BASELINE STUDY REPORT

Feasibility Study on Pasture Use Fee

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07 November 2017
Ulaanbaatar

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1. Review of existing literature on the ecosystem vulnerability with regard to carrying capacity

Grasslands ecosystems occur in regions that are too dry for forests but that have sufficient soil water to support a closed herbaceous plant canopy that is lacking in deserts. Thus, temperate grasslands usually start in areas with 25–100 cm of annual precipitation. About 32% of the Earth's surface is covered with grasslands. In Mongolia, grassland or pastureland accounts for around 70% of the land territory. By a common definition, Mongolian rangeland encompasses an extensive variety of ecosystems, including high mountains, mountain forests, mountain steppe, steppe, desert steppe, desert, alluvial meadows, and lowlands.

Grassland ecosystems are very important for a wide variety of different reasons like:

- **Habitat.** Grassland ecosystems are key habitats for a vast range of biodiversity
- **Soil quality.** The delicate balance of plants and animals in grassland ecosystems maintains a soil quality. When sustainable use is not practiced the soil quality declines
- **Natural Beauty.** Grassland ecosystems should be important to us, too, because they are quite simply very beautiful open spaces
- **Large open space.** The grassland ecosystem one of the largest and most important types of ecosystem in the world
- **Cradle of pastoralism and nomadic civilization.** Mongolian grasslands have been and still are the key resources base for livestock – critical source for people's livelihood for thousands of years.

According some sources[1],[2] for Mongolia, healthy rangelands can contribute: (i) to the resilience of livestock production. (ii) the herder community in the face of drought and natural disasters, (iii) healthy rangelands promote greater overall forage and better nutrition for animals, (iv) increased animal production (v) healthy rangelands promote well-fed, healthy animals coming into winter that are better able to survive dzud/drought, and (vi) healthy animals also provide a basis for marketing according to quality indicators in meat, hide, and the environment.

However, climate change and human interventions especially non-sustainable use pastureland are threatening grassland ecosystems.

The Intended Nationally Determined Contribution (INDC) Submission by Mongolia to the Ad-Hoc Working Group on the Durban Platform for Enhanced Action (ADP)[3] summarizes the key statements of climate change trends, impacts and vulnerabilities of both the ecology and ecosystems:

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[1] Information and Research Institute of Meteorology And Hydrology, SDC Green Gold project, 2015. National report on the rangeland health of Mongolia

[2] David R. Kemp, et al., 2013.'Innovative Grassland Management Systems for Environmental and Livelihood Benefits', Proceedings of the National Academy of Sciences, 110 (2013)

[3] Intended Nationally Determined Contribution (INDC) of Mongolia http://www4.unfccc.int/submissions/INDC/Published%20Documents/Mongolia/1/150924_INDCs%20of%20Mongolia.pdf

- Approximately 70% of pastoral land has degraded, while changing plant composition.
- Winter dzud (heavy snow, cold waves, storms etc.) risk is likely to increase leading to more losses in livestock sector
- The drying up of lakes, rivers and springs and melting of glaciers has intensified in the last decades. The recent surface water resource inventory confirmed that 12% of rivers, 21% of lakes and 15% of springs have dried up. Water temperature and evaporation are continuously increasing, leading to declining water resources.
- The frequency of extreme weather phenomena has doubled in the last two decades.

This is expected to increase by 23-60% by the mid of the century as compared to present conditions. Climate change assessments undertaken in Mongolia in 2009 and 2014, demonstrated that fragile ecosystems, a reliance on pastoral animal husbandry and rain-fed agriculture, and the growing population with a tendency of urbanization, all combine to make Mongolia's socio-economic development vulnerable to climate change[4].

Chuluun, T., et al. 2017[5] assessed the ecological vulnerability for the first time in Mongolia. Climate disasters and grazing intensity were two factors accounted for in this assessment. Ecological vulnerability was high when both dzud risk (with previous summer drought) and overgrazing are high. Based on findings of the assessment, an ecological vulnerability assessment map was produced as shown below. The ecological vulnerability has increased enormously since 1994 and this increase occurred almost everywhere with exceptions being only eastern aimags.

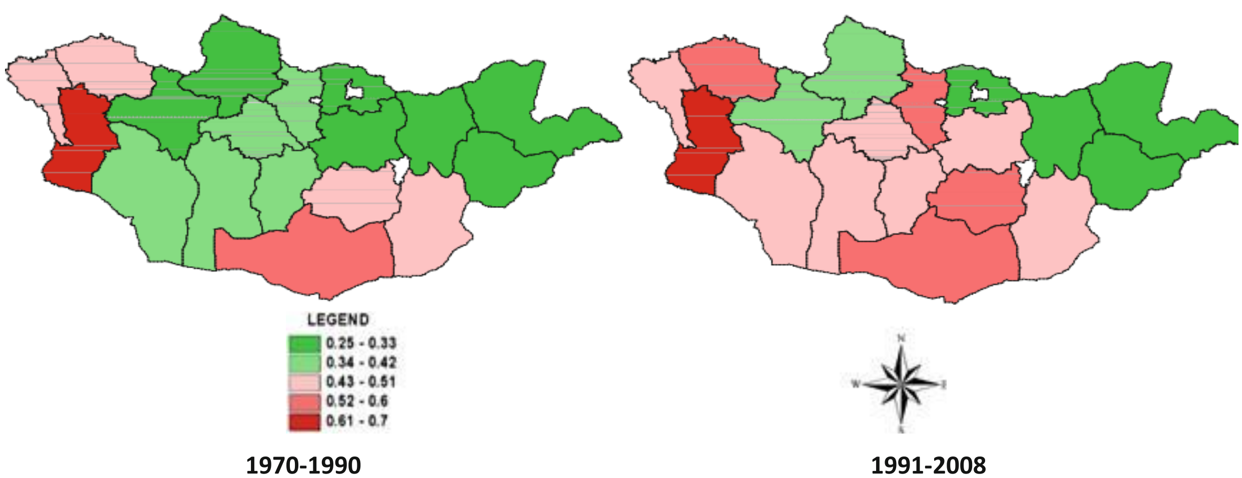

Figure 1 Ecological vulnerability assessment of Mongolia, including Biophysical (drought, *dzud*) and human (pasture degradation) impact

Source: Chuluun, T., et al. 2017. Vulnerability of Pastoral Social-Ecological Systems in Mongolia, https://www.researchgate.net/publication/316117395

[4] Ibid.

[5] Chuluun, T., et al. 2017. Vulnerability_of_Pastoral_Social-Ecological_Systems_in_Mongolia. at: https://www.researchgate.net/publication/316117395

The assessment also included a long-term ecological vulnerability dynamics in ecological zones of Mongolia.

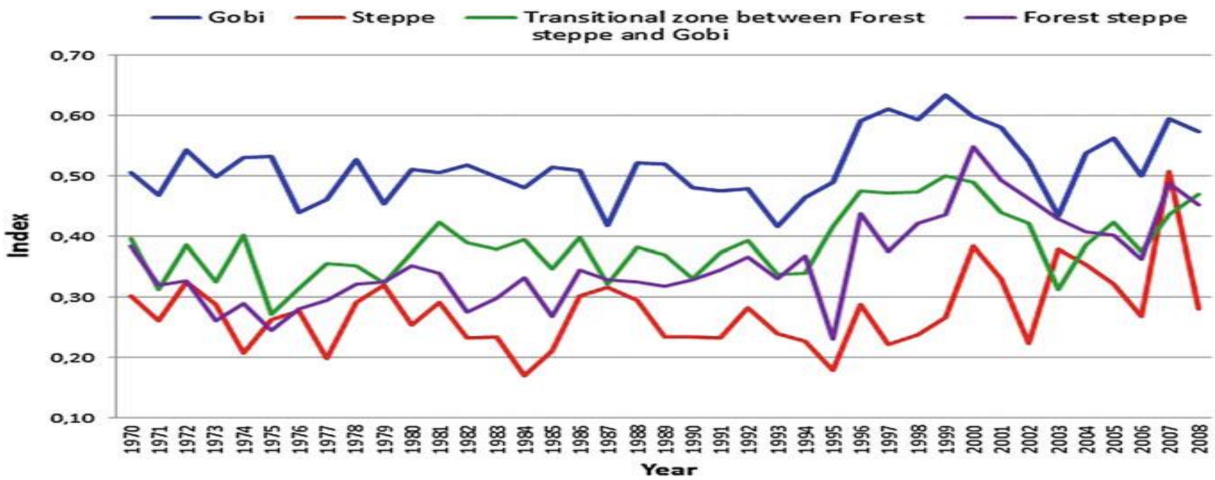

Figure 2 Ecological vulnerability index in the *Gobi* zone was the highest relative to other ecological zones, however it rapidly increased in the forest-steppe and steppe zones during the last decade[6].

The problem for Mongolian case is that the grassland ecosystems are used more intensive than they can be recovered or renewed. Several indicators could tell if the stocking rate is too high or too low, or how the pastureland ecosystem responds to grazing. For example high body condition may indicate potential to increase stocking rate, and low body conditions may be an indicator of a stocking rate that is too high. If desired forage species are declining in vigor or decreasing in number, stocking rate may be too high[7]. Thus, the issues that practically highlight the linkages between the potentials of ecosystem services and the pasture capacities via productivity and other key land patterns are as follows:

- Animal performance reduced
- Intake and forage quality reduced
- Desirable forage plants replaced by less desirable species
- Overall forage productivity reduced
- Increase in bare soil and preferred grazing areas become degraded
- Increased replacement feed costs

Chuluun, T, et al. 2017[8] highlight that pastoral systems exist largely in arid and semi-arid ecosystems in Mongolia with highly variable climate, where direct feedback exists between

[6] Chuluun, T., et al. Vulnerability assessment of Mongolian social ecological systems. In Proceedings of 4th International and National Workshop, Applications of Geo-informatics for Natural Resources and Environment, Ulaanbaatar (pp. 1–11), 2010
[7] Melvin George and David Lile. Stocking rate and carrying capacity, 2008
[8] Chuluun T., et al. 2017. Vulnerability of Pastoral Social-Ecological Systems in Mongolia. In: Rethinking Resilience, Adaptation and Transformation in a Time of Change. Springer, Cham

nomadic land-use systems and ecosystem dynamics. The traditional resilience of pastoral community-cultural landscape systems is being affected by climate and socioeconomic changes related to global warming, mining, and goat-cashmere production, which have led to losses in resilience and further degradation of the pasturelands, peri-urban areas, and water bodies.

The need to restore ecosystem services is especially important in the rangelands of Mongolia, which are highly vulnerable to climate change and are greatly affected by overgrazing because of weakened formal and traditional regulatory institutions and changing socioeconomic systems[9]. By commenting in such way, the author recognizes that well strengthened local herder groups were able to manage successfully rangelands in cooperation with local and central government regulators.

James E. M. et al., 2013[10] publishes findings of a survey as citing that the rates of both biodiversity loss and threats are growing, the identification of spatial gradients of ecosystem vulnerability to both global and regional drivers is required for the development of effective conservation measures. In terms of ecoregional stability, large part of Mongolia would be suspiciously less intact and predicted that as the air temperatures grow. According the map developed by this survey, the situation may a bit better in the southern areas – the Gobi. This is in agreement with conclusion of another large study[11] that in some areas, particularly in the Gobi Desert, there has been limited evidence of rangeland degradation because rainfall variability forces animals to move, thereby placing natural limits on grazing intensity[12,13].

In Mongolia, overgrazing is commonly acknowledged as a major human-induced threat to the grassland ecosystem in general and biodiversity in particular, a topic discussed in section 3.

2. Biodiversity concerns including critical habitat of the wildlife

The biodiversity of both domestic livestock and wildlife is closely correlated to the ecosystem services and closely interrelated. Anthropogenic climate change is affecting ecosystems globally, causing changes in phenology, species composition and range shifts[14], while increasing environmental degradation is leading to habitat fragmentation or loss. These two factors in

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9 Undarmaa, J., 2010. Involvement of Local Communities in Restoration of Ecosystem Services in Mongolian Rangeland. at: https://search.snapdo.com/?category=Web&p=5&st=dn&ic=1&q=Ecosystem+vulnerability+of+Mongolia

10 James E. M. et al., 2013. Mapping vulnerability and conservation adaptation strategies under climate change. At: https://www.colorado.edu/AmStudies/lewis/sustain/mappingclimatechange.pdf & https://www.nature.com/nclimate/

11 SDC Green Gold project, National report on the rangeland health of Mongolia. at: https://www.eda.admin.ch/content/dam/countries/countries-content/mongolia/en/Mongolia-Rangeland-health-Report_EN.pdf

12 Karsten W, et al., 2010. 'Effects of Large Herbivore Exclusion on Southern Mongolian Desert Steppes', Acta Oecologica, 36

13 Markus Stumpp, et al., 'Impact of Grazing Livestock and Distance from Water Source on Soil Fertility in Southern Mongolia', Mountain Research and Development, 25 (2005)

14 Chen, I. C., Hill, J. K., Ohlemuller, R., Roy, D. B. & Thomas, C. D. 2011. Rapid range shifts of species associated with high levels of climate warming. Science 333

concert are likely to result in exacerbated biodiversity decline and extinction in the near future[15]. In this connection, James E. M. et al., 2013[16] publishes findings of a survey that the rates of both biodiversity loss and threats are growing; the identification of spatial gradients of ecosystem vulnerability to both global and regional drivers is required for the development of effective conservation measures. According the map developed by this survey, Mongolia may attain the climate stability at lower level, where vegetation intactness would be vulnerable and the ecoregional climate stability and vegetation intactness – high. In terms of ecoregional stability, large part of Mongolia would be suspiciously less intact and predicted that as the air temperatures grow, this indicator would go to more vulnerable gradient. The map shows that the situation may a bit better in the southern areas – the Gobi. This is in agreement with conclusion of another large study[17] that in some areas, particularly in the Gobi Desert, there has been limited evidence of rangeland degradation because rainfall variability forces animals to move, thereby placing natural limits on grazing intensity[18,19].

Changes in biodiversity affect the ability of ecosystems to supply services and to recover from disturbances. When a species is added or lost at a particular location, the various ecosystem services specifically associated with that species are changed.

Some sources[20] describe that the fauna and flora in Mongolia, which are known well for their richness, are being acutely threatened. Species and habitat loss, deforestation and forest destruction, and the largely unregulated overuse of common pasture areas have produced a complex situation of vulnerability that poses a growing threat to the continued existence of entire ecosystems in co-existence with wildlife. Human-induced impacts, in combination with climate change, are causing declines and extinctions of flora and fauna, and may cause irreversible disrupt on of ecological functions and ecosystem services such as forage production, freshwater supplies and soil fertility[21].

It is known that the carrying capacity describes the maximum number of individuals or species a specific environment's resources can sustain for an indefinite period of time without degrading it. While there are small factors that may influence a particular environment - or habitat - from

[15] Brook, B. W., Sodhi, N. S. & Bradshaw, C. J. A. Synergies among extinction drivers under global change. Trends Ecol. Evol. 23, 453–460 (2008).
[16] James E. M. et al., 2013. Mapping vulnerability and conservation adaptation strategies under climate change. At: https://www.colorado.edu/AmStudies/lewis/sustain/mappingclimatechange.pdf & https://www.nature.com/nclimate/
[17] SDC Green Gold project, National report on the rangeland health of Mongolia**,** https://www.eda.admin.ch/content/dam/countries/countries-content/mongolia/en/Mongolia-Rangeland-health-Report_EN.pdf
[18] Karsten W, et al., 2010. 'Effects of Large Herbivore Exclusion on Southern Mongolian Desert Steppes', Acta Oecologica, 36
[19] Markus Stumpp, et al., 'Impact of Grazing Livestock and Distance from Water Source on Soil Fertility in Southern Mongolia', Mountain Research and Development, 25 (2005)
[20] Biodiversity and adaptation of key forest ecosystems to climate change II
[21] The Nature Conservancy 'Identifying Conservation Priorities in the Face of Future Development', 2011-2017

time to time, four major factors affect the carrying capacity of the environment or pasture that are feed availability, water sources, ecological conditions, and space. [22] Feed availability in any habitat is paramount to survival of a species, both domestic and wild. Attention should be paid to herbivores, grass eaters that can become stressed from a shortage of food in both amount and quality.

They have the same grazing habits similar to that of domestic livestock - as will feed first on their preferred feed, and then the staple feed that satisfies their nutritional needs. When no other feeds are available, herbivores will “shift” on emergency feeds that will fill them up, but not maintain their body condition and other bio-physiological functions. Water sources are an attractive to both domestic and wild animals. Where water becomes scarce due to seasonal availability or changes caused by man-made and climatic factors, feed may also become scarce as plants die, wild animals die or leave the habitats, and the remaining animals compete for whatever water is left. Ecological conditions within or adjacent to a habitat area also affect its carrying capacity. For example, close location to human populations, pollution, natural disasters and erosion and desertification of land and degradation of pasture in particular affects environmental carrying capacity. Space, sufficient within habitats allows the animals that inhabit it better opportunities to find adequate food and water. Without space, animals cannot ensure a place to hide and raise their young and need space to rest, even to play.

The response of wildlife to domestic grazing varies by habitat. Livestock grazing can have direct and indirect impacts on wildlife. Direct impacts include the removal and/or trampling of vegetation that would otherwise be used for food and cover, and livestock-wildlife interactions that may result in wildlife displacement or disease transmission. As the case for many countries, overcrowded invasion of domestic livestock into wildlife habitat affects the areas through hoof action, pawing, wallowing and pawing and, grazing animals trample plants; break up soil surface, damage seeds and compact soils. Indirect impacts result from changes in plant community composition, structure, and productivity which together largely determine wildlife habitat suitability[23].

Under MMC Peri-urban Pastureland project, CPR has developed an inventory of pasture use, which proposes forage needs of wildlife as an inseparable part of pasture feed utilization. To do so, the wildlife population converts into sheep unit and their need in seasonal pasture forage is calculated and put into annual pasture use plan[24].

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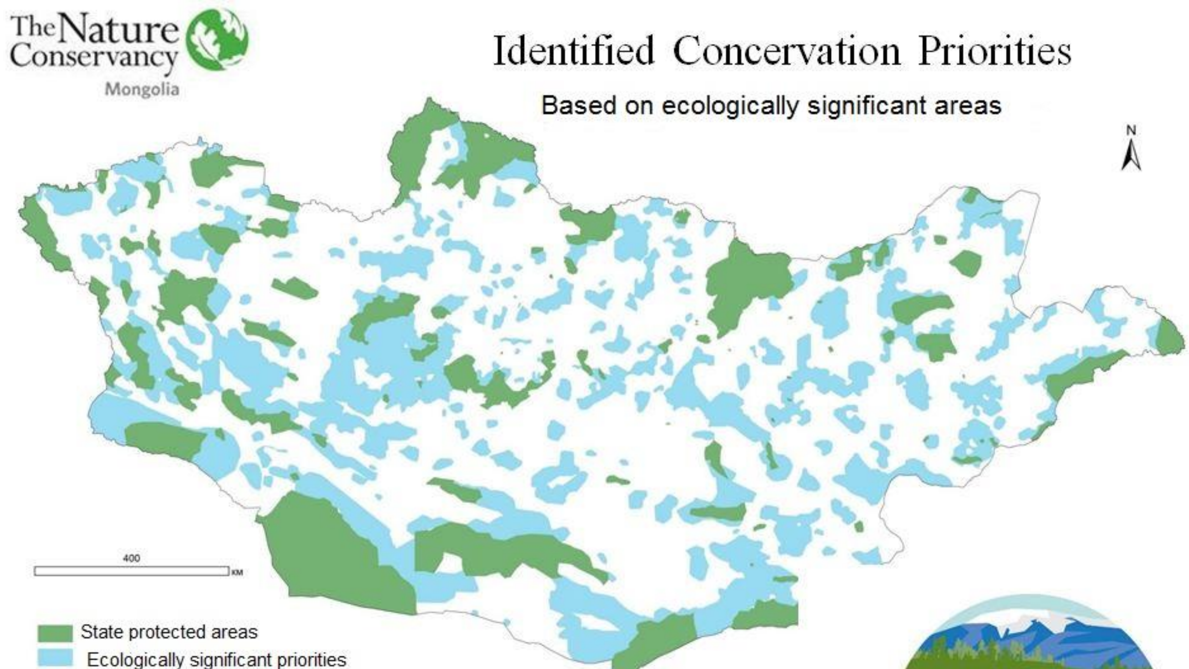
[22] Lori Garrett-Hatfield, What Factors Affect the Carrying Capacity of an Environment? http://education.seattlepi.com/factors-affect-carrying-capacity-environment-6190.html
[23] https://www.fws.gov/invasives/staffTrainingModule/methods/grazing/impacts.html
[24] Center for Policy Research, Grazing records, Peri-Urban Rangeland Project, MCA, 2012

In 2011-2017, the Nature Conservancy has undertaken ecoregional assessments of major ecological regions of Mongolia – Eastern Grasslands, Mongol Altai and Great Lakes Depression, Hangai-Huvsgul and the Gobi - and prepared reports 'Identifying Conservation Priorities in the Face of Future Development[25].

Recent surveys and assessments show that biodiversity conservation efforts in Mongolia tend to produce insufficient outcomes due to a range of reasons. Outstanding among them are difficulties associated with addressing overgrazing and other non-sustainable grassland use practices, lack of participation of local stakeholders, especially herder communities in these efforts and weak sustainability of efforts especially in the area of ensuring sufficient funding and commitment building. The key issue for two communities- herders and conservationists is to understand a vital condition: pastoralism and wildlife both have first-order conflicts. It is impossible to address wildlife issues without being closely associated with, and informed by, the livestock economy, for it is primarily in pastoral areas, or vice versa. In areas where wildlife management has been integrated with pastoralism, pastoral communities refer very positively. Functionally, wildlife and livestock are integrated into their land use production system[26].



By regions	Number of areas	Area size (км2)	Share in the national territory %
Steppe region	60	108,090.63	6.9%
Gobi region	53	149,984.06	9.6%
Altai, North Altai Gobi region	42	82,636.85	5.3%
Khanhgai, Khuvsgul region	60	91,526.74	5.9%
Total	**215**	**432,238.29**	**27.6%**

[25] The Nature Conservancy 'Identifying Conservation Priorities in the Face of Future Development', 2011-2017
[26] Ibid

Figure 3 TNC identified conservation priorities based on ecologically significant areas
Source: The Nature Conservancy 'Identifying Conservation Priorities in the Face of Future Development', 2011-2017

Addressing these challenges successfully requires a holistic viewpoint based on sustainable livelihoods approach (SLA). In 2014-2015, under UNDP-funded project "Natural Resource Management Protected Land Network" CPR has undertaken "Strengthening the management structure and establishing sustainable financing of Local Protected Lands in Toson Khulstai Region" to test innovative approaches to address biodiversity protection challenges by bringing tested best practices into one package for a community conservation model. The package included pastureland use and wildlife protection agreements with herder groups who were willing to pay proxy grazing fees to a common fund to be used for financing pastureland, risk management and environmental protection activities locally.

3. Current situation of land degradation and existing methodologies for determining pasture conditions and/or carrying capacity

Keystone of nomadic pastoralism in Mongolia was availability and rotational use of seasonal pastures and access to reserve areas in emergencies. For centuries this was regulated by customary arrangements and was effective in ensuring ecological sustainability and minimizing animal losses during natural disasters.

For the past 20 and more years the following situation emerged in which the keystone for traditional pastoralism much violated:

First. The end of XX century that witnessed the livestock privatization and shifting to a market economy was incomparable to the several thousand years of nomadic history when the national demand was met by a limited number of animals. Private interest of individuals to meet their enormously increased demand and resulting competition for pastures reached the level to actually 'kill' the effectiveness of customary arrangements that kept ecological balance for centuries.

Second. Since the beginning of transition in 1990 the number of herders families has grown from around 90 thousand to 160 thousand tremendously increasing the number of seasonal camp sites and virtually destroying the possibility of rotating pastures and keeping emergency reserves. The majority of new herders came from non-herding families who suffered decline and unemployment in the other industries meant that they seriously lacked the knowledge and conscience to keep the customary arraignments. One example is that herders became reluctant to migrate simply because trespassers came in to use pastures left for rest.

Third. Rapidly increasing urbanization and rural infrastructure development has changed the livestock distribution that was relatively even across the territory and increased localized overstocking and degradation.

As a result of the above mentioned situation the number of herders who migrate consciously to rotate pastures is shrinking to zero leaving a few places where pastures are rotated only because of unavoidable natural factors such as no water, no pastures, too cold or too much flies and mosquitoes. An example is long migrations between high mountains and the basin of Great Lakes in the Uvs lake region with clear cut natural boundaries between seasonal pastures. One hopes that pastureland can be preserved relatively well only in a few places with such geography.

However, in the entire steppe region and most of Gobi and mountain-steppe regions with relatively uniform landscape characterized by a lack of clear cut boundaries separating seasonal pastures very short migrations unable to rotate pastures has become commonplace leading to year around use and degradation. Given the weak seasonal boundaries herders tend to overgrow animal numbers as they make orientation to the entire area instead of the seasonal pastures. The steppe and Gobi regions are also more exposed to natural degraders such as wind erosion and sand movements. As a result of these factors the frequency of natural risks has increased causing severe losses to the livelihood of herders.

Pastureland degradation resulted from violation of traditional arrangements and a lack of effective state regulation became a key reason for not only undiminishing rural poverty by making the livestock sector extremely vulnerable to drought and *dzud* and the herders livelihood non-sustainable, but increasing desertification that lead to widespread ecological disaster. Decision makers who naively think that land producing green mass is intact have to see the danger of a drastic change in the green mass composition to less nutritional grasses and more weeds- a key feature of pastureland degradation.

Uncontrolled and chaotic use of pastureland patronizes increasing animal numbers without due consideration of carrying capacity. The national livestock population has reached 61.5 m in 2016. It looks good in terms of today's livelihood for herders, however, there is nothing to boast from the long-term sustainable development viewpoint. Because, this number is illusional or non-sustainable relative to the pasture carrying capacity and detrimental to future generations of herders as it causes serious overgrazing and degradation. One should not forget that boasting over record animal numbers of 44 m in 2008 was replaced with sad experiences of losing In the 2009-2010 dzud, about 8.5 million livestock had died, more than 20% of the country's livestock population, affecting 769,000 people or 28% of Mongolia's human population. According to the

Red Cross, 220,000 herding households were affected of which 44,000 households lost all of their livestock and 164,000 lost more than half their herd[27].

Any policy supportive of increasing animal numbers without due consideration of pasture carrying capacity is inhuman and myopic. It is inhuman in that instead of being consciously managed the destiny of several hundred thousand herders' families is left to the reign of volatile natural shocks - *dzuds* and droughts. As rightly described by María E. Fernández-Gimenez et al. In the period since livestock population and weather data have been regularly documented in Mongolia, dzud has played a critical role in limiting livestock populations before density-dependent competition for forage results in severe overgrazing, starvation, and livestock population crashes. Thus, despite its devastating consequences for herders, dzud serves an important ecological function in this social-ecological system, by reducing animals and hence grazing pressure, to a more sustainable level, albeit temporarily, and allowing pastures to rest and regenerate[28].

It is myopic as it nourishes the existing stagnant position of the extensive livestock industry which has 'absorbed' too many households far beyond its 'feeding' capacity only to keep in poor subsistence but does not allow them to either 'die' or develop, thwarts the herders' willingness to strive for innovation and more productive jobs, devitalizes the policy to resolve herders' poverty by actively addressing the excess labor problem to enable the remaining households to keep the herd size enough for sustaining their livelihood and as a whole confines one third of the population in chains of underdevelopment[29].

At present official estimates of the pasture carrying capacities nationwide are carried out by two major institutions the National Agency of Meteorological and Environmental Monitoring (NAMEM) under the Ministry of Environment and Tourism Development and the Agency for Land Relations, Geodesy and Cartography under the Ministry of Construction and Urban Development. The NAMEM estimates pasture carrying capacities using grass yield samples of around 1500 points (one point per bagh) taken in every August annually. The key advantage of the NAMEM methodology is that it estimates carrying capacities on an annual basis and has collected grass yield data for every soum for quite long period since early 1970s. However, only 5 points for grass yield samples is hardly representative of the entire soum territory which averages around 300,000 ha of land mass and covers a wide variety of ecological conditions. Although NAMEM

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[27] María E. Fernández-Gimenez, Batbuyan Batjav and Batkhishig Baival, Lessons from the Dzud: Adaptation and Resilience in Mongolian Pastoral Social-Ecological Systems, Colorado State University & the Center For Nomadic Pastoralism Studies, 2012

[28] Op. cit.

[29] A.Enkh-Amgalan, Let's Decide the Pasture Issue This Way, Article in the national daily newspaper Zuunii Medee, No 30, 18 December 2007

estimates give a kind of approximation for judging the pasture carrying at the soum level, they are not sufficient for estimating it at the level pastureland users or herders.

The Agency for Land Relations, Geodesy and Cartography (ALRGC) uses 1:100,000 scale land use and vegetation maps in estimating pasture carrying capacities. The vegetation maps contain the most detailed information on vegetation composition, grass yields and feed protein content for each vegetation type that averages around 3-5 per soum. The land use maps contain information on the land users- location of seasonal camps of herder households and wells etc., in addition to base information on topography, land use boundaries of other uses such as forests, settlements, crop farming, mining, protected areas, communications etc. As the pasture carrying capacities are shown as a part of the 1:100,000 vegetation maps they provide more representative data of pasture carrying capacities for every corner of the soum territory and as such can be a basis for decision making at the level of pastureland users-herders. 1:100,000 vegetation maps have been properly prepared for the first time under socialism and had to be updated every 5 years. However, since 1990s because funding shortages updates of these maps have been carried out with less quality control, resulting in the accuracy of grass yield and vegetation composition boundaries being eroded to some degree.

As for methodology for estimating grass yield, there are two debated issues. One is related to the way of catting grasses when taking samples. The most researchers agree now that grasses should be cut at 0 cm form the surface the estimate the entire biomass and then animal intakes should calculated as percentages from the total biomass. However, this approach is not fully abided by all institutions. For example, ALRC methodologies for carrying out updates of the 1:100,000 maps focus on animal intakes of the biomass, cutting grass samples at 3 cm from the surface[30]. As it is difficult to ensure exactly 3 cm cuts from the surface the weight of samples and resulting grass yields can vary according to skills of individuals who cut grasses. The next issue under debate is the percentage of converting biomass into animal intakes. Although the international best practices suggest 50% intake, in Mongolian conditions where overgrazing is severe with animal pressures exceed carrying capacities 2-5 folds in some aimags and soums, the application of 50% intake might be too far for enforcement. CPR has suggested 80% of intake for soums with severe overgrazing keeping in mind that 50% intake should kept as be longer-term target after land users reach 80% target first. In addition, coefficients to convert animal species into sheep units have also minor variations across researchers and institutions. The most researchers and institutions use coefficients of 5.7 for camel, 6.6 for horse, 6 for cattle and 0.9 for goat. Some researchers like those in the Research Institute of Animal Husbandry of the State University of Life Sciences use coefficients with minor changes. In 2011, under the World Bank funded Sustainable Livelihoods Project CPR has proposed as a art of the proxy grazing fee pilot modifications to the

[30] Section 2.2.5 Estimating pasture grass yield, "Temporary rules for undertaking field estimates of the state and quality of land", approved by the Head of ALRC, Order No A/174 dated 28 June 2013

coefficients based on claims that goats and horses damage pastures more than other species. The modified coefficients were sheep 1, goat 2, camel 3, cattle 4, horse 8[31].

Despite little variations in the exact figures due to methodological differences, all major institutions and researchers agree that the pastureland in Mongolia is severely overgrazed and degraded. According to the latest estimates carried out by the Information and Research Institute of Meteorology And Hydrology and SDC Green Gold project using 1450 monitoring points nationwide 65% of pastureland in Mongolia is degraded to some degree and 7% the degree of beyond recovery.

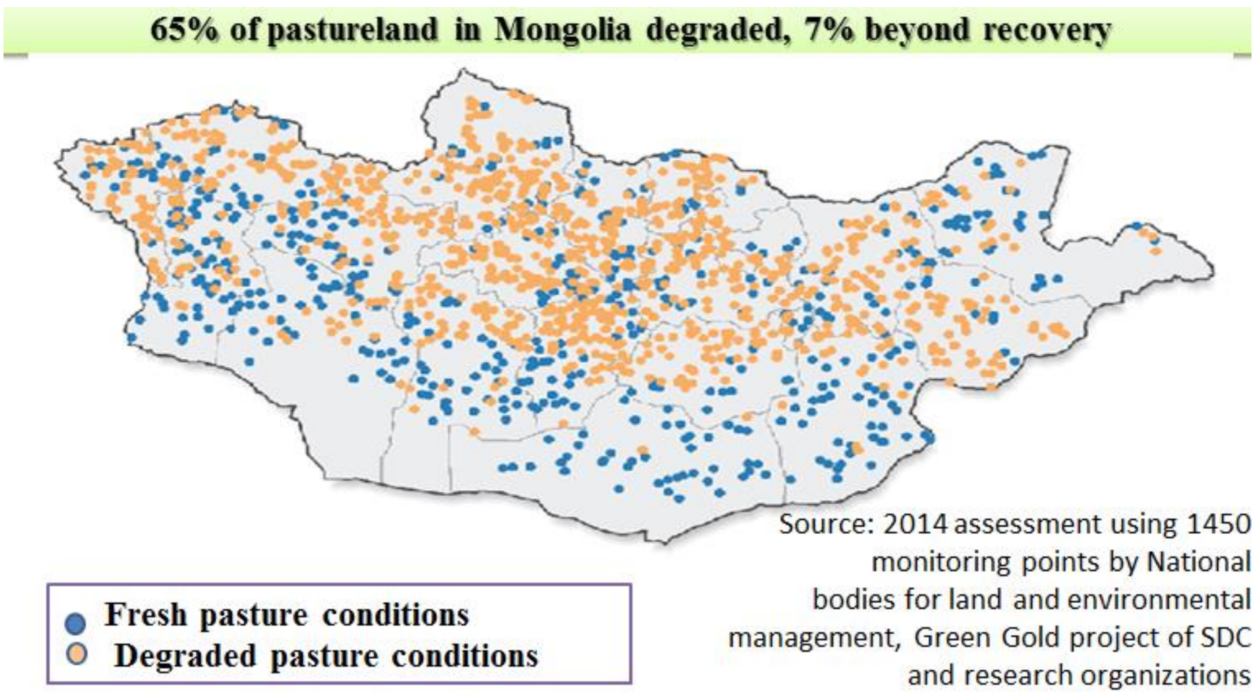

Figure 4 The situation with pastureland degradation in Mongolia
Source: Information and Research Institute of Meteorology And Hydrology, SDC Green Gold project, 2015. National report on the rangeland health of Mongolia

According to the Report on Environmental State of Mongolia of 2015-2016 the land degradation and desertification occur at even faster rates because of climate change, non-sustainable grazing practices and mining impacts resulting in 76.8% of the land territory subjected to desertification[32].

[31] Center for Policy Research, Unpublished project report, Sustainable Livelihoods Project, 2012
[32] Report on Environmental State of Mongolia, 2015-2016

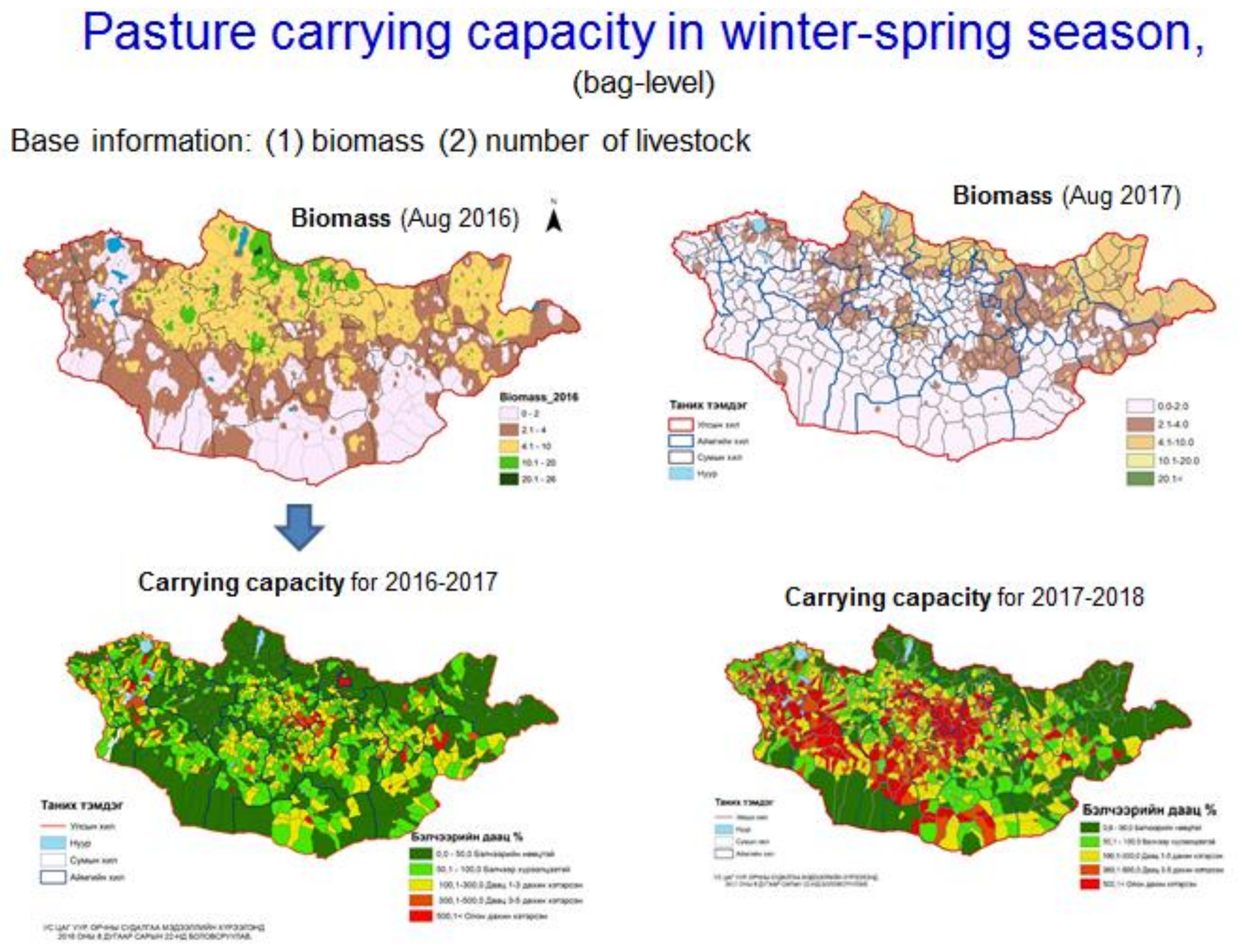

Figure 5 Sample of pasture carrying capacity map produced annually by the National Agency of Meteorological and Environmental Monitoring of Mongolia

The ADB[33] adds that Mongolia is severely impacted by desertification and climate change. More than 70% of Mongolia's land is degraded through overgrazing, deforestation, and climate change. Degradation is a downward spiral, as degraded lands are less resilient to climate change impacts. Average mean temperature increases are more than 2°C, and climate models indicate that temperatures will continue to rise. More than 80% of the county's territory is defined as highly vulnerable to climate extremes. Climate-related disasters, including droughts, severe storms, and flash floods, with high social and economic costs (particularly for herders), have doubled in frequency.

Mongolia is witnessing significant alterations to water and ambient air temperatures and precipitation patterns. Both the frequency and severity of extreme weather events are increasing. From 1940 to 2007, the annual mean air temperature in Mongolia increased by

[33] Making grasslands sustainable in Mongolia: Herders' livelihoods and climate change. Asian Development Bank, 2014

approximately 2.14^0C. This is three times higher than the global average. Warming is projected to further increase up to 5^0C by the end of the 21st century. To address the additional ecological challenges presented by climate change, there is still an urgent need to conserve and rehabilitate the ecosystem services upon which Mongolia's rural economy, traditional culture, and rich biodiversity depend. This required a paradigm shift to ensure that the very foundation of human livelihood - ecosystems and their services - is sufficiently resilient to climate change pressure, and to enable communities to adapt to climate change. A survey in different ecological regions of Mongolia finds that better maintaining and restoration of ecosystem services would depend on the capacity of local users and regulators (e.g. local government) and be successful if herders get organized in well-functioning user groups.

In 2016, CPR has undertaken a survey among herders on the draft pastureland protection law that promotes pastureland use agreements as a mechanism to regulate stocking densities. The survey has found that herders in Mongolia are encountered with pressing problems in the area of pastureland use and rank overgrazing (63.8%), lack of water (50.4%), grazing conflicts and disputes (42%) lack of regulation leading to chaotic use (34.9%) as the most pressing. The majority of consultation participants (80.2%) view that the existing Land Law is not effective in addressing the pressing problems and the new pastureland protection law is essential in addressing them properly (73.5%). There was general tendency that poor herders show greater support for the draft law as they lose most from overgrazing, declining land and animal productivity, natural calamities disasters and receding their grazing rights to expanding rich people and mining activities. Some rich herders take advantage of the existing common use regime for short-term gains to expand their herd size and control of pasture resources and they tend to oppose changes in the legal environment including the draft law. As of 2015, poor herders with less than 200 animals make up almost half of the herders' population (45.4%) but own only 13.9% of livestock while rich herders with 1000 and more animals making up only 5.4% of the herders' population own 21.6% of livestock. The study revealed that poor herders with less than 200 animals lose their control of winter spring camps – around one third have no own winter and spring camps. Rich herders tend to have 2-4 camps and further increase their control of most valuable pastoral resources.

A large majority of herders simply do not have enough animals to sustain themselves in the traditional way. They are either forced to combine subsistence livestock-keeping with a variety of other jobs, or they can choose to become more market-oriented herders. If they choose wisely, they can increase their incomes and maintain their pastures. However, this depends on renewed forms of land management institutions preventing a few rich (and partly absentee) herders from over-utilizing the pastures to the detriment of their poorer, and more-market oriented , fellow pastoralists.[34]

As an option for sustainable livestock development capable of increasing herders' income in an environmentally friendly way (not increasing but reducing animal numbers to optimum level) as well as to protect the interests of poor herders, CPR has been promoting 'Smart Herder' program since 2014. The idea was, based on tested best practices, to offer herders a solution pressing challenges like climate change, pastureland degradation, livestock productivity and income declines and increasing social inequality   economic, environmental and social challenges in a holistic manner. The program was supported by SDC's Green Gold project, international environmental organizations WWF and TNC to commence the program pilots in 3-8 *soums* each. The program seeks to implement the following mutually reinforcing components:

- Make Pastureland use agreement (LUA)s a herders' self-interest for sustainable use of pasturelands through regulating stocking densities and a protection against chaotic converting into mining and other uses by improving their effectiveness
- Annually estimate the pasture carrying capacity and in case carrying capacity has been exceeded, create a system in which animals that exceeded pasture carrying capacity are sold to increase the income of herders
- Organize the value chains of animals and animal products by herder organizations to improve linkages to markets, value, sales volumes and herder incomes
- Enhance market competitiveness by investing the earnings made from sold animals in improving animal quality, product standards and processing levels
- Establish Livestock Risk Management Fund /LRMF/ formed by herders' contributions and local budget to have sustainable funding sources for tackling livestock risks and improving the quality of products
- Encourage herders, who have established LUAs towards protecting wildlife and other natural resources and benefiting from their sustainable uses through establishing appropriate use agreements

Under the SDC Green Gold project CPR has assisted 17 herder groups in developing and implementing comprehensive 4-year action plans to achieve, among others, the stocking density targets stipulated by land use agreements. In total 17 herder groups have targeted to reduce the total sheep units from 76620 at the end of 2014 to 58930 in 2018, which is very ambitious as the national herd has a trend increase by 10% annually for the past 5 years. At the end of 2015, the first year target of reducing animal numbers has been achieved by 80% with some groups achieving the target by 102.5-131%.

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[34] Dietz., A.J., Enkh-Amgalan, A., Erdenechuluun, T., Hess, S. *Carrying capacity dynamics, livestock commercialization and land degradation in Mongolia's free market area*, Poverty Reduction and Environmental Management Research papers, Institute of Environmental studies, Netherlands, 2005

The benefits from the proposed 'Smart Herder' program are illustrated in case of an average *soum* of Mongolia for 2014 in **Table 1**. As of 2014 the soum has 258,391 sheep units of livestock which is 32.8% higher than the pasture carrying capacity. The program proposes to reduce animal numbers by 6% for big stock and 8% small stock annually for 5 consecutive years to reach optimum stocking densities, which will improve animal feed supply and opportunities for pasture rotations and accesses to *otor* reserves in emergencies. Despite reduced animal numbers, herders cash income increases from MNT 9.9 million to 13.9 million in 5 years /40.4%/. This is due to improved feed supply leading to increased output per animal and increased animal sales. In addition to herder incomes, the reduced stocking densities will greatly contribute to local environment conservation and tourism values.

In addition to clear productivity and income gains, the program is able to reduce greenhouse gas emissions /GHG/ from 44 to 31 Gg CO_2e per *soum* and 14510 to 10072 or by 4438 Gg CO_2e nationwide. This is almost 60% of the total reduction (around 7300 Gg CO_2e) in GHG Mongolia has committed to bring by 2030.

Table 1 'Smart Herder' program in case of an average *soum* of Mongolia

Indicators	Base 2015	Year 1	Year 2	Year 3	Year 4	Year 5
Animal numbers, physical units	157523	145331	134089	123724	114166	105353
Animal numbers, sheep units	258391	240280	223464	207849	193348	179879
Sheep units per herder household	613	570	531	493	459	427
Household total income, '000 MNT	12879	19485	18845	18221	17611	16882
Home consumption, '000 MNT	2938	2938	2938	2938	2938	2938
Cash income, '000 MNT	9941	16547	15907	15282	14673	13944
Cash value of decreased herd size '000 MNT	0	3133	2930	2741	2564	2399
Emissions from enteric fermentation & urine and dung (Gg CO_2e), a *soum*	44	41	38	35	33	31
Emissions from enteric fermentation & urine and dung (Gg CO_2e), national	14510	13485	12535	11652	10833	10072

Source: A.Enkh-Amgalan, Climate-Smart Livestock (CSL) Case Study, Mongolia, 2017, FAO

This shows that Mongolian herders as the guardians of one of the largest remaining grasslands on Earth can make an important contribution to global climate change mitigation through proper incentive mechanisms for managing the grasslands in a sustainable way.

4. Analysis of herder household income and livelihood in relation to number of livestock and herd structure and to market location and infrastructure availability

4.1 Methodological issues of herders' income

Herder household income in the current context mostly depends on:

- animal productivity or output per head
- animal species structure
- animal numbers
- prices of livestock products

As the assignment purpose is to estimate grazing fee, we need to focus on variables that reflect the quality of pastures excluding or neutralizing other factors that are not relevant or dependent on the quality of pastures.

Animal productivity. Economic literature and statistics measure per head productivity in year *t* as a ratio of the total output to the number of animals at the beginning of year *t.*

$$P = \frac{\mathrm{O}}{\mathrm{Ao}} = \frac{\mathrm{A*Y*K}}{\mathrm{Ao}} \qquad (1)$$

Where:

P = per head productivity

O = output

A= Total number of animals from which output was obtained

Y= Yield per animal

K = Degree of harvesting particular product from animals

Ao = Number of animals at the beginning of the year

Here yield represents output of several products, such as meat, wool, hides and milk. As (1) shows, per head productivity for a given number of animals at the beginning of year *t* can be increased as a result of (i) increased yield per animal (ii) increased number of animals which produce output (iii) the degree of harvesting of produce per animal.

Increased yield per animal is achieved by improving its quality, usually through breeding. An increased number of output-producing animals in year *t* can be achieved by either increasing their birth rate or decreasing their mortality rate. The degree of harvesting animal products depends on availability of labor, market demand for particular product (in many regions small stock is not milked because of law milk demand, while wool and cashmere harvesting is carried out using hired labor if household labor is not sufficient), local customs and others. Using this approach, *Y* in (1) is referred to as the biological per head productivity and *P* is referred to as the economic per head productivity.

The biological productivity shows physical potential of animals to generate outputs and directly reflects the supply of pasture in terms of both quantities and quality. The number of animals, which produce outputs and the degree of harvesting of products depends on, among others, human factors mentioned above and therefore, variations caused by human factors need to be neutralized. A simple way to neutralize variations in human factors is to use regional averages of the relevant variable.

Animal species structure. Animal species are usually better suited to concrete ecological regions, for example, camels are best suited in the Gobi region and cattle in the forest-steppe region. Horse and small stock more or less evenly suited to all regions. Thus, animal species structure reflects to a certain degree the differences in the quality of pastures and need to be considered in estimating herders incomes for the purposes of land evaluation and estimating grazing fees.

Animal numbers. Animal numbers themselves do not directly reflect the differences in the quality of pastures. They reflect more the herders' economic behavior or income generation strategies. Widstrand[35] noted that a pastoral livestock operation is not a capitalistic undertaking aimed at producing a marketable surplus, its aims are rather to provide a good, regular supply of food for the family, to enable it to survive physically and socially. This statement is also in agreement with the viewpoint of Dillon and Hardaker[36]. They wrote that pastoralists regard their livestock as a walking bank, a measure of social status and security, but seldom as an enterprise to be rationally managed to produce profit. In contrast, commercial ranching and dairy farming aim at converting herbage into marketable produce, and that objective is achieved with large herds upon which only a small number of people are dependent. Enkh-Amgalan has highlighted that one of the main distinguishing characteristics of pastoral economies stems from the relationships between pastoralists and the natural resource base. Animals are owned by individuals but the natural resources necessary for livestock operations, such as grazing and water, are not. As pastureland is state owned and the ownership of livestock is individual, the perceptions of nomad livestock

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[35] Widstrand, C.G. 1975, 'The Rationale of Nomad Economy', *AMBIO*, No 4, 146-53.

[36] Dillon, J.L. and Hardaker, J.B. 1984, Farm Management Research for Small Farmer Development, FAO, Agricultural Services Bulletin, 41.

owners concerning the options open to them leave them little choice but to continue on their present course of trying to increase the size of their herds, even though that course leads to ecological disaster[37]. Thus, income estimates need to reflect the currently dominant herders behavior of maximizing animal numbers.

Prices. Prices are simply a way to convert animal productivity into monetary terms. Secondly as a mirror of the demand for particular product, its quality and other characteristics, prices may indirectly reflect the differences of ecological regions as particular animal breeds and sub-breeds are suited better in particular regions.

Based on the above considerations it is recommended to estimate herders' income as an average household income per every ecological region using the following variables:

- Average herd size per herder household calculated as the total number of animals in the region including those owned by absentee herders divided by the total number of herders households. The inclusion of animals owned by absentee herders as a part of herder household animals is dictated by the need to account for total income produced on any pastures regardless of ownership.
- Use the regional averages of animal species structure
- Use the national average indicators for animal productivity, off-rates rates, mortality rates, the share of breeding females and herd growth rates. Although these indicators may slightly vary across regions, there is no region-specific reliable data available. In addition, it is assumed that regional differences in these variables are minor and will not lead to differences in herders incomes
- The latest national average of livestock and livestock product prices

The average herder household income estimated using the above described variables and the herd turnover model developed by CPR shown in **Table 2** by major 5 ecological regions.

[37] A.Enkh-Amgalan, A. Production Function Analysis of the Extensive Livestock Industry in Mongolia, Master of Economics Thesis, University of New England, (UNE), Armidale, Australia, 1998

Table 2 Herder households, animals and livestock income per herder household, 2016

Ecological Regions	Animals looked after by herder household							Herder house-holds	Livestock income per herder household	
	Camel	Horse	Cattle	Sheep	Goat	Total	Total in sheep units		Total MNT million	Per sheep Unit, MNT 000
High Mountains	0.3	15.6	28.6	150.9	110.0	305.4	526	36715	11960	22.7
Forest-steppe	0.1	25.0	35.8	162.8	110.4	334.2	643	41882	14043	21.8
Steppe	1.0	34.5	26.5	223.3	169.7	455.0	768	30275	15133	19.7
Gobi	9.2	20.0	11.1	163.6	226.1	430.0	618	31048	12745	20.6
Depression of Great Lakes	3.3	17.3	19.0	182.3	232.6	454.4	638	20730	14147	22.2
Total	2.5	22.7	25.4	174.2	159.6	384.4	634	160650	13535	21.3

Ecological regions are those developed for livestock regional development planning taking into consideration natural components most important for livestock herding and regional boundaries are drawn by administrative boundaries of soums[38].

Supporting data used for estimating indicators in Table 2 are provided in **Tables 3-4**.

Table 3 Livestock numbers by ecological regions, 2016, 000 heads

Ecological Regions	Camel	Horse	Cattle	Sheep	Goat	Total
High Mountains	10.6	573.1	1048.8	5541.9	4039.0	11213.4
Forest-steppe	5.0	1047.6	1499.6	6820.4	4623.5	13996.0
Steppe	28.8	1043.4	801.5	6761.1	5138.7	13773.6
Gobi	285.8	621.7	344.3	5080.7	7019.3	13351.7
Depression of Great Lakes	68.5	357.8	393.6	3779.3	4821.4	9420.5
Total	398.7	3643.7	4087.8	27983.4	25641.8	61755.3

[38] Agricultural zoning map, National Atlas of Mongolia, Ulaanbaatar 1990

Table 4 Livestock species structure by regions, %

Ecological Regions	Livestock species structure, %					
High Mountains	2.7	15.7	25.7	19.8	15.8	18.2
Forest-steppe	1.2	28.8	36.7	24.4	18.0	22.7
Steppe	7.2	28.6	19.6	24.2	20.0	22.3
Gobi	71.7	17.1	8.4	18.2	27.4	21.6
Depression of Great Lakes	17.2	9.8	9.6	13.5	18.8	15.3
Total	100.0	100.0	100.0	100.0	100.0	100.0