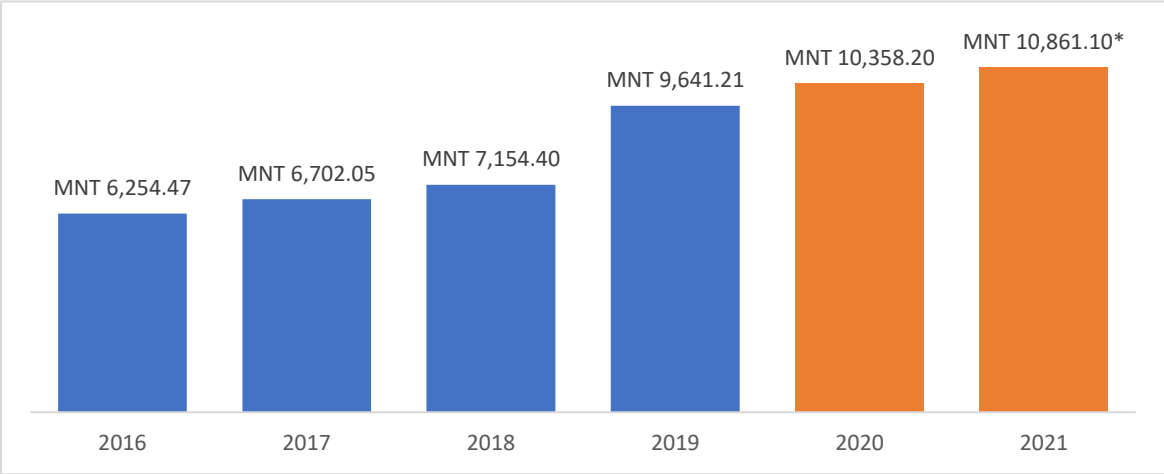
Type	Livestock ('000 hd)	Offtake Rate (3-year average)	Slaughter ('000 hd)	Carcass Wt. kg/hd	Meat Production ('000 mt)
Sheep	28,907	32%	9,250	20	185.0
Goat	25,437	32%	8,140	16	130.2
Total	**62,864**		**18,758**		**548.0**

Source: NSO data and consultant's calculations

(4) Meat Prices and Government Interventions

While industrial processing of meat can improve food safety and quality, the increased production costs translate to higher retail prices which negatively affects the purchasing power of Mongolian consumers. Consumer prices for meat in urban centres such as Ulaanbaatar have increasing steadily since 2016 with negative impacts on consumer purchasing power and food security (Figure 29).

Figure 29: Annual Average Meat Price, Ulaanbaatar, (MNT/kg)



** - Price for the first quarter of 2021.*
Source: derived from NSO Data; ADB Managing Food Insecurity During COVID 19

In 2021, meat processing facilities prepared up to 20,000 tonnes of meat to be stored for consumption in Ulaanbaatar, Erdenet, Darkhan and aimag centres under the Reserve Stock Meat government-run program. This is roughly equivalent to the annual consumption needs of 6% of Mongolia's population (3.3 million people and 102 kg meat consumption/year) but most of the total meat processed in industrial factories each year. During the seasonal slaughter period, slaughter facilities operate at full capacity with positive impacts on revenue and jobs creation. Meat is frozen and released into the market during the late winter, early spring period when fresh meat is scarce and prices spike. The Government sets the maximum price for reserve meat and meat processing facilities received a subsidy or incentive of MNT 500-100 for sorting, packaging and delivering meat.

While this system ensures a certain quantity of meat in the market and a lever for managing prices, it has several issues. The meat provided is considered low quality after several months of cold storage and the artificially low price distorts the market for higher quality product. This can be a disincentive for meat

processors to operate and invest in new technologies. The system is expensive to run in terms of subsidies, incentives, and inspection costs.

It would be more effective and efficient to address the food security issue with target income supplements for vulnerable families in need and leave the private sector to respond to the market signals sent by late winter price spikes. A better use and targeting of government subsidies would be to incentivize investment in year-round feeding and slaughter. Prices could be stabilized by providing a larger and steady supply of industrially produced meat year-round with related improvements in establishing disease free zones (DFZs) and increasing the capacity of storages and warehouses. This would have additional benefits in supporting export development and facilitating a decrease in total herd size back towards pasture carrying capacity.

(5) Trends in Consumer Demand

Mongolian consumers have no tradition or culture of consuming meat processed in factories; rather they prefer meat slaughtered traditionally. For thousands of years, Mongolian have slaughtered animals in traditional ways and consumed fresh meat. They have tended to criticize factory-processed meat as being over-cleaned, of poor taste, and bones cut by saw and not separated and sorted traditionally. Hence, Mongolians often still buy meat slaughtered traditionally.

However, the situation has been changing in the last few years, so it is it important to use the media to advertise the safety of meat processing facilities and how they produce safe and healthy food, to increase public awareness, provide understanding to policy makers, improve government support and inspection and create the most conducive legal environment. Meat processors also need to meet public demand and requirements, including consumer tastes/interests of consumers, add produce types and improve quality.

(6) SWOT Analysis

A Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis was completed on the key stages of the livestock and meat production and trade. The analysis is presented in Tables 58, 59 and 60, below.

Table 58: SWOT Analysis of Livestock and Meat Production

Strength	Weakness
1. Extensive expertise and experience in pastoral animal husbandry. 2. Experienced and skilled workforce with animal husbandry. 3. The rapidly growing network of roads enables products to be delivered to markets within a short period of time without a change in the quality. 4. Majority of the herders have their own fences and barns.	1. Decrease in young generation herders. 2. Pasture degradation increased due to the growth of livestock numbers and the limited seasonal moves. 3. Higher risks of natural disasters due to lesser opportunity of natural hay harvesting. 4. Meat production is active only in cold seasons due to lack of proper storage means. Not able to take advantage of spring price rise due to lack of storages. 5. Price of hide and by-products dropped. 6. Agricultural and fodder production is not developed in the region; thus fodder is scarce and costly.

	7. Animal selection has been neglected, as a result animal productivity is declined. 8. Due to water scarcity, some pastures are depleted. 9. Large investment needed for raising production, intensifying livestock and technological innovation, but funding sources are limited and low. 10. Cooperation with by-product producing entities has not been established. 11. No coordination for migration and temporary grazing transitions, increasing pasture degradation.
Opportunity	**Threat**
1. There's a rising tendency of the demand of eco products in the market. 2. Under the "Mongolian livestock" national program[23], measures to treat and disinfect livestock have started. 3. The government is applying a policy to increase the export of meat and meat products. 4. By commissioning of private and jointly owned storages, the government aims to decrease the seasonal effects of the meat and increase the economic efficiency using price rises.	1. Last few years, drug use for livestock has drastically increased without proper monitoring, thus traces of the drugs remain in the meat. 2. Surface and groundwater resources decreased. 3. Due to the rapid climate change and increased heat, there's a tendency for surface water resources and plant species to decrease; and yields to lessen. 4. Meat consumption could be affected negatively due to decreased livestock fattening resulting from climate change and change in vegetation diversity. 5. Vaccines are used erratically by herders because of the lack of control over provision of veterinary services. 6. Continual outbreaks of epidemic livestock diseases in the region could cause restriction in the supply.

Table 59: SWOT Analysis of Livestock and Meat Trade Activities

Strength	**Weakness**
1. Traders can establish their own sales channel compared to herders. 2. Low operating costs per unit, due to a large volume of goods being transported at one time. 3. Buyers have a well-known and established supplier in the field of animal and meat preparation. 4. Product quality can be assessed. 5. Excellent growth of the road network has made it possible to deliver products to the markets in a short time and without any change in quality.	1. Specialized warehouses and vehicles are scarce 2. No vehicles intended for the carriage of meat during the warm season. 3. No stocking up in the hot season due to the lack of a dedicated storage tank and risk of change in product quality. 4. Do not take advantage of price increases in spring season due to the lack of storage. 5. Meat export restrictions have been tightened to protect the domestic market. 6. Despite the large investment required to expand operations and upgrade warehouses and vehicles, funding sources are limited and small.

[23] *https://www.gafspfund.org/sites/default/files*

	7. Product price is not correlated with quality.
Opportunity	**Threat**
1. In the world market, the demand for organic products is growing. 2. The state has a policy of increasing exports of meat and meat products. 3. The state has begun to stock up on meat to limit the rise in meat prices, which has given it the opportunity to supply large quantities of meat to certain customers.	1. There are still outbreaks of livestock diseases in the region, which could limit supply.

Table 60: SWOT Analysis of Meat Production

Strength	Weakness
1. Adequate supply of raw materials per year. 2. Extensive experience gained from working many years in the field. 3. Valid work experience on current technology and equipment. 4. The rapidly growing network of roads has enabled to deliver and distribute products shortly without any changes in the quality. 5. It is possible to employ local representatives in the local area and the training unit.	1. No competitiveness capacity with foreign buyers. 2. Do not have technological capacity to conduct veterinary examinations and tests for export. 3. Meat factories do not get veterinary medicine residues, heavy metals, toxicological or bacterial tests done regularly on products and wastewater. 4. Delayed settlement due to financial insufficiency adversely affects livestock and meat preparation. 5. Use technology that is outdated and costly. 6. Investments in production and technology upgrades are needed, but funding sources are limited and low. 7. No mutually beneficial cooperation with the meat producers and business entities established. 8. Weak system to control livestock theft. 9. Difficulty in livestock transition due to increased livestock numbers, degraded pastures, and reduced water supply. 10. The cost is higher due to the auto transportation of a certain part of the prepared meat products. 11. Lean meat, offal and heads are not stored separately due to the unavailability of storage by animal type. 12. Meat products are limited in the region due to livestock diseases. 13. The skills of detaching and cutting the meat are insufficient when the buyer requests.

	14. Small-scale of deep processing, products are limited. 15. Revolving fund is limited. 16. The cost of slaughtered livestock in the factory is higher than slaughtered livestock by hand. 17. Non-compliance with the state standard of meat sorting or cutting; no price differentiation by cuts.
Opportunity	**Threat**
1. Demand for eco-products is expected to grow in the world market. 2. The government is pursuing a policy to increase exports of meat and meat products. 3. The meat demand of Mongolian livestock is increased in the neighboring countries.	1. Due to the neglect of the control of veterinary drug usage, prepared meat products may contain drug residues, heavy metals, toxicological or bacteriological traces; may get banned. 2. There is a risk of export embargoes due to livestock diseases. 3. The state has poor control over the activities of foreign invested entities.

(7) Summary of issues

The following challenges and difficulties have been observed in the meat industry in recent years. It includes:

- Livestock diseases outbreaks which limit export market access.
- Goat herds that have poor quality and poor meat yield have increased.
- Livestock genetic quality and the output per unit of livestock is declining.
- Herders focus on increasing livestock numbers rather than livestock intensification.
- Livestock numbers are increasing rapidly, leading to pasture degradation and desertification.
- There has been no efficient strategy to improve the meat processing system.
- Domestic processing plants are still struggling to compete in the market due to lack of operating capital to purchase livestock and process meat.
- China invested primary processing plants have been operating in Emeelt, Nalaikh and other rural areas. They have already established their own units everywhere and purchase large quantities of livestock and meat from suppliers based on their financial advantages. Because of this, domestic meat factories cannot compete with them.

It is vital to devote attention to increasing meat prices by primary processing, sorting, deboning and packaging. Intermittent processing negatively affects processing facilities that operate on a seasonal basis when staff remain idle for some time. Full-scale meat processing is significant in stabilizing factory operations and staff engagement. A clear example is shown in a case study of Makh Market LLC, where sorting, deboning and heat treatment increases profit margins by 20- 30%, reduces transport costs, widens the variety of choice for consumers and increases consumer satisfaction by supplying safe and healthy food.

8.3.3 Target Markets

(1) Competitive and Collaborative Environment

The major local competitor is Dornod Meat, a large-scale industrial plant with capacity of 150-200 large animals using western-style methods and 800-1000 small stock/day using HALAL slaughter methods. They currently slaughter for the government reserve program but plan to export 2000-3000 tons of meat and meat products annually. They have recently installed thermal processing to support exports. Since they are focussed on different end markets (export, government reserves) may not be a direct competitor.

Dornod Meat presents some collaborative opportunities. They provide custom slaughter for herders and middlemen who then deliver the carcasses to Khaan Khuun and others for further processing. Dornod Meat is planning a feedlot adjacent to the slaughterhouse that would have 18 pens and areas for both beef and sheep. Several hectares have been allocated and two wells are already on site.

Khaan Foods LLC (Dornod Branch) produce 1500 mt/year which is 50% of their capacity. The plant supplies 10% of the meat product in Dornod while 30 to 40% of their production goes to Ulaanbaatar. Supply is 90% sheep and goat and 10% cattle. Issues include the seasonality of livestock supply, animal health issues and sheep carcasses not meeting their 20 kg requirement. The plant provides support to herders by advancing payments to vets for services and then deducting the cost from payment for the carcass. They have a policy to buy meat directly from herders and hope to decrease sales from middlemen from the current level of 80% down to 50% or 60%. They think the plant in Bayantumen could be feasible and would have no problem penetrating the market at its intended scale. It would provide Khaan Khuun an avenue to purchase carcasses directly from herders and they would consider investing in it. They now collaborate with other plants to source carcasses. Khaan Khuun piloted a higher quality/safe meat product, but the small market did not justify the increased costs. Instead, they will develop new processed, semi-processed and chicken-based convenience products (buuz, dumplings).

Feedlots and feedlot/slaughterhouse complexes exist between Dornod and Ulaanbaatar with established end markets in Ulaanbaatar. They have an ongoing need to quality feeder cattle. These include:

- MCS, Hentii aimag: A 5,000 head feedlot will open in late 2022. The feedlot is fully integrated with crop production, providing all of the feedstuffs required. Slaughter will begin using mobile units, which provides the flexibility to add capacity or contract in the future.
- Jargalkhan Soum, Hentii aimag: A new slaughterhouse with capacity for 1,500 sheep and 350 cattle per day will open in 2023. A planned feedlot would have an annual capacity of 15,000 sheep and 9,000 cattle. The company has produced sausage in Ulaanbaatar for 13 years. The slaughterhouse/feedlot complex will secure their supply chain and provide export market diversification. The location was selected based on access to major highways, the availability of land, feed and water and access to livestock.
- Bayandelger Meats: This plant supplies sells eMart and is planning their own shop to market top quality products. They are a vertically integrated operation with a feedlot, their own breeding stock and cropland as well as business relationships with local crop and livestock producers. They are open to additional partnerships with other livestock suppliers.

- **Lavai:** The company was established a food market in 2017. The absence of well-developed supply chains makes it difficult to work in the meat sector. There is very strong competition in Ulaanbaatar, especially from the Khujit market where herders take their livestock. Their strategic advantage is that they follow all regulatory and food safety standards and market under their own brand label. They are developing a feedlot to control production and food safety standards at every stage. They currently use custom slaughter but want to establish their own slaughterhouse using a mobile unit.

(2) Meat Export

Bayantumen soum is in Dornod province which borders with China and Russia. These markets are very close compared to Ulaanbaatar, which is 650 km to the west. The export market is being pursued by meat companies and supported by national programs and international donor projects.

However, because of the weak animal health systems, infectious diseases such as Foot and Mouth Disease (FMD) are not under control and borders close each time there is an outbreak. The instability of export markets makes any investment targeted at them extremely risky. Export markets also require a high level of coordination and communication with other actors in the value chain (importers, distributors). This would require skills and expertise that may not be in the local area or would have to be hired at considerable cost. Competitiveness in the export market would require the ability to supply minimum order sizes and certain quality specifications on a consistent basis. To keep transaction costs low on a cost/kg of meat sold, high volumes would be needed. Given the seasonality of supply, this could be a major constraint.

While export markets should not be ruled out in the long term, they are not considered a feasible target market for the start-up of a small community-based plant. Furthermore, the small scale plant designed for the community level does not meet the international requirements of export markets because the various stages of slaughter and processing are not separated into different rooms.

(3) Domestic Meat Markets

The official population of Choibalsan is 38,537 while Ulaanbaatar has a population of 1,645,000. Using daily consumption levels of red meat in these two locations reported in 2020[24], the potential market shares of the Bayantumen slaughter plant were calculated (Table 61). The Bayantumen plant production would represent 8% of the Choibalsan market but less than 1% of the Ulaanbaatar market.

Table 61: Red Meat Consumption Levels and Bayantumen Market Share

Red Meat	UB	Dornod	*Average*
gr/day[a]	320.2	284.0	*302.1*
kg/year	117	104	*110.3*
Population, capital city	1,645,000	38,537	
Daily consumption (mt)	526.7	10.9	
Annual Consumption (mt)	192,256	3,995	
Bayantumen Market Share	0.2%	8%	

a: Diet and Nutrition Status of Mongolian Adults, May 2020.

[24] *Diet and Nutrition Status of Mongolian Adults, May 2020*

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7284332/table/nutrients-12-01514-t001/?report=objectonly

The domestic market consists of several segments across multiple locations. Each has opportunities and constraints for the start-up operation (Table 62). As the marketing becomes more complex, either in terms of geographic location or the level of value-added, the cost of product increases, either because of increased transportation, increased marketing and market development costs or a combination thereof.
The remote location of Bayantumen soum relative to the major premium meat markets in Ulaanbaatar impacts transportation logistics and costs as well as communication and coordination between the local community and various other actors in the value chain, especially outside of Dornod aimag. Dornod's remoteness from Ulaanbaatar makes transportation a major expense. Livestock is produced in every province between Dornod and Ulaanbaatar and those producers would be able to land their product into the Ulaanbaatar market with lower transportation costs. This means that any "traditional" quality meat would be unlikely to compete on price against these closer provinces.

Table 62: Summary of Market Opportunities for Bayantumen Soum

Product Type	Market Segment /Distribution		Dornod	Ulaanbaatar	Comments
			Increasing Transport & Marketing Costs		
Traditionally slaughtered carcass	Direct to consumer	Increasing Production and Marketing Costs	√		Not likely to be cost competitive outside Dornod
	Small shops		√		
	Further processors		√		
Inspected carcass from hygienic meat plant	Direct to consumer		√	√	Opportunities increase but without a better-quality carcass, transportation costs will make it hard to be competitive.
	Small shops		√	√	
	Supermarkets		√	√	
	Further processors		√	√	
	Restaurants		√	√	
	Institutional use		√	√	
Carcass broken to major cuts	Direct to consumer		√	√	Cut differentiation is not common in Dornod. Market exists in Ulaanbaatar but requires more marketing effort.
	Small shops		√	√	
	Supermarkets		√	√	
	Further processors		√	√	
	Restaurants		√	√	
	Institutional use		√	√	
Further processed (sausage, dumplings etc)	Direct to consumer		√	√	Markets exist in both locations. Requires brand development and additional capital. Competitive market with lower cost manufactures at scale.
	Small shops		√	√	
	Supermarkets		√	√	
	Further processors			√	
	Restaurants		√	√	
	Institutional use		√	√	
	Direct to consumer - online		√	√	
Carcass or cuts based on value-added traits ("Dornod meat", "green", etc)	Direct to consumer		Maybe	Maybe	Limited market in Dornod. Market in Ulaanbaatar not well developed and willingness to pay not well defined. Needs strong marketing program.
	Small shops		No	No	
	Supermarkets		Maybe	Maybe	
	Further processors		No	No	
	Restaurants		No	No	
	Institutional use		No	No	
	Direct to consumer - online		Maybe	Maybe	

This implies that Bayantumen should seek to produce a higher quality product to allow them to sell at a higher price in the market. This will allow them to differential their product from the average meat product and help to offset the higher per unit production costs they will have as a small plant with limited scale. This, however, requires a more sophisticated marketing program and product control back to producers to ensure that the product quality claim can be delivered on.

Figure 30: End Markets for Bayantumen Slaughterhouse

END MARKET

Number of people to consume the meat from Bayantumen: 4000 people or 1000 households

Possible Markets

Choibalsan:		**Ulaanbaatar:**	
Distance	12 km	Distance	650 km
Population	38,537	Population	1,645,000
% of market	8%	% of market	0.2%
Opportunities: Access to chain stores, restaurants Easier to develop customer relations Sell carcasses direct to Khaan Khuun		**Opportunities:** Higher incomes, changing diets More restaurants wanting young meat Market "Bayantumen" Brand and story	
Issues: Very small high-income segment Prefer traditional or convenient to "eco"		**Issues:** Cost of transportation Distribution channels Harder to maintain customer relations	
Risk: Can't compete on price against traditional and industrial slaughter		**Risk:** People not ready to pay for younger or "eco" meat. Can't compete on price with small scale and long distance.	

8.4 Building Resilient Livestock Supply Chains

8.4.1 Current Situation: Supply-driven, Vulnerable Price-Takers

Herder households are primarily smallholders vulnerable to poverty and the impacts of climate change. As price-takers, they sell livestock as individual producers into a highly seasonal market. Selling during the traditional fall slaughter season to middlemen means they usually receive seasonally depressed prices with little transparency in price formation. There are limited market options and returns to the household are low. The production system is based on an eco-system threatened by overuse and climate change. Feed supply is not reliable and there is limited knowledge and technical/extension support to manage feeds and feeding programs based on livestock nutritional needs. New marketing systems and business models are needed that will allow herders to: i) access stable markets for livestock and livestock products; ii) benefit from price differentiation for quality livestock; and iii) access the capacity investment and operating finance needed to invest in productivity improvements and climate change adaptation.

In Bayantumen soum, the average herd size in 2020 was 299 animals consisting of 46 horses, 36 cattle, 129 sheep, 87 goats and 1 camel. In Table 63, the revenue and profit generated by cattle and sheep in the typical herd is estimated. Sales are based on current practices and calving and lambing rates of 46% and 48% respectively in Mongolia[25]. Only native hay is feed and there are no feed purchases. The gross revenue is 10.3 million MNT (USD 3,938) with direct production costs of 2.9 million MNT (USD 1,092) leaving a gross margin of 7.5 million MNT (USD 2,856) or $238/month. Cashmere sales would add 2.6 million MNT revenue (USD 994) and increase gross income to 10.1 million MNT (USD 3,850) or $321/month. This estimate is in line with the average annual income of a herding household, which is estimated at 15.6 million MNT (around $5,000) from all sources of income in 2022[26]. Mongolia's poverty line is set at USD 5.50 /day[27] ($2007/year/person) or $8,000/year (USD 669/mo.) for a household of four people. This indicates that the average herder household is living at or below the poverty line.

[25] *Gantuya case studies 2017-2018*
[26] https://bne.eu/the-economics-of-herding-in-mongolia-248998/?source=mongolia
[27] https://www.macrotrends.net/countries/MNG/mongolia/poverty-rate

Table 63: Gross Margin Analysis for Cattle and Sheep, Average Bayantumen Herd

Item	Description	Total (MNT)	Total USD (@ 2620)
REVENUE			
Cattle	2 steers, 3 open/cull cows	8,244,000	3,147
Sheep	10 sheep 30 months old, 7 ewes	2,099,328	801
Total		**10,343,328**	**3,948**
EXPENSES			
Feed - Purchased			-
Vet and Medicines		330,032	126
Marketing		780,000	298
Fuel - hay making		1,750,000	668
Total Production Costs		**2,860,032**	**1,092**
GROSS MARGIN		**7,483,296**	**2,856**
per month		623,608	238

8.4.2 Future Possible: Quality Oriented, Resilient and Sustainable

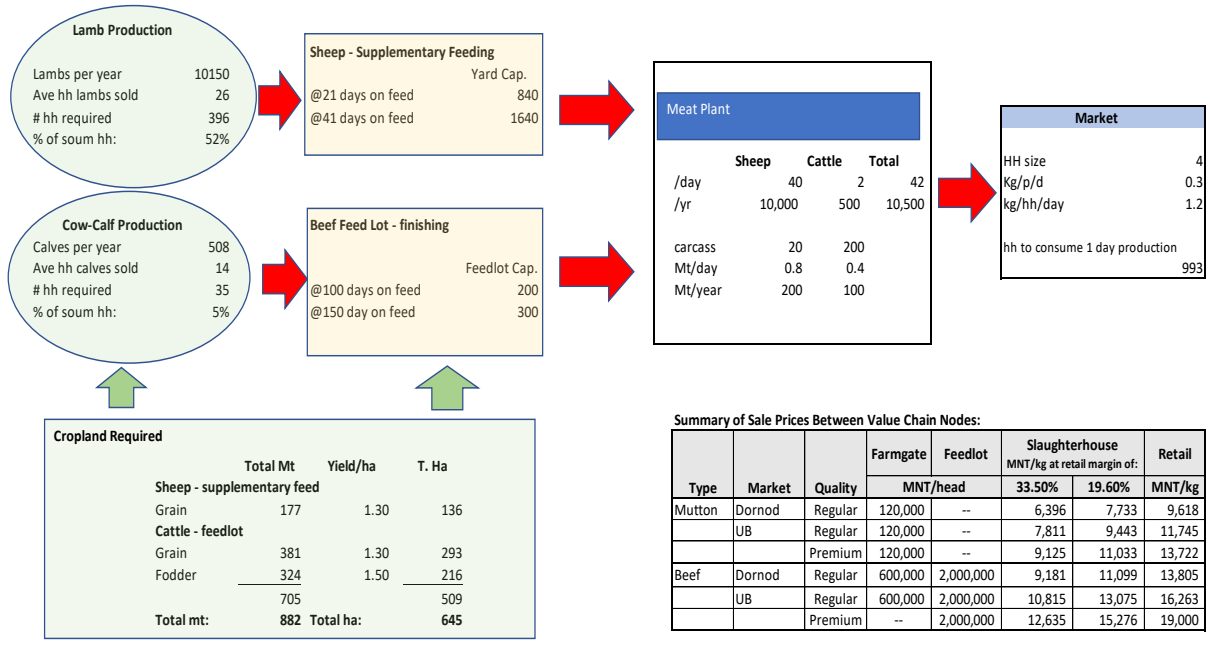
(1) Re-imagining the Supply Chain

More profitable and sustainable livestock supply chains are needed to lift rural people out of poverty, ensure food security and protect the environment. Improved supply chains would consist of:

- Informed consumers driving the demand for higher quality and safe meat products, nutritious food, less food waste, animal welfare and climate-smart production.
- Meat slaughterhouses and further processors operating year-round at high level of capacity utilization that provides the market a stable supply of meat throughout the year and minimizes seasonal price spikes while supporting improved and more stable profits.
- Feedlots and backgrounding operations providing a year-round supply slaughter-ready livestock to slaughterhouses.
- Livestock producers selling a high proportion of young stock from high quality, healthy and productive breeding stock and practicing sustainable, regenerative pasture management methods that improve soil quality, enhance water retention and support biodiversity.
- Integration between the livestock and crop sector to provide a reliable and affordable supply of quality feedstuffs through the introduction of diverse crop rotations and climate smart agriculture practices.

Figure 31 illustrates how improved supply chains in Bayantumen soum could be established through integration with meat slaughtering and the establishment of feedlots and supplementary feeding. The system illustrated is based on the proposed community-based slaughterhouse and shows the product flows and resources required at each supply chain node.

Figure 31: A New Supply Chain for Bayantumen Soum



Summary of Sale Prices Between Value Chain Nodes:

Type	Market	Quality	Farmgate	Feedlot	Slaughterhouse MNT/kg at retail margin of:		Retail
			MNT/head		33.50%	19.60%	MNT/kg
Mutton	Dornod	Regular	120,000	--	6,396	7,733	9,618
	UB	Regular	120,000	--	7,811	9,443	11,745
		Premium	120,000	--	9,125	11,033	13,722
Beef	Dornod	Regular	600,000	2,000,000	9,181	11,099	13,805
	UB	Regular	600,000	2,000,000	10,815	13,075	16,263
		Premium	--	2,000,000	12,635	15,276	19,000

The meat plant would slaughter 40 sheep and 2 cattle per day during a five-day work week, 50 weeks per year. The plant would purchase 10,000 sheep and 500 cattle per year. With cattle on feed for an average of 125 days, a feedlot with a capacity of 250 head would be needed. If sheep received supplementary feed for 21 days, there would be approximately 840 on feed at any given time. Given the new herd structure described in the previous section, the lamb feeding program would involve 396 households selling 26 lambs per year, or 52% of the Bayantumen soum herding households. The feedlot would engage 35 households selling an average of 14 calves per year, or just 5% of the soum herding households. The supplementary feed requirements to support the slaughterhouse and feedlot value chain are 882 mt of grain and green fodder which can be harvest from approximately 645 hectares.

These numbers are all technically feasibility given the land resources, households, herd sizes and end market present. In the following sections of the report, the business and financial viability of each individual node in the new value chain are examined.

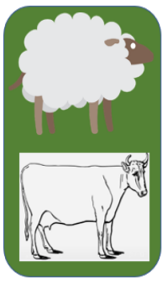
(2) Producing Young Stock (Cow-calf, lamb farms)

Restructuring herds to have a greater percentage of breeding females and greater annual offtake can be an effective approach to decreasing total livestock numbers so that pastures can be rehabilitated. The better availability of pasture and feedstuffs for the smaller number of livestock being overwintered can improve survivability and productivity. Little capital investment is required. The changes to be made are primarily in marketing and management. The potential increase in herder household revenues from the increased annual sales of livestock can be significant.

New skills and techniques are needed, including culling strategies, breeding management and new marketing skills. Access to improved breeding stock is required as is extension support to help herders learn and adopt new practices. The key risks are associated with being able to consistently secure buyers who are wanting to purchase younger and improved livestock. This demand is most likely going to come from the emerging feedlot sector.

Figure 32: New Herd Structure

Resources	Critical Skills/Inputs	Key Risks	ESG
Land is adequate but pastures are degrading. Little new capital investment needed.	New herd management skills: - Culling - Breeding management - Improved breeding stock New marketing skills and/or coop.	Market for selling younger animals. Need access to feedlot: - Own - MCS - Bayandelger - Lavia - *Dornod Meat*	• Strong positive on pasture • Better climate resilience • Improved herder incomes • Greater inclusion in markets



Criteria	Now	Future
Market		
Feed and water		
Livestock health		
Breeding		
Infrastructure/Equip		
Human resources		
Environmental		

Complete 5 | Most 4 | Partial 3 | Low 2 | Very Low 1 | Non 0

The environmental, social and governance benefits of this adaptation are numerous. There is a strong positive impact on the ability to return livestock numbers towards pasture carrying capacity. Allowing pasture to regenerate and having more feed available per animal being overwintered will decrease the risk of large animal losses during dzud, thus improving climate resilience. Because of the increased annual sales, herders' incomes could increase significantly. Shifting to a quality product and be becoming more active actors in the value chain will improve market governance.

Using the decision support criteria (Figure 32) to assess the viability of adopting the herd structuring strategy, we can see that the current market for young, quality animals is low. The feed and water required is partially in place, but more supplementary feeds should be added into local crop rotations. Livestock health is very low, as multiple infectious disease outbreaks have occurred in the past year. The infrastructure and equipment required is mostly in place. Human resources are partially in place with new knowledge and skills required in the topics previously mentioned. The environment is current in a low condition and at risk to overgrazing and climate change, which could threaten the viability of the existing production system in the future. However, looking at the medium term, all these conditions could improve as the feedlot sector continues to expand, government programs for livestock health are improved, improved breeds become more available. In short, the risk of not acting is probably greater than the business risks taken on by becoming early adopters of a new livestock management and marketing approach.

In the following example, the average herd in Bayantumen soum is restructured. With increases in sales numbers only and no increases to productivity (weaning rates), total revenue would increase by 20%. However, with more feed available per animal animals overwintered, along with better herd management, breeding programs and animal health, weaning rates are assumed to increase to 75%. In this case, annual sales of cattle increase from 5 to 17 while annual sales of sheep increase from 17 to 31. The number of cattle to overwinter declines from 35 to 25 while the number of sheep to overwinter declines from 130 to 91. Total revenue increases from 10.3 M MNT to 17.2 M MNT, an increase of 66%.

Table 64: Improved Herd Structure and Revenue Impact, Average Bayantumen Herd

Current Structure, Sales and Revenue	
CATTLE (wean 46%)	
Breeding Cows	16
On pasture in Aug	45
# in December	35
Total # Sold	5
Total Revenue, Cows	8.244 M
SHEEP (wean 48%)	
Breeding ewes	70
On pasture in Aug	163
# in December	130
Total # sold	17
Total Revenue, Sheep	2.099 M
TOTAL REVENUE	10.343 M

Improved Structure, Sales and Revenue	
CATTLE (wean 75%)	
Breeding Cows	22
On pasture in Aug	45
# in December	25
Total # Sold	17
Total Revenue, Cows	13.483 M
SHEEP (wean 75%)	
Breeding ewes	52
On pasture in Aug	128
# in December	91
Total # sold	31
Total Revenue, Sheep	3.701 M
TOTAL REVENUE	17.183 M increase 66%

In 2018, Mercy Corp[28] conducted a study of the potential costs and benefits of Mongolian herders shifting to a quality vs quantify focused approach to beef cattle production. Their findings showed that it can take up to two years to make the transition after which, the benefits included:

- increases in net profit through increased calf sale prices.
- higher sale prices and income per calf due to increased calf weight at sale time and improved quality of the animal (good beef breed genetics).
- better livestock survival due to improved cattle condition when winter begins.
- more diversity in income streams by selling more calves for breeding and for meat.
- Improved access to loans and loan terms from banks due to increased profits and asset values.

(3) Supplementary Feeding of Cattle for Consistent Quality and Supply

(a) Beef Backgrounding

When backgrounding cattle, calves are kept over one winter and sold the next year. Supplementary feed is provided through the winter to ensure that they do not lose weight. Without having to regain weight in the spring and summer, calves can be ready for market in their second summer (< 24 mo.). This practice is common in countries where feedlots are well established and need a steady supply of cattle coming into the feedlot throughout the year.

Bayantumen soum has adequate land for hay and supplementary feed production by incorporating livestock feed crops into rotation with wheat and by establishing new stands of perennial forages on marginal cropland. If herders began to produce the hay and supplementary feeds themselves, equipment purchases would be necessary. If existing crop farmers added forage crops and feed grains to their

[28] *Improving Beef Cattle Production: The financial implications of shifting from quantity to quality-focused beef cattle production, Mercy Corp, April 2018*

rotations, production could be done with existing equipment. Improved storage for livestock feeds would be needed as current methods results result in high losses in quality.

New skills would be required by herders and farmers in feed production, improved methods of cutting, handling and storing feeds, livestock nutrition and feed and ration formulation. New marketing skills for selling younger stock would be needed. As with the previous scenario, the key risks are in being able secure a steady market for young stock as the feedlot sector is developing. Some individual herders with haymaking equipment may take up this activity.

Using the decision support criteria, the results for backgrounding cattle is very similar to the previous scenario for restructuring herds but with more capital investment and another layer of new knowledge and technical skills required by herders.

Figure 33: Beef Backgrounding

Resources	Critical Skills/Inputs	Key Risks	ESG
Land for hay / fodder production. Equipment. Storage.	New herd management skills: - Feeds and feeding - Marketing New marketing skills and/or coop.	Access to feedlot to sell cattle: - Own - MCS - Bayandelger - Lavia - *Dornod Meat*	• Improved herder incomes

Criteria	Now	Future
Market		
Feed and water		
Livestock health		
Breeding		
Infrastructure/Equip		
Human resources		
Environmental		

Complete 5	Most 4	Partial 3	Low 2	Very Low 1	Non 0

(b) Beef Feedlots

Using the IFC guidebook for feedlots, a 250 head feedlot would be required to supply the Bayantumen slaughterhouse with a steady supply of finished beef cattle[29]. This would take two hectares of land for the feedlot itself with an additional 40 ha of irrigated land for corn silage production and 100 ha of unirrigated land for other feed grain production. In 2019, the total capital investment required for the feedlot only was 440.5 million MNT. If the feedlot operator did not already have land and equipment for crop production, an additional 836.6 million MNT would be needed, taking the total capital investment required to 1,277 million MNT. Adjusting for inflation since 2019, the feedlot model costs have been increased 27%. Adjusted

[29] *Developing Feedlots in Mongolia, A Guidebook for Herders, Feedlot Owners and Managers, Investors and Policy Makers, IFC, 2019 used for Feedlot Start-Up Costs and Parameters*

to 2022 values, the total cost of the feedlot and crop equipment would be 1,624 million MNT (USD 620,000) while the cost of the feedlot only would be 560 million MNT (USD 214,000).

Beef feedlots are capital intensive operations requiring high levels of skill in livestock management, animal nutrition, feeds and feeding, animal health and marketing, amongst others. Good record keeping and constant monitoring of input and output prices is essential to make the feedlot financially viable. Feedlots face several risks. Market risks are substantial because of the variability of slaughter cattle prices, feeder prices and grain prices which can cause huge swings in the profitability from one lot of cattle to the next. The manager must also deal with operational livestock health risks. Because of the high capital investment and ongoing high levels of operating credit required for the purchase of calves and feed, financial risk is also high.

Figure 34: Beef Feedlots

Resources	Critical Skills/Inputs	Key Risks	ESG
250 hd = 2 ha Capital Invest (2022) Feedlot only: • 560 m MNT Crop 40 ha irrigated and 100 dryland: • 1,064 m MNT Total: • 1,624 m MNT	• Animal nutrition and feeding • Animal health • Marketing • Record-keeping • Risk management • Livestock handling and feeding • Financial management	High risk business • Price risk – cattle and feed • Operational risk • Livestock disease risk • Profits vary greatly from year to year as cattle and grain prices change	Positive: • Less pressure on pastures • organic fertilizer Negative: • risk of water contamination by manure • High water use: 30-75 l/hd/d or 7500 – 18750/d @ capacity

Criteria	Now	Future
Market		
Feed and water		
Livestock health		
Breeding		
Infrastructure/Equip		
Human resources		
Environmental		

Complete 5 | Most 4 | Partial 3 | Low 2 | Very Low 1 | Non 0

Feedlots can have the positive environmental benefits of taking pressure off pastures and creating a source of organic fertilizer for crop production. They are also a potential source of ground water contamination through manure run-off, which makes proper design and manure management important. Feedlots also require access to a large quantity of high-quality water, as cattle will consume 30 to 75 liters per head per day. The Bayantumen feedlot would need 7,500 to 18,750 liters of water per day. Therefore, feedlot site selection and design to ensure animal health and welfare and environmental safety is very important.

Using the decision support system, (Figure 34) the feedlot sector has no infrastructure or equipment in Bayantumen currently. Related criteria for market, feed and water, livestock health and knowledgeable and skilled human resources are low or very low. Improved genetics are available in the aimag but are not commonly used by herders. In the future, the market and availability of improved genetics are expected to develop. Local feed supplies may take longer to develop given the capital investment required, the low productivity of Dornod soils and the impact of climate change on precipitation patterns. Through

government, project and private sector extension, the knowledge of skills herders and feedlot operators could be improved.

In Table 65, the financial returns to the feedlot are modelled under two price scenarios for finished cattle. In Case A, the final sales price is 5,000 MNT/kg for a 400 kg animal. In Case B, the final sales price is 4,000 MNT/kg for a 400 kg animal. All other variables are unchanged: calves are purchased at 200 kg for 3,000 MNT/kg and feed costs are 500 MNT/kg, 75% of the capital investment is borrowed at commercial rates of 18 percent. Half of the calf cost and feed costs are financed by operating credit at 18 percent. In Case A, the profit per animal is 224,874 MNT (USD 71) and total feedlot profits over the year are 120.6 million MNT (USD 35,191). Debt repayment is possible in this scenario. In Case B, a loss of 127,918 MNT per head (USD -37) is realized with total losses of 63.0 million MNT (USD -18,000) over the year and the debt cannot be repaid.

Table 65: Feedlot Profits – Highly Price Sensitive (at commercial interest rates of 18%)

	Case A		Case B	
Full Farm Analysis	**/hd sold**	**Full Capacity**	**/hd sold**	**Full Capacity**
Number of calves in:	1	500	1	500
Death loss	1.5%	1.5%	1.5%	1.5%
Calves sold	1	493	1	493
Total cost of calves	600,000	300,000,000	600,000	300,000,000
Total sales revenue	2,000,000	985,000,000	1,600,000	788,000,000
Cost of Gain				
Total Feed Costs	694,444	342,013,889	694,444	342,013,889
Total Other Costs	216,411	106,582,301	216,411	106,582,301
Total Selling Costs	9,800	4,826,500	9,800	4,826,500
Total Cost of Gain:	920,655	453,422,690	920,655	453,422,690
Total Variable Cost (calf cost + cost of gain)	1,520,655	748,922,690	1,520,655	748,922,690
Gross Margin = Sale Value – Total Variable Cost	**479,345**	**236,077,310**	**79,345**	**39,077,310**
Fixed Costs	207,263	102,076,927	207,263	102,076,927
PROFIT/LOSS before tax	**272,082**	**134,000,383**	**- 127,918**	**- 62,999,617**
Tax	27,208	13,400,038	-	-
PROFIT/LOSS after tax but before debt and living	**244,874**	**120,600,345**	**- 127,918**	**- 62,999,617**
(USD)	*71*	*35,191*	*- 37*	*- 18,383*
After debt repayment (over 5 years)	**76,823**	**37,835,269**	**- 295,969**	**- 145,764,692**
(USD)	*22*	*11,040*	*- 86*	*- 42,534*

Assumptions	**Feeder calf**	200 kg * 3000 MNT	200 kg * 3000 MNT
	Finished calf	400 kg * 5000 MNT	400 kg * 4000 MNT
	Grain price	500 MNT/kg	500 MNT/kg
	Fodder price	500 MNT/kg	500 MNT/kg

If the soft interest rate of 3 percent available through some agriculture development funds is obtained, the feedlot profitability and ability to absorb price shocks improves. In Case A, the profit per animal after debt repayment would be 285,847 MNT (USD 83). The loss at a sale price of 4,000 MNT/kg would be reduced to 74,153 MNT/head (USD -22) with a total loss of 36.5 million MNT (USD -10,657).

The introduction of feedlots can help to reduce pressure on pastures by providing a market for young stock and they will be an important step in developing more quality focussed and efficient meat value chains. Because of their high capital and knowledge requirements and multiple risks, it is most likely that they will be started by investors who can access capital at affordable rates and/or farms that already have the land and equipment base and seek to develop another market for their grains by feeding cattle.

At the level of individual herders and small farmers, the development of feedlots might follow that of Western Canada and the United States in the previous century, where mixed farms (crops and livestock) would build a small feedlot with enough capacity to feed their own calves (30 to 100 head) using feed grains, forages, and crop residues from their own farming operations. At this scale, the feedlot provides integration between crop and livestock on a single farm, diversifies markets and risks for the household and utilizes available labour over the year.

(4) Supplementary Feeding of Sheep

The Bayantumen slaughterhouse would require a steady supply of 40 sheep per day throughout the year of a standard weight and grade to produce a 20 kg carcass. With a typical feeding period of 40 days, a single feedlot would need to have up to 2,000 sheep on feed at anytime. Based on consumption 4.7 liters/head/day, up to 9,500 liters of water would need to be provided daily.

The literature review on the economics of sheep feeding showed that intensive feeding of sheep had marginal viability in both Australian feedlots and Mongolian feeding trials. In the Australian case, large scale feedlots (5,000 to 10,000 head) were modelled, and the conclusion was that "Feedlotting profitability based on input values analyzed and regardless of feedlot size or throughput is generally negative or low" and is most strongly influenced by the spread between feeder and finished lamb prices versus the ration cost[30]. In Mongolia, intensive feeding trials on sheep were conducted by the Centre for Policy Research under the World Bank Livestock and Marketing Project (LAMP). In the Mongolian pilot, lambs went through an adaption period on pasture to become accustomed to supplementary feeds and then were fed in an enclosed area (feedlot). This resulted in a net loss of 6,294 MNT/head leading to the conclusion that, "Feeding Mongolian lambs is not justified economically, and it is better to maximize weight gain on pastures to keep lambs' comparative advantage of being green and free-range product with unique taste."[31]. A third study, conducted in Inner Mongolia in 2016, fed 6-month-old lambs for a 75-day period (15 day introductory, 60 days intensive) with grass, native hay or a hay/concentrate combination. Lambs fed a hay/contrate ration had lower financial returns than grass fed lambs while lambs fed a ration of only native hay had negative financial returns[32].

Several risk and management factors that must be considered if feedlotting sheep. First, between 5 and 10 percent of lambs will not adapt to the feedlot and will need to be removed for early sale or returned to pasture[33]. Ration costs are significant, and all feeds should be tested for energy and protein. Lambs need to go through an introductory period (usually about 14 days) before entering the feedlot. Based on Australian standards, they will consume about 15-20 kg of feed without any significant weight gain during this introductory period followed by the feeding phase when a feed conversion ration of 6:1 can be

[30] *Investor-Ready Sheep Feedlot Project, A Sheep Industry Business Innovation Project, Department of Agriculture and Food, WA, Geoff Duddy, June 2017*

[31] *A pilot feeding of Mongolian lamb under the WB-supported Livestock and Agricultural Marketing Project (LAMP), Center for Policy Research, 2015*

[32] *Growth performance, carcass characteristics, and meat quality of Mongolian lambs fed native grass or hay with or without concentrate on the Inner Mongolian Plateau, Authors: Shuai Du, Sihan You, Jian Bao, Gentu Ge, Yushan Jia jys_nm@sina.com, and Yimin Ca, Canadian Journal of Animal Science 29 January 2020 https://doi.org/10.1139/cjas-2019-0126*

33 Feedlotting lambs, Department of Primary Industries, NSW Government, July 2016.

expected, requiring 60 kg of feed to produce 10 kg of gain[34]. Risks include lamb deaths, lambs not adapting to feed, poor growth rates and changes in prices for feed and finished lambs. Managing these risks requires adequate, quality feed supplies at secured prices, good feedlot and animal health management and forward contracting with slaughterhouses at set prices. Many services (feed testing, feed formulation, forward contracting, etc.) are not readily available in Mongolia currently, which makes it more difficult for producers to control these risks.

By comparison, supplementary feeding sheep on pasture using grain, hay or silage can have positive benefits with a much lower capital investment requirement[35]. It has the benefits of:

- reducing grazing pressure on pastures
- improving utilisation of existing pasture
- provides the sheep's energy and protein requirements to prevent weight loss
- improves production of meat or wool[36].

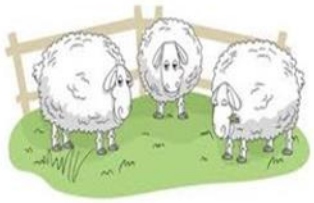
Supplementary feeding can be for lambs only (creep feeding) whereby, adult sheep are excluded from the supplementary feeding area (a pen or a pasture with a small opening that only a young animal can get through). This approach was piloted by the Food and Agriculture Organization (FAO)/Worldwide Fund for Nature (WWF) Eastern Steppes project in 2022 with promising early results.

Supplementary feeding on pasture requires feed purchases or cropland and related equipment, fencing and feed storage. Adequate water in the feeding area will be required. Providing supplementary feed to enable the marketing of younger animals would require new skills in feeds and feeding. New marketing skills would be required to access the market for younger animals.

[34] *ibid*
[35] *ibid*
[36] *Supplementary feeding and feed budgeting for sheep, Department of Primary Industries and Regional Development, Government of Western Australia, 2022*

Figure 35: Sheep Feeding Alternatives

Resources	Critical Skills/Inputs	Key Risks	ESG
Feed on Pasture: Land for fodder. Equipment, feed storage, fencing. **Feedlot:** Capacity 1600-2000 Water: 4.7l/hd/day = 7,571 - 9,464 l/day	New herd management skills: - Feeds and feeding - Marketing New marketing skills and/or coop.	Studies in Mongolia and abroad show sheep feedlots to have marginal returns. Supplementary feeding on pasture can get sheep to market weight faster with less risk. *More info is needed*	• Improved herder incomes •



Criteria	Now	Future
Market		
Feed and water		
Livestock health		
Breeding		
Infrastructure/Equip		
Human resources		
Environmental		

Based on the available information and using the decision support criteria (Figure 35), Bayantumen soum is currently more prepared to take on supplementary feeding on pasture, either creep feeding young lambs in accelerate growth or backgrounding weaned lambs to maintain weight over winter, than in feedlots. This approach could be adopted by herder households with a relatively low capital investment. The average Bayantumen soum herder household would have about 26 lambs to feed. A marketing coop at the soum level could be formed to aggregate animals for group sale. The same coop could organize transport to market and the bulk purchase and transport of feedstuffs. This coop could be affiliated with pasture users' groups.

More information on the productivity of Mongolia sheep breeds and cross breeds and their performance under feeding programs is needed to project potential financial returns. There is a strong need for Mongolian research institutes, projects and industry associations to conduct practical feeding trials to provide this information to industry.

(5) Value-added through meat processing

The proposed multi-species slaughterhouse has a capacity of 50 head of sheep or equivalent mix of sheep and cattle. For this analysis, a mix of 40 sheep and two cattle per day were used. Operating five days per week, 50 weeks per year would require purchases of 10,000 sheep and 500 cattle per year. With improved carcass weights of 20 kg sheep and 200 kg for cattle, total meat production would be 200 mt of mutton and 100 mt of beef per year. A land base of 1 hectare would be required.

Using the simplified floor plan and equipment approach proposed in Deliverable 4.1, the investment cost required for this plant would be roughly 524 million MNT (USD 200,000). An alternative to local

construction would be to import a mobile slaughterhouse, which would include the building structure and fixtures. The civil works, cooler, small tools and vehicles would still need to be purchased (Table 66). Cost estimates have been based on discussions with stakeholders, internet research and expert opinion of the team.

Table 66: Investment Costs for a Community Scale Slaughterhouse

Investment costs	Description	MNT/unit	USD/unit
Civil works	water, power, sewerage/waste	131,000,000	70000
Facility			
- Building & utilities	Large block construction	196,500,000	75,000
- Equipment	Lift, hooks/rails	26,200,000	10,000
- Cooler	Units range up to 10,000 USD	26,200,000	10,000
- Other (small tools, clothes)	small tools, clothes, furniture etc	26,200,000	10,000
Total Facility		**275,100,000**	**105,000**
Vehicles	cooler truck, used	65,500,000	25,000
Total Vehicles		**65,500,000**	**25,000**
TOTAL COSTS		**471,600,000**	**200,000**

The slaughterhouse could run at capacity with a staff of three to five butchers. Mongolian regulation states that the company must have a veterinarian on staff for inspections. A driver would be required for product delivery. Management and administrative staff would include an operations manager with experience running a meat plant and an accountant/office manager. These positions could be combined. If the management/admin staff do not have marketing experience, a marketing person may also be required. Total staff would range from seven minimum to a maximum of ten.

The critical skills required to make the plant successful include meat production and slaughterhouse management, marketing, food safety and hygiene and butchering. The main risks facing the plant are, in no particular order: i) the scale is too small to be profitable or price competitive; ii) difficulty accessing higher value markets because of the remote location in Dornod and or the lack of marketing skills; iii) operational risks related to securing a steady supply of livestock 12 months per year; iv) finding and keeping skilled staff; and vi) food safety and animal health issues.

If the plant could be run profitably, the benefits would include employment for 7 to 10 people, potentially improved returns and incomes for herders, an increased number and transparency of market options for herders, and greater participation in high value livestock markets by herders from Bayantumen.

Figure 36: Slaughterhouse

Resources	Critical Skills/Inputs	Key Risks	ESG
Land = 1 ha. Capital Invest: • Civil works • Building • Equipment • Vehicle(s) Total: • 594 million MNT • (USD 200,000)	• Management • Marketing • Food Safety and hygiene • Butchering	• Scale is too small to compete on price • Higher value markets are far away • Operational risk – supply of livestock, finding / keeping trained staff • Livestock disease	• 5 – 10 full time employees • Improved returns and incomes for herders • More transparent market • More inclusion in markets and benefits

Criteria	Now	Future
Market		
Livestock health		
Infrastructure/Equip		
Human resources		
Environmental		

Complete 5	Most 4	Partial 3	Low 2	Very Low 1	Non 0

Using the decision support criteria (Figure 36), the current situation is only partially complete. There is a new market opportunity for hygienic, quality meat, but the infrastructure and human resources are incomplete. There are also environmental issues to be addressed because the markets for slaughter by-products and methods for handling wastes are undeveloped. Animal health status is very low, which affects quality and marketability. In the future, the market will continue to develop, although it may take years for high quality and branded meat products to take a major share of the market given traditional preferences and the lack of purchasing power of a large segment of the Mongolian population. Similarly, it may take years to develop the by-product markets and waste management systems. While there are many skilled butchers in Mongolia, developing and retaining staff with knowledge in new grades, cuts and food safety standards may continue to be a challenge.

In the following scenarios, the ability of the plant to run profitably under different market and financing conditions have been assessed:

- Retail/wholesale to slaughter price margins of 19.6 percent and 33.5 percent as indicated in the UNCTAD value chain report
- Interest rates of 3 percent and 18 percent annually and a repayment period of five years representing soft rates available under the SME program and average commercial rates.
- Capacity utilization of 100 percent and 80 percent, with 80 percent being the highest currently achieved in Mongolia.

Local Markets for Regular Quality Meat

The local market opportunity includes sales to retailers, local institutional sales and to local processors making dumplings and other prepared foods. The market for premium meat in Dornod is limited. This

scenario was modelled assuming the sale of regular quality meat on a year-round basis. In this case, only 4,000 MNT/kg is paid for slaughter cattle (1,600,000 MNT/head).

If the retail margin on meat is 33.5 percent (i.e., the slaughterhouse receives 66.5 percent of the retail price), the plant cannot reach breakeven even at 100% capacity and 3 percent financing. Losses before debt repayment are 143 million MNT (USD 41,844) and the operation defaults on its loan.

If the retail margin on meat is 19.6 percent, the scenarios improve but are still highly sensitive to the rate of capacity utilization. With commercial financing of 18 percent and 100 percent capacity, the plant could return an after-tax profit of 194 million MNT (USD 56,673), repay its debt and have 91 million MNT (USD 26,673) remaining. However, if capacity utilization fell to 80 percent, losses of 291 million MNT would accrue (USD – 85,000) and the debt would be unpaid.

At retail margins of 19.6 percent and financing at 3 percent, the plant still cannot absorb the risk of low rates of capacity utilization. At 100 percent capacity, an after-tax profit of 264 million MNT (USD 76,923) is achieved with 161 million MNT (USD 46,923) remaining after debt repayment (Table 67). If utilization falls to 80 percent, a loss of 214 million MNT (USD 62,553) occurs and the operation defaults on its debt (Table 68). With secured sales contracts and possible investment and partnership from local processors and the soum government to ensure full capacity utilization, this model might be made viable. However, competition from larger scale plants with lower unit operating costs and direct-to-processor sales by other herders could easily undercut this market.

In this scenario, there is no premium paid to feedlots for fed cattle. As shown in the previous section, without such a price premium, the feedlot operations become unviable. While the plant may be able to source the 500 older cattle per year, it would provide no incentive for producers to feed or for herders to sell younger stock and alter their herd composition and size.

Table 67: Slaughterhouse Profits: Local Market, 100% Capacity, 3% Interest, 19.6% Retail Margin

PROFITABILITY	MNT/UNIT	DESCRIPTION	UNITS	TOTAL	USD
REVENUE					
Mutton	7,733	MNT/kg * kg per year	200,000	1,546,574,400	**451,291**
Beef	11,099	MNT/kg * kg per year	100,000	1,109,922,000	**323,876**
Sheepskins with wool	2,700	MNT/skin * skins per year	10,000	27,000,000	**7,879**
Hides and skins > 2 meters	3,688	MNT/hide * hides per year	500	1,844,000	**538**
Total Revenue				**2,685,340,400**	**783,583**
EXPENSES					
Live animal Costs					
Sheep	120,000	MNT/hd * head per year	10,000	1,200,000,000	350,160
Cattle	1,600,000	MNT/hd * head per year	500	800,000,000	233,440
Total				**2,000,000,000**	583,601
Labour	5	plant workers	800,000	*4,000,000*	*1,167*
	1	vet	800,000	*800,000*	*233*
	1	driver	800,000	*800,000*	*233*
	1	Manager/Accountant	1,500,000	*1,500,000*	*438*
	0	Marketing	1,500,000	-	-
			Cost/mo	*7,100,000*	*2,072*
			Annual	**85,200,000**	24,861
Total Livestock and Labour:				**2,085,200,000**	608,462
Ratio to Total Revenue:		*(target = 60%)*			*78%*
Margin after Livestock and Labour				**600,140,400**	**175,121**
Operating costs					
power	12	months per year	500,000	6,000,000	1,751
water (pumping costs)	12	months per year	250,000	3,000,000	875
materials	5000	MNT/hd processed	10,500	52,500,000	15,320
waste disposal	49	MNT/kg waste	287,250	14,075,250	4,107
other ….				-	-
Subtotal				**75,575,250**	**22,053**
Ratio to Total Revenue:		(target = 20%)			*3%*
marketing	12	promo/advertising monthly	1,500,000	18,000,000	5,252
sales - delivery	100	km return * MNT/kg/km * T kg	0.49	14,700,000	4,289
training/food safety	12	training/compliance	500,000	6,000,000	1,751
other ….	12		500,000	6,000,000	1,751
Subtotal				**44,700,000**	**13,043**
TOTAL VARIABLE COSTS				**2,205,475,250**	**643,559**
GROSS MARGIN				**479,865,150**	**140,025**
Ratio to Total Revenue:					*18%*
FIXED COSTS					
Adminstration/office	5%	estimated at x% of revenue		134,267,020	39,179
Regulatory costs	1	license, etc	3,000,000	3,000,000	875
interest on debt	3%	on 75% of capital investment	514,050,000	15,421,500	4,500
depreciation	5%	of investment - 20 yr lifespand	685,400,000	34,270,000	10,000
other ….				-	-
TOTAL FIXED COSTS				**186,958,520**	**54,555**
TOTAL COSTS				**2,392,433,770**	**698,113**
PROFIT/LOSS BEFORE TAX				**292,906,630**	**85,470**
Tax	10%			29,290,663	8,547
PROFIT AFTER TAX				**263,615,967**	**76,923**
after tax return on investment				38%	38%
debt repayment	5	year repayment term	514,050,000	102,810,000	30,000
remainder after debt payment				160,805,967	46,923

Table 68: Slaughterhouse Profits: Local Markets, 80% Capacity, 3% Interest, 19.6% Retail Margin

PROFITABILITY	MNT/UNIT	DESCRIPTION	UNITS	TOTAL	USD
REVENUE					
Mutton	7,733	MNT/kg * kg per year	160,000	1,237,259,520	**361,033**
Beef	11,099	MNT/kg * kg per year	80,000	887,937,600	**259,101**
Sheepskins with wool	2,700	MNT/skin * skins per year	8,000	21,600,000	**6,303**
Hides and skins > 2 meters	3,688	MNT/hide * hides per year	400	1,475,200	**430**
Total Revenue				**2,148,272,320**	**626,867**
EXPENSES					
Live animal Costs					
Sheep	120,000	MNT/hd * head per year	10,000	1,200,000,000	350,160
Cattle	1,600,000	MNT/hd * head per year	500	800,000,000	233,440
Total				**2,000,000,000**	583,601
Labour	5	plant workers	800,000	*4,000,000*	*1,167*
	1	vet	800,000	*800,000*	*233*
	1	driver	800,000	*800,000*	*233*
	1	Manager/Accountant	1,500,000	*1,500,000*	*438*
	0	Marketing	1,500,000	-	-
			Cost/mo	*7,100,000*	*2,072*
			Annual	**85,200,000**	24,861
Total Livestock and Labour:				**2,085,200,000**	608,462
Ratio to Total Revenue:		*(target = 60%)*			*97%*
Margin after Livestock and Labour				**63,072,320**	**18,405**
Operating costs					
power	12	months per year	500,000	6,000,000	1,751
water (pumping costs)	12	months per year	250,000	3,000,000	875
materials	5000	MNT/hd processed	10,500	52,500,000	15,320
waste disposal	49	MNT/kg waste	287,250	14,075,250	4,107
other ….				-	-
Subtotal				**75,575,250**	**22,053**
Ratio to Total Revenue:		(target = 20%)			*4%*
marketing	12	promo/advertising monthly	1,500,000	18,000,000	5,252
sales - delivery	100	km return * MNT/kg/km * T kg	0.49	11,760,000	3,432
training/food safety	12	training/compliance	500,000	6,000,000	1,751
other ….	12		500,000	6,000,000	1,751
Subtotal				**41,760,000**	**12,186**
TOTAL VARIABLE COSTS				**2,202,535,250**	**642,701**
GROSS MARGIN				**- 54,262,930**	**- 15,834**
Ratio to Total Revenue:					*-3%*
FIXED COSTS					
Adminstration/office	5%	estimated at x% of revenue		107,413,616	31,343
Regulatory costs	1	license, etc	3,000,000	3,000,000	875
interest on debt	3%	on 75% of capital investment	514,050,000	15,421,500	4,500
depreciation	5%	of investment - 20 yr lifespand	685,400,000	34,270,000	10,000
other ….				-	-
TOTAL FIXED COSTS				**160,105,116**	**46,719**
TOTAL COSTS				**2,362,640,366**	**689,419**
PROFIT/LOSS BEFORE TAX				**- 214,368,046**	**- 62,553**
Tax	10%			-	-
PROFIT AFTER TAX				**- 214,368,046**	**- 62,553**
after tax return on investment				-31%	-31%
debt repayment	5	year repayment term	514,050,000	102,810,000	30,000
remainder after debt payment				- 317,178,046	- 92,553

Ulaanbaatar Market for Premium Meat

Premium meat markets emerging with the middle-class, expatriate and tourist populations, primarily in Ulaanbaatar, offer the opportunity for premium prices that can drive change within the domestic meat value chain. In the following scenarios, the slaughterhouse production is sold in Ulaanbaatar to premium supermarkets and the restaurant trade. An additional staff member focused on marketing and sales is added. Marketing costs increase to transport meat to Ulaanbaatar, an estimated roundtrip of 1400 km. Feedlot cattle providing a better-quality carcass are purchased at 5,000 MNT/kg (2,000,000 MNT/head).

At a 33.5 percent retail margin and 18 percent interest, the premium prices are sufficient to allow the plant to turn a profit (195 million MNT or USD 57,022) and repay debt if it runs at 100 percent capacity. This leaves 92.6 million MNT (USD 27,022) after debt repayment. However, if capacity falls to 80%, a loss of 334 million MNT (USD 97,465) is incurred and the operation defaults on its debt. If subsidized finance of 3 percent is obtained, profit after tax increases to 265 million MNT ($USD 77,272) with 162 million MNT (USD 47,272) remaining after debt repayment. However, the subsidized interest does not provide a sufficient buffer against low-capacity utilization. If capacity use falls to 80 percent, losses of 267 million MNT (USD 74,965) occur and the operation defaults on its debt.

At a retail margin of 19.6%, revenues to the slaughterhouse improve significantly. At 18 percent interest and 100 percent capacity utilization, after-tax profits are 747 million MNT (USD 218,085) with 645 million MNT (USD 188,085) remaining after debt repayment (Table 69). This scenario can also withstand a lower capacity utilization. At 80 percent capacity, after-tax profits are 141 million MNT (USD 41,132), offering a 21% return on investment. After debt repayment, there is 38 million MNT (USD 11,132) remaining (Table 70). Any lower level of capacity utilization moves the operation in the loss position. Accessing subsidized interest will decrease annual interest costs from USD 27,000 to USD 4,500, improve profitability and allow the plant to operate at a marginally lower capacity rate. With 3 precent interest, the plant could operate at 77 percent capacity and return an after-tax profit of 119 million MNT (USD 34,839) with 16.6 million MNT (USD 4,839) remaining after debt repayment. Any lower capacity levels result in a loss.

Table 69: Slaughterhouse Profits: Premium Market, 100% Capacity, 18% Interest, 19.6% Retail Margin

PROFITABILITY	MNT/UNIT	DESCRIPTION	UNITS	TOTAL	USD
REVENUE					
Mutton	11,032	MNT/kg * kg per year	200,000	2,206,497,600	**643,857**
Beef	15,276	MNT/kg * kg per year	100,000	1,527,600,000	**445,754**
Sheepskins with wool	2,700	MNT/skin * skins per year	10,000	27,000,000	**7,879**
Hides and skins > 2 meters	3,688	MNT/hide * hides per year	500	1,844,000	**538**
Total Revenue				**3,762,941,600**	**1,098,028**
EXPENSES					
Live animal Costs					
Sheep	120,000	MNT/hd * head per year	10,000	1,200,000,000	350,160
Cattle	2,000,000	MNT/hd * head per year	500	1,000,000,000	291,800
Total				**2,200,000,000**	641,961
Labour	5	plant workers	800,000	*4,000,000*	*1,167*
	1	vet	800,000	*800,000*	*233*
	1	driver	800,000	*800,000*	*233*
	1	Manager/Accountant	1,500,000	*1,500,000*	*438*
	1	Marketing	1,500,000	*1,500,000*	*438*
			Cost/mo	*8,600,000*	*2,509*
			Annual	**103,200,000**	30,114
Total Livestock and Labour:				**2,303,200,000**	672,075
Ratio to Total Revenue:		*(target = 60%)*			*61%*
Margin after Livestock and Labour				**1,459,741,600**	**425,953**
Operating costs					
power	12	months per year	500,000	6,000,000	1,751
water (pumping costs)	12	months per year	250,000	3,000,000	875
materials	5000	MNT/hd processed	10,500	52,500,000	15,320
waste disposal	49	MNT/kg waste	287,250	14,075,250	4,107
other ….				-	-
Subtotal				**75,575,250**	**22,053**
Ratio to Total Revenue:		(target = 20%)			*2%*
marketing	12	promo/advertising monthly	1,500,000	18,000,000	5,252
sales - delivery	1400	km return * MNT/kg/km * T kg	0.49	205,800,000	60,053
training/food safety	12	training/compliance	500,000	6,000,000	1,751
other ….	12		500,000	6,000,000	1,751
Subtotal				**235,800,000**	**68,807**
TOTAL VARIABLE COSTS				**2,614,575,250**	**762,934**
GROSS MARGIN				**1,148,366,350**	**335,094**
Ratio to Total Revenue:					*31%*
FIXED COSTS					
Adminstration/office	5%	estimated at x% of revenue		188,147,080	54,901
Regulatory costs	1	license, etc	3,000,000	3,000,000	875
interest on debt	18%	on 75% of capital investment	514,050,000	92,529,000	27,000
depreciation	5%	of investment - 20 yr lifespand	685,400,000	34,270,000	10,000
other ….				-	-
TOTAL FIXED COSTS				**317,946,080**	**92,777**
TOTAL COSTS				**2,932,521,330**	**855,711**
PROFIT/LOSS BEFORE TAX				**830,420,270**	**242,317**
Tax	10%			83,042,027	24,232
PROFIT AFTER TAX				**747,378,243**	**218,085**
after tax return on investment				109%	109%
debt repayment	5	year repayment term	514,050,000	102,810,000	30,000
remainder after debt payment				644,568,243	188,085

Table 70: Slaughterhouse Profits: Premium Market, 80% Capacity, 18% Interest, 19.6% Retail Margin

PROFITABILITY	MNT/UNIT	DESCRIPTION	UNITS	TOTAL	USD
REVENUE					
Mutton	11,032	MNT/kg * kg per year	160,000	1,765,198,080	**515,086**
Beef	15,276	MNT/kg * kg per year	80,000	1,222,080,000	**356,603**
Sheepskins with wool	2,700	MNT/skin * skins per year	8,000	21,600,000	**6,303**
Hides and skins > 2 meters	3,688	MNT/hide * hides per year	400	1,475,200	**430**
Total Revenue				**3,010,353,280**	**878,422**
EXPENSES					
Live animal Costs					
Sheep	120,000	MNT/hd * head per year	10,000	1,200,000,000	350,160
Cattle	2,000,000	MNT/hd * head per year	500	1,000,000,000	291,800
Total				**2,200,000,000**	641,961
Labour	5	plant workers	800,000	*4,000,000*	*1,167*
	1	vet	800,000	*800,000*	*233*
	1	driver	800,000	*800,000*	*233*
	1	Manager/Accountant	1,500,000	*1,500,000*	*438*
	1	Marketing	1,500,000	*1,500,000*	*438*
			Cost/mo	*8,600,000*	*2,509*
			Annual	**103,200,000**	30,114
Total Livestock and Labour:				**2,303,200,000**	672,075
Ratio to Total Revenue:		*(target = 60%)*			*77%*
Margin after Livestock and Labour				**707,153,280**	**206,348**
Operating costs					
power	12	months per year	500,000	6,000,000	1,751
water (pumping costs)	12	months per year	250,000	3,000,000	875
materials	5000	MNT/hd processed	10,500	52,500,000	15,320
waste disposal	49	MNT/kg waste	287,250	14,075,250	4,107
other ….				-	-
Subtotal				**75,575,250**	**22,053**
Ratio to Total Revenue:		(target = 20%)			*3%*
marketing	12	promo/advertising monthly	1,500,000	18,000,000	5,252
sales - delivery	1400	km return * MNT/kg/km * T kg	0.49	164,640,000	48,042
training/food safety	12	training/compliance	500,000	6,000,000	1,751
other ….	12		500,000	6,000,000	1,751
Subtotal				**194,640,000**	**56,796**
TOTAL VARIABLE COSTS				**2,573,415,250**	**750,924**
GROSS MARGIN				**436,938,030**	**127,499**
Ratio to Total Revenue:					*15%*
FIXED COSTS					
Adminstration/office	5%	estimated at x% of revenue		150,517,664	43,921
Regulatory costs	1	license, etc	3,000,000	3,000,000	875
interest on debt	18%	on 75% of capital investment	514,050,000	92,529,000	27,000
depreciation	5%	of investment - 20 yr lifespand	685,400,000	34,270,000	10,000
other ….				-	-
TOTAL FIXED COSTS				**280,316,664**	**81,797**
TOTAL COSTS				**2,853,731,914**	**832,720**
PROFIT/LOSS BEFORE TAX				**156,621,366**	**45,702**
Tax	10%			15,662,137	4,570
PROFIT AFTER TAX				**140,959,229**	**41,132**
after tax return on investment				21%	21%
debt repayment	5	year repayment term	514,050,000	102,810,000	30,000
remainder after debt payment				38,149,229	11,132

Limitations of the Models

The models underscore the risk slaughterhouses face because of the seasonality of supply and the related impact on capacity utilization. The models have used 100 percent capacity utilization as the best-case scenario and 80 percent capacity for sensitivity analysis. However, the value chain information earlier in this report indicated that the best capacity utilization reported in Mongolia was 80 percent with most industrial slaughterhouses operating at less than 50 percent. Under these conditions, profitability and loan repayment would not be possible.

The models have used annual average prices for input and output variables. This is a generalized approach and does not consider management strategies that would capture seasonal price opportunities to maximize sales revenue or to purchase and stockpile feedstuffs at seasonally low prices. On the other hand, achieving the capacity utilization rates required to make the plant successful would require year-round sales contracts to retailers and restaurants which could limit the opportunity to lower production levels during seasonally low meat prices. Similarly, the model assumes that all feeds are purchased and does not consider the financial impacts of an integrated crop-feedlot operation.

The slaughterhouse models discussed have not included operating interest on livestock purchases. It assumes a rapid turnover of inventory self-financed by the operation. The additional of operating finance requirements would further decrease the expected returns under all scenarios.

Marketing costs related to selling premium meat to outlets in Ulaanbaatar may be underestimated. It is difficult to know how much a marketing and sales specialist able to develop contract and maintain business relationships would be paid. Other cost related to marketing which may be underestimated include the amount and cost of advertising and the full cost of deliveries (trucks, operating costs, driver related costs).

Published information on slaughterhouse operational and capital costs in Mongolia is limited. Furthermore, no business plan documents were available to the team that might have provided localized costs parameters pertinent to this specific business case. Therefore, several assumptions have been made regarding operating costs which should be improved and verified should a full feasibility study be carried out.

(6) Feed Production

Dornod has 117,000 hectares of designated cropland of which 72,300 hectares were cultivated by 20 companies in 2019[37]. Khalkhgol soum accounts for 85 percent of the cropland. During the Soviet period, 11,000 hectares were cultivated under irrigation in Bayantumen soum. No irrigated land was reported in the soum in 2021.

Farms commonly practice a crop-summerfallow rotation, meaning they seed half of their land each year. Accordingly, the 2021 seeded area in Dornod was 34,711 hectares of which 4,000 were in Bayantumen

[37] https://www.ijset.net/journal/2598.pdf

soum. Bagh 4 reports 2,100 hectares of cultivated land, but only 700 hectares were seeded in 2021 (Table 71).

The proposed slaughterhouse and related feeding programs would require about 645 hectares of cropland. This land is available within Bagh 4 with more accessible within the soum. Introducing feed crops and nitrogen-fixing forages in rotation would diversity crop revenue for farmers and provide benefits in terms of soil health and fertility.

Table 71: Cropland and Feed Availability, Bayantumen soum and Dornod

Item	Unit	Bagh 4	Bayantumen Soum	Dornod
Soviet era cultivated	ha		11,000	
Soviet era irrigated	ha		11,000	
Current cultivated	ha	*2,100*		
Current irrigated	ha	-	-	
Current seeded	ha	*700*	4,000	*31,271*
Wheat	ha	-	2,000	
Oats for fodder	ha	*1,700*	2,000	
Yield, 2021				
Wheat	mt/ha	*1.1*	1.1	*1.1*
Oats for fodder	mt/ha	*1.6*	1.6	*1.6*
Total Production			**2022 est**	**2021**
Wheat	mt	-	2,220	34,711
Oats for fodder	mt	2,720	3,200	2,321

Source: NSO and local interviews

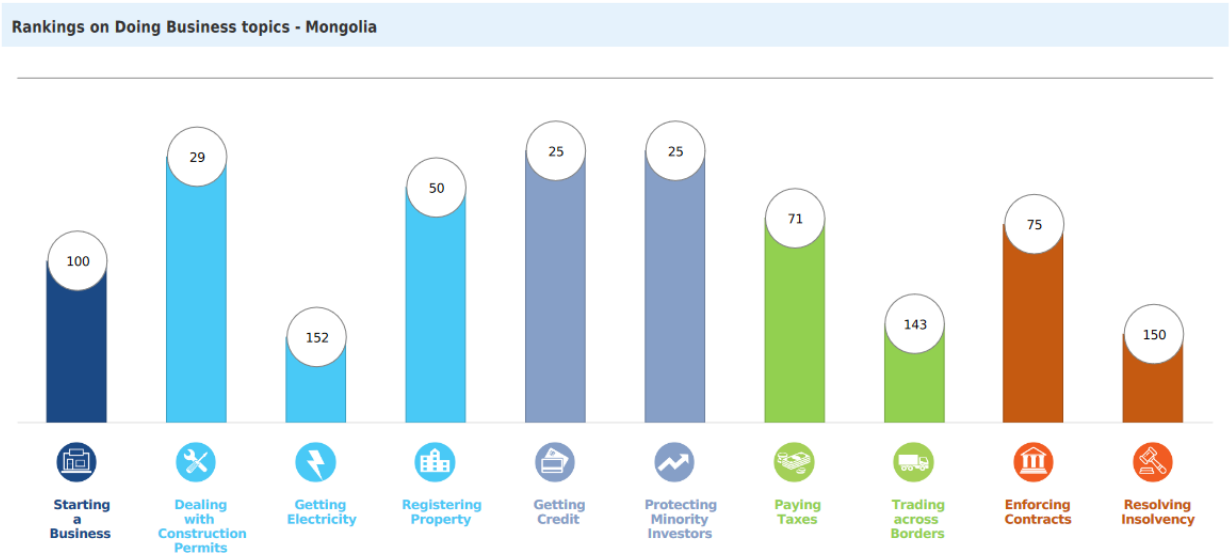
8.5 Business Models and Ownership Structure

8.5.1 Business Model Options

(1) Doing Business in Mongolia

All businesses in Mongolia will face some common issues, regardless of the ownership and business model they select. The World Bank "Doing Business 2020" report assessed the difficulty of doing business in 190 countries, including Mongolia. Table 72 shows how Mongolia compares to other countries in the study. Major weaknesses exist in getting electricity, trading across borders, enforcing contracts and resolving insolvency. The study was conducted with businesses in Ulaanbaatar, so it could be expected that these challenges may be greater in rural areas, especially around the access to electricity.

Table 72: Difficulty of Doing Business in Mongolia. Rankings Out of 190 Countries



Source: https://www.doingbusiness.org/content/dam/doingBusiness/country/m/mongolia/MNG.pdf

The SME sector is a vibrant contributor to the economy and vital in remote areas lacking major employers. The main challenge faced by new start-ups is access to capital followed by governmental policies and taxes and related procedures[38].

(2) Private ownership

Private ownership has become the standard model in Mongolia since transition to a market economy. The feasibility study in Deliverable 4.1 pointed the need for private ownership of the slaughterhouse if it is to be run efficiently, market competitively and maintain all food safety standards. There is a need to have a lead person who has the technical skills and experience to run a meat plant and has personal ownership in its success through investment of their own capital. As the meat market modernizes and becomes more competitive, it is likely that there will be more consolidation with larger companies' holder a larger market share. Their economies of scale will make it difficult for small enterprises to compete.

(3) Cooperatives

It is difficult for individual producers with little volume and market power to increase the prices and values on their own. Cooperatives are a business model that allows small producers to gain greater scale, market share and power. Different structures of cooperatives are possible. In a closed cooperative, a new member must purchase membership rights. In an open cooperative, entry is free.

Agricultural cooperatives are still poorly developed in Mongolia. They tend to be family-based organizations and have often been formed to access project or government program benefits (financing and technical support) rather than being formed based on a long-term market incentive.

[38] https://www.ifc.org/wps/wcm/connect/fa1da257-f7a3-43a7-961f-720c19eb9e25/Women+SME-Mongolia-Final.pdf?MOD=AJPERES&CVID=kFmAtKt

Regardless of the type, a cooperative must be competitive with private sector enterprises to survive. The success of a cooperative depends on several factors[39], including:

- Marketing management expertise.
- Value system coordination - the ability of the supply chain partners (distributors, processors, primary producers) to communicate and coordinate with each other.
- Scale – achieving sufficient volume to access markets and compete on price.
- Value-added traits – organic certification, connection to a geographic location, an attractive "story" about the product and/or producers can all gain the attention of consumers.
- Production system – a "push" system produces and then seeks the sales while a "pull" system produces when orders are received from the customer.
- Relationship with the end customer - the cooperative needs to have a good understanding of its customer base.

McCann and Montabon (2012) studied three beef cooperatives in the United States. Each took a different approach to marketing and production. Two were successful and one failed within five years. Table73, summarizes the case studies of the three cooperatives.

Table 73: Three cooperative Case Studies (summarized from McCann and Montabon)

US Premium Beef Ltd	Tallgrass Prairie Producers Coop	Country Natural Beef
Membership included all stages of the cattle production. Each member had 1 vote, regardless of number of cattle. Knowing that a large slaughter and processing plant would not be viable, due to high fixed costs and investment, they partnered with a large slaughterhouse with excess capacity and took an equity share. Because of their participation in the processing business, they could communicate to their beef producer members about carcass quality problems and how to improve. This coop reached economic scale and demonstrated how smaller producers can partner with larger feedlot and slaughter systems to participate in and benefit from value chains.	The cooperative was formed to produce "sustainable" beef that conserved natural resources, protected animal welfare, used no chemicals and had low fossil fuel use. These concepts were new and needed professional management, critical mass of volume, cost-efficiency, and realistic pricing. It was essential to find a distributor or retailer that could buy enough volume. Because their cattle were grassfed, production was seasonal with no way to guarantee a steady supply of beef through the winter. The coop never developed sufficient volume or secured a processing plant or distributor. They also over-estimated what consumers would pay. The cooperative failed in five years.	The coop is based on the Japanese concept of mutually beneficial partnerships and relationships (*Shinrai*). Instead of owning processing plants or feedlots, the coop partners with companies who manage those processes. Feedlots are managed by cooperative members but are not owned by the cooperative. Slaughtering grew from 3,000 head of beef in 1990 to 47,000 head in 2009. Each member is required to visit retail establishments to build relationships with consumers and employees of retailers. This "pull" approach requires high levels of coordination with customers and processers and might not be profitable for coops without access to premium markets.

[39] *McCann, N., & Montabon, F. (2012). Strategies for accessing volume markets in the beef industry: A review of three cooperative business models. Journal of Agriculture, Food Systems, and Community Development, 2(2), 37–49. http://dx.doi.org/10.5304/jafscd.2012.022.014*

The following table shows how each of the cooperatives approached the success factors.

Table 74: Summary of Case Studies of Cooperative Business Models for Beef Marketing

Attribute	U.S. Premium Beef	Tallgrass Prairie Producers Co-op	Country Natural Beef
Marketing Management Expertise	Professional, full-time management	Not significant	Internal partners hire expertise as needed
Value System Coordination	Emphasis on communication between value chain stages	Poor due to seasonal production	Shared Risk and Rewards
Scale	Sufficient to secure processing capacity	Unable to maintain proper scale	Proper, in part due to pull production
Value-Added Traits	Lower priority	Primary attribute	Appropriate to what market will bear
Production System	Push system	Push system	Pull system
End-Customer Relationship	Not emphasized	Significant attribute	Customer visits required

Source: McCann and Montabon

Finding the appropriate scale of operation is important. If the coop has a small volume of sales, it cannot afford to hire a professional marketing manager. Yet, without professional marketing skills, a new coop would have a very hard time entering specialized or distant retail markets.

8.5.2 Business Models for Bayantumen Soum

Bayantumen soum has the physical resources to develop a new value chain approach for sheep and beef production and marketing. Identifying the right market segment and channel for Bayantumen livestock and products can provide an improved return to herders and provide the incentive for changes to production and marketing practices. However, the obstacles to be overcome are numerous. The business environment is challenging in Mongolia, especially for rural start-up enterprises. Agricultural cooperatives are legal and promoted in Mongolia, but few have managed to develop successfully. Access to commercial finance is difficult and rates are extremely high while soft loans for agriculture start-ups are limited. New technical skills and knowledge are needed and there are limited sources of information available. Finally, building a market for a branded product requires a level of marketing expertise that may not be available or affordable for the small-scale community plant.

For this reason, it is recommended to take a staged and layered approach that considers the current baseline of production standards and market opportunities and how to strategically meet a higher level of quality over time. Rather than trying to manage all nodes of the supply chain under one entity, the focus should be on building improved supply chain communication and coordination between them (Table 75).

Slaughterhouse: A small community scale plant targeted at the domestic market could be built on site or purchased as a mobile slaughterhouse. Given the investment, operating costs and relatively small scale, the plant would have to secure a soft investment loan and run at more than 80% capacity to earn a profit

and repay its debt. It would need a manager with experience operating a slaughterhouse, managing food safety programs and marketing. This is a formidable task and, as recommended in Deliverable 4.1 and in the case studies in Section 5.1.3, most likely to be successful if left to a private sector investor with the appropriate skills, market connections and investment capital.

Developing a high-quality branded product sold for higher prices could offset the issue of scale for the plant. Branding takes time and, in the short to medium term, the plant would probably market locally to Choibalsan. There is an opportunity to market directly to Khaan Khuun, which has the capacity to absorb all the slaughterhouse production. As the plant builds a recognized brand, additional market channels could be added. Developing a quality-based brand would require a strong relationship with local herders to ensure that quality specifications and production practices were followed and verifiable. Clear contracting and pricing based on quality specification as well as improved breeding services, animal health services, access to finance and other strategies of mutual benefit.

Feedlots: Feedlots require a high level of investment and operating capital, technical knowledge in several areas of livestock production, marketing expertise and financial management. At this time in Mongolia, they are most likely to be established by companies that already have outlets for meat products and need to secure a steady supply of cattle. These companies may be large (i.e., MCS) or small (i.e., Xanadu Razorback) but seek to secure their supply chain by integrating the retail, slaughter, feedlot and feed production functions. In this case, the capacity of the feedlot would be driven by the capacity of the slaughter facility and its input needs.

Feedlots are not only a method of adding value to livestock. They are a method of adding value to crop production. Established farms, of any size, seeking to diversify their crop production, find better markets for lower quality grains, utilize crop residues, and keep workers engaged over the winter are also likely to establish feedlots. In this case, the capacity of the feedlot would be driven by the availability of feedstuffs produced on farm.

Primary Production and Backgrounding: Herders can immediately focus on improving the primary production of sheep and beef, where they already have experience and resources. A producers' cooperative could manage the joint marketing of feeder calves to feedlots, ensuring the feedlot uniform lots of cattle based on age and weight, thus improving the net price to herders, and decreasing transportation and marketing costs. Likewise, the coop could market standard lots of slaughter sheep (net 20kg carcass) directly to slaughterhouses. Prices could be pooled and split between members with a small portion of the revenues set aside for pasture and breed improvement activities. The coop could also be involved in the bulk purchase and transport of livestock feed to lower costs to members.

Table 75: Business Model Options

	Strategy	Ownership & Collaboration
End Market	**Short to Medium Term:** Develop high value markets as volume and relationships grow with buyers and herders. **Short Term:** Local	Ownership: Private

	Strategy	Ownership & Collaboration
	markets. Sell direct to food processors on a contract basis.	
Meat Plant	**Short to Medium:** Small facility for the domestic market to minimize costs. Target high value markets to make-up for lack of economy of scale.	Ownership: Private Contract with and/or own feedlot for direct connection with herders. Contract with herders for "Grassfed Beef / Sheep"
Feedlots	**Short to Medium:** Most feedlots run by integrated meat companies or crop farms with existing land, equipment. Crop rotations and manure improve soil fertility. Risk is diversified.	Ownership: Private. Collaborate with or own meat plant to secure sales and value added. Contract with herder coop to secure supply of calves.
Feeding on Pasture	**Medium Term:** Some herders with hay land and equipment begin to background cattle and sheep.	Private ownership of animals. Individuals sell directly to feedlots. If coop members are backgrounding, coop could handle sales.
Primary	**Short Term:** Restructure herds and begin selling young stock to existing feedlots and/or direct to slaughterhouses.	Private ownership of herds Coop to manage contracts, coordination and collect uniform animals. Link to Pasture User Groups (PUGs). Use a % of sales to for pasture and breed improvement.

8.5.3 Social Economic Impacts

The direct employment opportunities from the slaughterhouse and feedlot are quite small. The proposed slaughterhouse would provide up to 10 jobs. Roughly half of these would be in butchering has traditionally been done more often by men than women. Similarly, drivers are more commonly men. The positions of veterinarian, accountant and manager have higher participation by women. Another one or two jobs would be created at the feedlot feeding animals, cleaning pens, moving animals, and tending to animal health.

The larger and significant impact of the new value chain model will be at the herder household because of the increased revenues earned by selling younger stock. 52% of the soum families would benefit from sheep sales and 5% from cattle sales. The projected 66% increase in revenue from sheep and cattle sales would ease household vulnerability and lift some households out of poverty entirely. Women-headed households, migrant households and young families would benefit.

Caring for fewer animals through the winter would reduce the workload in the household, including for women. This would reduce their burden of unpaid work. Because animals would be better able to survive hard winters, households would also become more resilient against climate disasters.

(1) Gender

The result of the Time Use Survey (2019) revealed that a rural man over 12 years old spends more than 1.5 time than a woman in production activities, but 3.9 times less in home chores and more time for self-

development and private times (NSO, 2019). Rural women spend the most time on production activities, of which 71 percent of production activities are on household final products for consumption. Therefore, our research participants confirmed that "men are involved in agricultural production activities, and women are dominantly involved in milk and milk products processing and housechores". In addition, it proves that rural women have lack of opportunities to "earn" cash income from agricultural activities (Table 76).

Table 76: Gendered division in livestock farming and house chores

Activity	Man\Husband	Woman\Wife	Boy	Girl	No
11. Herding, watching and caring animals	83.3	10.8	5.9		
12. Search for animals	91.0	3.0	6.0		
13. Milking and preparing diaries	6.1	88.9			4.0
14. Haymaking and harvesting	74.0	3.0	4.0		19.0
15. Fencing pasture	44.9	3.4	1.1	1.1	49.4
16. Plant hay land or cropland	40.4	2.2	1.1		56.2
17. Housework (take care of child, clean houses, wash, cook and etc.)	7.1	84.7	2.0	6.1	
18. Meet with officials for business	70.7	24.2	2.0		3.0
19. Participating in herders' group's activities such as meetings, trainings and etc.	68.7	26.3	1.0		4.0
20. Treating animals, preventing diseases, washing and tec.	74.2	19.6	5.2	1.0	
Source: Herders' survey in Bayantumen soum, Dornod, June, 2022					

The relatively low participation of female herders in the agricultural production activities is related to the fact that the herder families are live separately in the soum center and countryside during the school year. In Bayantumen soum, 185 families live separately in the soum or aimag center during schooling, including 28 families from the target bagh who live separately in the soum center (Table 77). This separate living has reduced women's participation in the livestock production as well as their income and power (or authority) in the family. In addition, when the woman is absent and only one family member is producing the household products, it limits both production and income, increases human resource constraints, and increases household expenses as well, if these products must be purchased.

Table 77: Number of herder households that separate in soum center during schooling

	1st bagh	2nd bagh	3rd bagh	4th bagh	Total (soum)
Separated households because of schooling	66	50	41	28	185
Source: Social worker's registration sheet of Bayantumen soum, 2022					

If the suggested slaughterhouse and feedlot will provide job places for women, it will contribute to increasing the women's participation rate in the labor force at the soum level. Women who live separately

in soum center and have few livestock could be hired by the new slaughterhouse for plant operations (clean intestines, skin and process animal skins, meat cutting, other) or as veterinarian, driver, accountant and manager. The beef feedlot positions of feeding animals, cleaning pens, moving animals and tending to animal health have higher participation by women.

Increasing the number of young animals sold in the fall will result in caring for fewer animals through the winter. This will reduce the workload in the household, including for women. This would reduce women's burden of unpaid work. Because animals would be better able to survive hard winters, households would also become more resilient against climate disasters.

Statistical information on Bayantumen soum and 4th bagh female herders show they have very limited opportunities to share interest and present voice in decision making processes and that they lack the possibility to benefit equally from the public policies and measures (Table 78). To ensure gender equality in sustainable livestock herding and slaughtering, it is necessary to create a structure that can effectively ensure women's real participation:

1. Create a sub-council of women within herders' groups or cooperatives.
2. Organize trainings with aims to develop members' life skills and leadership of the sub-councils.
3. Update herder groups and cooperatives bylaws to integrate sub-councils' voice.
4. Integrate participatory monitoring and evaluation into herder group or cooperative management.

Table 78: Men and women's participation at the decision-making level of the target soum and bagh

Organization	Man	Woman	Total
Chairman of soum's Citizens' Representative Khural (CRK)	1		1
Representative of soum's CRK	16	5	21
Herder representative of soum's CRK	3 (1 is from 4th bagh)	1 (with higher education certificate)	4
Soum governor		1	1
Council of soum governor	5	8	13
4th bagh governor	1	1	
Bagh's citizens' council	5	2	7
	Rich herder	Middle	Lower
Herder representative of soum's CRK	2	1	1

(2) Vulnerable households

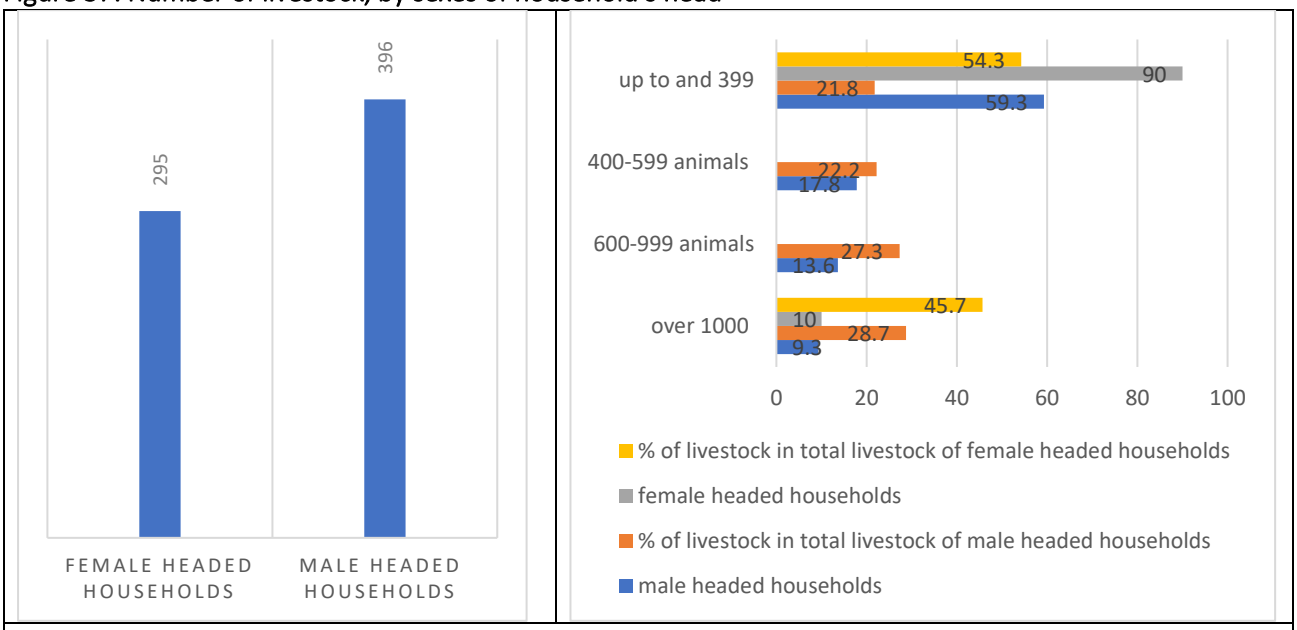
In the 4th bagh of Bayantumen soum, livestock ownership is highly concentrated with about 10 percent of herder households owning 28.7 percent (about one in three) of the livestock while 61.7 percent of herders own 399 or fewer animals and 70.9 percent of have 200 or fewer animals. This indicates that most herders are poor and at risk of poverty because they are extremely vulnerable to unexpected natural disaster and pastural degradation. The average herd size of female headed households was 100 head smaller than for male headed households. In the highest size category (more than 1,000 animals), male and female households were equally represented at 10 percent. These female-headed households own nearly half (45.7 percent) of the total number of animals herded by female-headed households Women are over-

represented in the small herd size categories; 90 percent of the female headed households but only 59 percent of the male headed households own 399 or fewer animals (difference of 31 percent) (Figure 37). During the study, the majority of herders expressed that they will increase the size of their herds to increase their livelihood.

It was observed that households with few animals will herd the animals of the wealthy households from other aimags and regions. As a result, the average number of animals per household, calculated from the Vulnerability Study was higher by 100 animals than the average calculated in the official census. This data may alternatively present that extra animals which are not registered in the official census or registration of the target bagh or soum.

Disparities in herd size among the target population relate to an authority or power gap between rich and poor herders observed at the target bagh (Table 79). Insufficient participation and representation at the local decision-making level is observed among the herders, especially herders with small herds. Herders with many animals are mostly chosen as a head or leader of a herders' group or cooperatives.

Figure 37: Number of livestock, by sexes of household's head



Source: livestock census information of 4th bagh, Bayantumen soum, 2021

If a local slaughterhouse and feedlot can be socially inclusive and promote community participation, it could replace the strategy of increasing livestock numbers to improve economic well-being of the herders with few livestock. As calculated earlier, the direct employment opportunities from the slaughterhouse and feedlot are quite small. The proposed slaughterhouse would provide up to 10 jobs. Almost of the job positions can be filled by local men and women from vulnerable households if they are trained on the job. Strict adherence to the Labor law and other regulations of Mongolia at the suggested slaughterhouse and feedlot will protect employees' and employers' labor rights while ensuring that neither is subject to unfair treatment or exploitation.

The larger and significant impact of the new value chain model will be at the herder household because of the increased revenues earned by selling younger stock. 52 percent of the soum families would benefit from sheep sales and 5% from cattle sales. The projected 66 percent increase in revenue from sheep and cattle sales would ease household vulnerability and lift some households out of poverty entirely.

58 percent of herders with less than 300 head have winter camp and 54.5 percent have received their certificate. 28.6 percent of them have fall camp (Table 79). It is difficult for herders with a few animals to have their own winter camp and certificate. They may also face a shortage of pasture due to the in-migration of families and animals from other provinces and large herders who buy a land. Therefore, local governing bodies should pay special attention to providing official certificates to own and use of winter, spring camp and hay land for the vulnerable households that could not exercise their land right. Some soums have implemented a land ownership program titled "Winter camp for every herder household".

Table 79: Ownership of camps by number of livestock herding (%)

Camps\number of livestock	0-300	301-500	501-999	1000 and over 1000
Winter camp	58.3%	80.0%	86.4%	95.0%
Spring camp	28.6%	50.0%	76.2%	94.4%
Summer camp	34.5%	60.0%	70.8%	87.5%
Fall camp	27.6%	61.5%	47.6%	100.0%

(3) Migrants

According to the NSO (2021), the number of households in Bayantumen soum, especially number of rural households, has been increased by 2.3 times since 2003 (Figure 38). Between 2018-2022 totally 212 households migrate to this soum. The increase of the number of households was caused by the migration to this soum and birth rate as well as separation of households into every younger member because of interest to own a separate land to use as a winter camp. As a soum's citizens registration information, almost twice as many people migrated to Bayantumen soum in 2022 compared to 2018. In 2022 60 percent of the migrants are men (Table 80).

Table 80: Information on migration to the target soum (2018-2022)

Migration to the target soum	2018			2019			2020			2021			2022		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
Migrated population	36	23	59	27	21	48	57	23	80	62	24	86	67	45	112
Migrated households	47			45			39			45			36		
Source: Soum's citizens' registration staff's information, 2022															

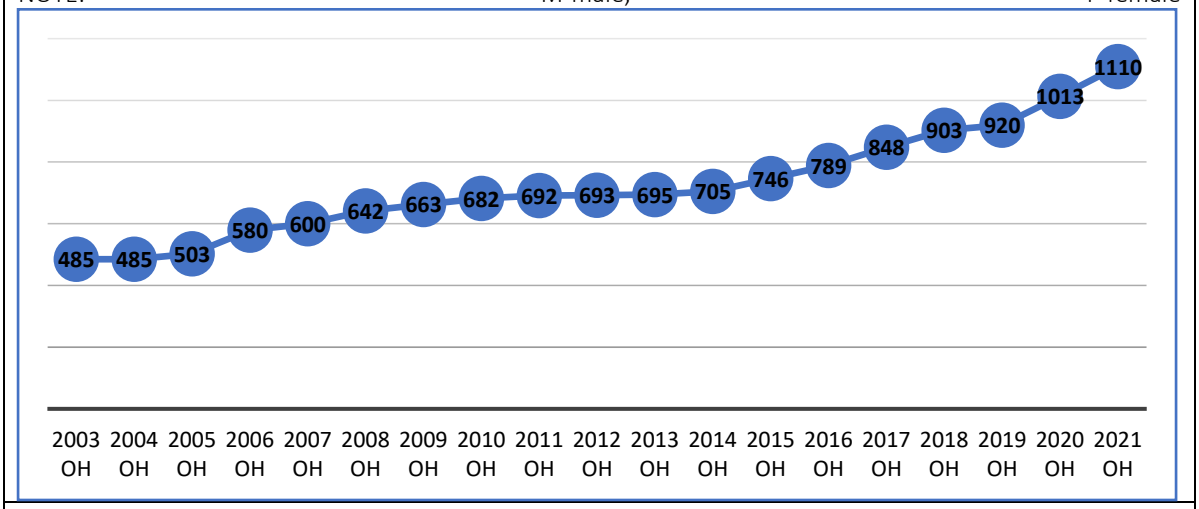


Figure 38: Number of households in Bayantumen soum (2003-2021), NSO

The following issues have been raised because of migration in this soum:

1. Migration of wealthy herders has contributed to increased degradation of pasture;
2. Wealthy households can buy winter camps or obtain land permits from local government. It leads to vulnerable herders - who do not own their land – being at risk of losing their pastures and land for the building of new winter camps for wealthy households;
3. Migrants with few livestock complete with the local herders to use public pasture, gaining access though informal leasing negotiations with the local herders. These migrants face social discrimination and economic pressure; and,
4. Male dominated migration to this soum is distorting the gender proportion of the local herders.

The recommended pasture and herd management and new value chain model will create benefits for both local and migrant herders as they will decrease of number of livestock. In addition to this, if the new value chain model will be learned in different soums and aimags as a best practice the migration to this soum will be decreased in future.

(4) Youth

Children of the herders, usually girls, tend to prefer higher level education and to live at urban area. All educational programs from preschool to upper secondary education do not consider the preparation of herders. Rather, they are mainly focused on leaving the animal husbandry lifestyle. To this point, in Bayantumen soum there are no students currently majoring in the field of animal husbandry at the Mongolian University of Life Sciences. If the labor of animal husbandry can be reduced and profits increased, a younger generation of herders will be attracted to the sector. The suggested new value chain model will contribute to this prospect. Herding and pasture management revision will also influence on next generation's career choice.

Table 81: Number of herders, aged 15-35 (m/f) Bayantumen soum, 2022

Bagh's name	Total	Male herders	Female herders
1st bagh	282	157	125
2nd bagh	274	166	108
3rd bagh	188	108	80
4th bagh	120	75	45
Total in soum	864	506	358

8.5.4 Financing Options

Access to adequate amounts of investment and operating capital at affordable rates will be critical to the success of the project. Commercial interest rates are high in Mongolia. Several different programs offer soft rates, including:

- IFC Meat Program for meat plants and feedlots
- WB Livestock Commercialization Project. The next phase of this project will support meat plant and feedlot clusters.
- Small and Medium Enterprise Support Fund provides 3 percent interest to agricultural investments.
- ADB Agricultural and Rural Development Loans via TDB and Golomt Bank. This program provides loans of 2-8 billion MNT for up to seven years at an interest rate of 8 percent.
- "Herder" operating loans (18 percent) repaid twice per year. These loans are provided through:
    - Khan Bank: up to MNT 20 million for 24 months at 19.2 to 21.6 percent.
    - State Bank: up to MNT 30 million for 24 months at 18 to 21.6 percent.

The Green Climate Fund (GCF) has three programs in Mongolia. The Improving Adaptive Capacity and Risk Management of Rural Communities in Mongolia project (implemented by the UNDP) provides climate information and planning, and support to resource management and market access. This project is exploring an Impact Investment Fund that could provide a pool of up to $20 million over 10-years to support sustainability in livestock and climate-resilient livestock products. The GCF MSME Business Loan Program for GHG Emission Reduction (XacBank) supports investments into green energy and building improvements for energy efficiency.

The largest GCF project has not begun implementation. The Aimags and Soums Green Regional Develop. Investment Program (ASDIP) has an overall value of more than USD 700 million. It was approved by GCF 19 Mar 2021 but is pending ADB and local approvals. Its focus is to limit the number of animals and strengthen agribusiness value chains, like what is proposed for Bayantumen soum. The project would create the Partnership for Low-Carbon and Climate-Resilient Rangeland Management in Asia fund catalyze investments. Funding programs would include climate finance and private sector investment, grants, agribusiness loans, micro-finance, and Payments for Environmental Services (PES). The project would begin in Bayan-Ulgii, Khovd, and Uvs over the first three years and then expand across the county.

PES is a supplementary funding steam that can support biodiversity protection and restoration by providing carbon offsets payments for carbon sequestered by improved pasture management. The Mongolian

Nomad Project is implemented by the Mongolian Society for Rangeland Management (MSRM) and the University of Leicester. Payments are managed through the Plan Vivo platform and standards. Payments to herders are based on management changes that increase soil carbon. The program is helping to restore the traditional nomadic way of life to reduce over grazing pressure on sensitive ecosystems. Individuals and business can "buy" carbon offsets online at https://www.clevel.co.uk/mongolian-nomad-project/. The project protects four key grassland habitats including riparian meadow, mountain meadow, mountain steppe and steppe and four key species including ibex, saxaul trees, marmot and Mongolian gazelle. This program is not yet available in Dornod.

8.5.5 Supporting Actions Required

Developing a new value-chain approach will require support from Government, researchers, extension programs, projects, banks and the private sector. Some of the following recommended activities are already supported by the National and *Aimag* Government through implementing relevant national programmes and other initiatives supported by donors and private sectors.

- Pasture Management
  1. Provide training and technical support for pasture management and monitoring emphasizing the importance of carrying capacity, stocking rates, timing and length of grazing, percentage of forage consumed and period of rest.

- Herd Management and Marketing
  2. Encourage herders to improve meat sales by culling less productive animals and provide information on which basis herders should make decisions about holding or selling the livestock.
  3. Focus on improving breeds while taking natural and climatic features and strengths of soum, feed production base and consumer needs into consideration.
  4. Provide training and technical support on animal nutrition, livestock feeds and feeding programs.

- Animal Health
  5. Provide the quality and accessibility of veterinary services and pay business entities that work in the field based on the resolution of soum and bagh Citizens' Representatives' Khurals.
  6. Initiate regular community awareness, advocacy and information exchange programs to educate herders on the importance of obtaining mandatory animal health services. Themes would cover how to avoid misuse of veterinarian drugs, the benefits of obtaining veterinarians services for diagnostics to help prevent disease from spreading within the herd, and how to organize preventative measures such as deworming and vaccination.

- Processing and Trade of Livestock and Livestock Products
  7. Support local businesses and cooperatives willing to establish slaughterhouses, further processing and by-product processing and facilitate access to finance through banks, government and donors.
  8. Promote standardized meat cuts and grading with price differentiation.
  9. Arrange low-interest lending for investments in new technology, equipment and facilities upgrades and improved logistics (e.g., refrigerated trucks, storage) for businesses and cooperatives.

10. Improve and monitor the control of professional organizations in hygiene, sanitation and safety of meat that is sold in central areas such as Ulaanbaatar, Darkhan, Erdenet and aimag centres.
11. Facilitate networking, information exchange and training from state and professional non-governmental organizations for meat producers.

- Business and Cooperative Management and Development

12. Organize training on entrepreneurial skills for herders, cooperatives, and small businesses.
13. Educate herder cooperatives with relevant existing policy, programs and training to help them improve the cooperative management and governance.
14. Facilitate access to soft loans with longer repayment terms for enterprise start-up, improvements and operating.

- Coordination Between Value Chain Actors

15. Establish and implement cooperation means between herders and cooperatives and provide information and training to understand what market they should target and the related market requirements and specifications.
16. Coordinate herder cooperatives to have direct linkages with domestic meat processors.
17. Develop a bargain and credit system for effective cooperation with herders.

- Consumer Awareness

18. Carry-out consumer awareness and public education programs on food safety and nutrition, taking care to address misinformation currently in the public domain.

Annex A. Summary Data on Dornod and Bayantumen Soum

The following is a summary of information to provide a profile of Bayantumen soum.
The research team is assembling a comprehensive data and literature set to support the feasibility study

Item	Mongolia	Dornod	Bayantumen
Location	Central Mongolia	Most Eastern province	12 km from aimag center
Distance from Ulaanbaatar (km)	--	648	648
Administrative units	21 aimags	14 soums	4 baghs
Population (2021)	3,383,741	83,422	2,840
Capital City	Ulaanbaatar	Choibalson	Bayantumen
Capital City Population (2021)	1,466,431	47,153	
Area	1,564,100 km2	123,600 km2	832,000 (ha)
# herding households (2021)	246,302	8,687	788 Bagh 4 = 167
Livestock (2020)			
Horse	4 093 861	324,450	34,670
Cattle	4 732 010	305,110	27,430
Camel	472 934	6,220	80
Sheep	30 049 428	1,303,060	97,660
Goat	27 720 253	810,850	6,570
Total	67 068 486	2,749,680	226,260
Meat Plants (2016)	48	5 Eastern; 1 Dornod	0
Meat Production (2020) '000 mt			
Beef	158.5		
Mutton/Goat	343.1		
Goat	000.3		
Total	744.5		

NEARC

- Approximately km from Bayantumen soum center
- 400 ha of crop land under a long-term lease; 12 ha of alfalfa, fenced.
- Water wells
- Power line
- Demonstration plots
- Training facility
- E-Nomads social media site

Annex B. GHG and Carbon Sequestration Calculations

Table B1: Reported emission intensity factors for cattle and sheep under different grazing management and production practices.

Location	Cattle						Sheep						Reference	Remarks
	Baseline		Pasture		Livestock		Baseline		Pasture		Livestock			
	(kg CO2e/kg LW)	(kg CO2e/head)	(kg CO2e/kg LW)	(kg CO2e/head)	(kg CO2e/kg LW)	(kg CO2e/head)	(kg CO2e/kg LW)	(kg CO2e/head)	(kg CO2e/kg LW)	(kg CO2e/head)	(kg CO2e/kg LW)	(kg CO2e/head)		
Mongolia	10.8		9.9				15.4		13.1				Asian Development Bank, 2013 (Publication Stock No. RPT136010)	
Argentina	19.6		13.7		17.8								Nieto et al., Sustainability 2018 (10)	Rotational vs Continuous grazing
Scotland								210			163		Moxey & Thomson, 2021, Scottish Government (Sheep Emission Report)	
India							9.5	350						
Mediterranean													Ripoll-Bosch et al., 2013, Agric. Syst. (116)	Zero grazing and pasture grazing : 19.5 and 25.9 kg CO2e per kg of LW
New eland	6.9	####					17	300					Carbon Farming Group, 2021; https://www.carbonfarming.org.nz/	
China													Tang et al., 2019, Science of the Total Environment (654)	methane emission decrease up to 50 % from HG to MG
Western Canada	10.4						13.2						Dyer and Desjardins, 2014, Sustainable Agriculture Research (19)	
Western Australia							8.2				7.7		Black et al. 2021, Animals (11)	livestock productivity improvement of 10% results in 6.5 % decrease in emission.

Table B1 continued

Location	Cattle						Sheep						Reference	Remarks
	Baseline		Pasture		Livestock		Baseline		Pasture		Livestock			
	(kg CO2e /kg LW)	(kg CO2 e/he ad)	(kg CO2e /kg LW)	(kg CO2 e/he ad)	(kg CO2e /kg LW)	(kg CO2e /hea d)	(kg CO2e /kg LW)	(kg CO2 e/he ad)	(kg CO2e /kg LW)	(kg CO2 e/he ad)	(kg CO2e /kg LW)	(kg CO2e /hea d)		
Mongolia	10.8		9.9				15.4		13.1				Asian Development Bank, 2013 (Publication Stock No. RPT136010)	
Argentina	19.6		13.7		17.8								Nieto et al., Sustainability 2018 (10)	Rotational vs Continuous grazing
Scotland								210			163		Moxey & Thomson, 2021, Scottish Government (Sheep Emission Report)	
India							9.5	350						
Mediterranean													Ripoll-Bosch et al., 2013, Agric. Syst. (116)	Zero grazing and pasture grazing : 19.5 and 25.9 kg CO2e per kg of LW
New eland	6.9	####					17	300					Carbon Farming Group, 2021; https://www.carbonfarming.org.nz/	
China													Tang et al., 2019, Science of the Total Environment (654)	methane emission decrease up to 50 % from HG to MG
Western Canada	10.4						13.2						Dyer and Desjardins, 2014, Sustainable Agriculture Research (19)	
Western Australia							8.2				7.7		Black et al. 2021, Animals (11)	livestock productivity improvement of 10% results in 6.5 % decrease in emission.

Table B2: Reported carbon sequestration rates under different grazing management and production practices.

Vegetation Type	Soil depth (cm)	SOC (tC/ ha)	Baseline		Pasture/ grazing		Reference	Remarks
			Rate (tC/ha/yr)	Rate (t CO2e/ ha/yr)	Rate (t SOC/ha /yr)	Rate (t CO2e/h a/yr)		
Downstream wetland	0-100	65.0					Liu et al., 2022; Ecological Indicators 139 (2022) 108945	
Semi-arid grassland					0.10	0.35	Asian Development Bank, 2013 (Project No. 47286-001)	
Semi-arid grassland					0.03	0.12	Asian Development Bank, 2013 (Publication Stock No. RPT136010)	Improved grassland management; Conservatively assumed no soil carbon emission in baseline
Semi-arid grassland							Byrnes et al. 2018, J. Environ. Qual.(47)	Heavy grazing decrease soc by 14%
Semi-arid grassland							Byrnes et al. 2018, J. Environ. Qual.(47)	Rotational vs. contineous grazing increase soc by 29%
Mountain steppe - heavily degraded	0-20		0.26	0.95			Chang et al. 2015, Agriculture, Ecosystem and Environment (212)	
Mountain steppe - heavily degraded	0-20	10.9					Chang et al. 2015, Agriculture, Ecosystem and Environment (212)	
Mountain steppe - lightly degraded	0-20		0.30	1.10			Chang et al. 2015, Agriculture, Ecosystem and Environment (212)	
Mountain steppe - moderately degraded	0-20	31.0					Chang et al. 2015, Agriculture, Ecosystem and Environment (212)	
Mountain steppe - moderately degraded	0-20		0.35	1.28			Chang et al. 2015, Agriculture, Ecosystem and Environment (212)	
Riparian meadow - heavily degradated	0-20	17.0					Chang et al. 2015, Agriculture, Ecosystem and Environment (212)	
Riparian meadow - moderately degraded	0-20	34.5					Chang et al. 2015, Agriculture, Ecosystem and Environment (212)	
semi-arid grasslands					0.05	0.18	Conant and Paustian, 2017, Ecological Applications (11)	Change from overgrazed to moderately grazed
Meadow steppe	0-20	66.5					Dai et al. 2014	
Typical steppe	0-20	34.1					Dai et al. 2014	
Grassland							Eze et al., 2018, J. Environ. Manage.(223)	Heavy grazing decrease soc by 27%
Grassland							Eze et al., 2018, J. Environ. Manage.(223)	Sowing legumes increase soc by .4 to .9 ton/ha/yr
Grassland			0.27	0.99			Fan et al., 2012, Grassland and Turf (32)	
Typical steppe	0-30	22.7					Feng et al. 2019	
grassland			0.49	1.80	0.39	1.80	Garnett et al., 2017, University of Oxford	Review of literature

Table B2 Continued

Vegetation Type	Soil depth (cm)	SOC (tC/ ha)	Baseline		Pasture/ grazing		Reference	Remarks
			Rate (tC/h a/yr)	Rate (t CO2e/ ha/yr)	Rate (t SOC/ha /yr)	Rate (t CO2e/h a/yr)		
rangeland					0.06	0.23	Henderson et al. 2015, Agriculture, Ecosystem and Environment (207)	Change in grazing pressure; Conservatively assumed no soil carbon emission in baseline
rangeland					0.55	2.00	Henderson et al. 2015, Agriculture, Ecosystem and Environment (207)	Legume sowing add 2 t/co2/ha/yr (compensation for nitrous oxide emission); Conservatively assumed no soil carbon emission in baseline
Semi-arid grassland					0.15	0.55	Henry et al., 2015	Due to vegetation recovery/ improvement; Conservatively assumed no soil carbon emission in baseline
Semi-arid grasslands					0.10	0.36	Lal, R., 2004, Geoderma (123)	Improved grazing practices; Conservatively assumed no soil carbon emission in baseline
Semi-arid grasslands					0.20	0.73	personal communication	
Semi-arid grasslands							Sagar et al. 2019 Journal of Plant Ecology (12)	Conversion of biomass to carbon - 41% for Stipa species
Mountain steppe		26.6					Upton et al., 2015, Plan Vivo Project Design Document	
Mountain steppe					0.03	0.10	Upton et al., 2015, Plan Vivo Project Design Document	Grazing pressure from 80 to 50%
Mountain steppe - summer					0.08	0.12	Upton et al., 2015, Plan Vivo Project Design Document	Grazing pressure from 80 to 50%
Mountain steppe - winter					0.08	0.28	Upton et al., 2015, Plan Vivo Project Design Document	Grazing pressure from 80 to 50%
Riparian meadow		31.7					Upton et al., 2015, Plan Vivo Project Design Document	
Riparian meadow - summer					0.10	0.36	Upton et al., 2015, Plan Vivo Project Design Document	Grazing pressure from 80 to 50%
Riparian meadow -winter					0.05	0.02	Upton et al., 2015, Plan Vivo Project Design Document	Grazing pressure from 80 to 50%
Mountain steppe -Moderately degraded	0-20	33.2					Wang et al., 2013	
Mountain steppe -haveliy degraded	0-20	11.8					Wang et al., 2013	
Riparian meadow - Moderately degraded	0-20	24.1					Wang et al., 2013	
Riparian meadow -haveliy degraded	0-20	16.3					Wang et al., 2013	
Mountain steppe -Moderately degraded	0-20				0.21	0.77	Wang et al., 2013	Between 0.13～ 0.65 t C ha-1yr-1 for degraded pastures under changed grazing (summer grazing)
Mountain steppe -haveliy degraded	0-20				0.34	1.25	Wang et al., 2013	Between 0.13～ 0.65 t C ha-1yr-1 for degraded pastures under changed grazing (summer grazing)
Riparian meadow - Moderately degraded	0-20				0.22	0.81	Wang et al., 2013	Between 0.13～ 0.65 t C ha-1yr-1 for degraded pastures under changed grazing (summer grazing)
Riparian meadow -haveliy degraded	0-20				0.28	1.03	Wang et al., 2013	Between 0.13～ 0.65 t C ha-1yr-1 for degraded pastures under changed grazing (summer grazing)
Typical steppe	0-100	67.0					Yang et al. 2007	
Typical steppe							Zhou et al. 2017, Glob. Chang. Biol.(23)	Heavy grazing decrease soc by 10%

Annex C. Beef Cow Productivity

With a focus on farming for profit through quality rather than quantity, the cow becomes the profit center. Physical and economic performance can be measured relative to the cows over-wintered.

Table 2. Economic Performance Indicators ($/Cow Wintered)

			2016	2017	2018	2019	2020	Average of Years
		Average Farm Size (wintered cows)	167	161	214	211	182	188
					$/Cow Wintered			
(A)	1.	Weaned Calves	977.86	1,057.17	1,016.57	1,083.54	1,049.14	1,038.78
	2	Cull Cows/Open Heifers	204.95	163.60	176.44	192.25	194.77	185.60
	3.	Bulls	29.12	37.79	22.53	33.05	23.91	28.79
	4.	Bred Cows/Bred Heifers	57.93	71.20	52.48	64.15	64.41	61.44
	5.	Miscellaneous Receipts	24.63	6.44	21.59	10.52	1.31	13.09
	6.	Government Programs	11.23	21.11	3.30	3.67	3.78	7.79
	7.	Inventory Adjustment	-83.55	182.95	159.35	81.38	185.44	113.87
	8.	Less: Cattle Purchases	420.09	334.25	393.60	284.50	452.94	374.54
		Value of Production	**802.08**	**1,206.01**	**1,058.47**	**1,184.06**	**1,069.82**	**1,074.81**
(B)	1.	Winter Feed	390.01	373.02	342.43	413.53	375.24	377.10
	2.	Bedding	19.00	25.31	12.42	17.79	17.78	17.89
	3.	Pasture	240.99	270.45	287.78	316.02	300.91	286.36
	4.	Veterinary & Medicine	30.55	39.74	32.01	36.39	32.85	34.26
	5.	Breeding Fees/Bull Rental	0.10	1.50	2.53	3.25	6.85	2.96
	6.	Trucking & Marketing Charges	17.04	16.61	17.33	12.32	20.31	16.62
	7.	Fuel	20.34	19.59	24.58	20.76	14.60	20.31
	8.	Repairs - Machine	23.07	22.62	15.44	18.28	16.56	18.70
	9.	Repairs - Corrals & Buildings	10.74	24.53	14.48	11.21	12.38	14.53
	10.	Utilities & Miscellaneous Expenses	38.52	32.88	31.25	40.71	27.31	33.99
	11.	Custom Work & Specialized Labour	2.62	4.63	8.14	6.09	7.06	6.02
	12.	Operating Interest Paid	3.10	3.23	9.97	9.64	2.30	6.20
	13.	Paid Labour & Benefits	22.20	20.20	17.02	18.86	23.95	20.10
	14.	Unpaid Labour	51.31	62.01	59.64	67.05	55.48	59.62
		Variable Costs	**869.58**	**916.34**	**875.01**	**991.91**	**913.59**	**914.67**
(C)	1.	Share/Lease Cattle Payments	0.04	4.59	2.58	4.42	0.00	2.46
	2.	Taxes, Water Rates, Lic. & Insurance	12.42	17.60	16.64	11.23	12.56	14.18
	3.	a) Equipment & Building Depreciation	67.23	61.18	60.04	56.74	56.22	59.88
		b) Lease Payments	6.90	1.48	0.65	5.28	3.01	3.23
	4.	Paid Capital Interest	5.43	5.77	21.45	6.69	8.47	10.51
		Total Capital Costs	**92.01**	**90.63**	**101.36**	**84.36**	**80.26**	**90.25**
(D)		**Cash Costs (B+C-B14-C3a)**	**843.05**	**883.77**	**856.69**	**952.48**	**882.15**	**885.42**
(E)		**Total Production Costs (B+C)**	**961.58**	**1,006.97**	**976.37**	**1,076.27**	**993.85**	**1,004.93**
(F)		**Gross Margin (A-D)**	**-40.96**	**322.24**	**201.78**	**231.58**	**187.67**	**189.39**
		Return to Unpaid Labour (A-E+B14)	**-108.19**	**261.06**	**141.74**	**174.84**	**131.45**	**129.51**
		Return to Investment (A-E+C4)	**-154.08**	**204.81**	**103.55**	**114.47**	**84.43**	**80.39**
		Net Return (A-E)	**-159.50**	**199.04**	**82.10**	**107.79**	**75.96**	**69.89**

Source: AAFRD, AgriPofit$, 2016-202 Economic, productive and financial performance of Alberta cow/calf operators

Annex D. Feedlot Location Checklist

Site:

Location:

Business Function	Questions to Ask	Score (0, 1-5)	
		Current	Potential

Human resources	• Why do you want to establish a feedlot? What are your objectives, and do family members and employees agree?
	• Are you committed to feeding cattle long enough to justify the investment?
	• Have you developed a management team that includes experts and consultants in animal nutrition, animal health, marketing, engineering, financing? Have you discussed your plan with them?
	• Do you have, or can you hire, the labor to feed and take care of the cattle?
	• Do you have, or can you learn or can you hire, the skills or expertise to successfully feed cattle, including:
	  • Purchasing cattle
	  • Marketing of the fed cattle
	  • Risk management for cattle and feed inputs
	  • Cattle management (reading bunks, walking pens, sorting cattle, veterinary treatment of cattle)
	Technology for record keeping (computers, etc.).		

Farm resources	When looking at the feedlot in the context of the whole farm system, are there synergies that can be captured by adding a feedlot, or is it a stand-alone enterprise? Can you grow most of the feed you will need for the feedlot? What are the local feed opportunities? What can be purchased locally? Do you have land near the feedlot for applying the manure from the feedlot? Can existing machinery and buildings/facilities be used more efficiently? Will additional equipment and infrastructure need to be purchased? Do you have enough equity and loan borrowing capacity to add the feedlot, cattle and feed without putting existing farm business or other assets at risk? Do you have a long-range budget, cash-flow budget, and loan repayment plan? How long is the period of loan		

Business Function	Questions to Ask	Score (0, 1-5)	
		Current	Potential
	repayment? What kind of return on your investment do you anticipate? Is this realistic?		
Site selection	Is the feedlot site easily accessible for trucks hauling livestock and feeds (for example, the condition of the road year-round)? Does the site for the feedlot have sufficient separation distance to other peoples' homes to avoid nuisance form dust, smells flies and noise? Does the site for the feedlot already have, or can it economically obtain, sufficient: Electrical supply? Water supply? Wind protection for winter conditions? Exposure to cool summer winds? Does the site for the feedlot have south-facing exposure for winter feeding? Slopes of 2-8 percent to provide good feedlot pen drainage? Does the site for the feedlot have the possibility to grow in the future if you plan to expand the size of it?		
Zoning and permits	Is the location in a site approved within local land use and development regulations?		