"Backwards" as an Innovative Towards Sustainable Development: The case of "Mongolian pastoralism"

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Abstract

The integration of traditional nomadic practices with modern technologies and policies could provide innovative solutions to contemporary environmental and economic challenges.

This paper explores how the principles of nomadic pastoralism in Mongolia can be applied to broader global sustainability efforts, particularly in regions facing similar challenges related to land degradation, climate change, and rural development. It suggests that nomadic pastoralism, through its deep connection to the land, offers a model for ecological balance, adaptive management, and community-based governance that could be applied in different contexts around the world.

Additionally, the paper calls for more research and support for policies that recognize the value of traditional ecological knowledge and encourage its incorporation into modern land management practices. By doing so, the world can learn from the adaptability and resilience that have allowed nomadic pastoralist societies to thrive in often challenging environments.

In conclusion, the International Year of Rangelands and Pastoralists (IYRP) provides an important opportunity to celebrate and advance these traditional practices while ensuring their integration with contemporary solutions for sustainable development. The paper highlights the potential for a future where both traditional and modern approaches work in harmony to support the livelihoods of pastoralist communities and the ecosystems they depend on.

Keywords: pastoralism, past lesson, future paradigm, look back, synergy, challenge turned to opportunity
JEL Classification Codes: Q01, Q15, O13

Inclusive Way of Life Without the "Tragedy of the Commons"

Throughout Mongolia's long history, its ecosystems have largely been shaped by the global climate system and its regional effects. Human activity had minimal direct impact on natural cycles, aside from the grazing pressures of both wild and domestic animals. In response, natural mechanisms were in place to balance these pressures, ensuring the sustainability of the environment over centuries.

Mongolia's pastoralist societies have successfully navigated periods of social upheaval, economic challenges, and climate variability. Their lifestyle based on pastoralism allowed them to maintain a life-sustaining system that provided for their Basic Human Needs (BHN). This system was resilient and adaptable, functioning within natural limits to avoid crossing critical thresholds that would either harm the environment or threaten the survival of the herding communities. This balance of maintaining a sustainable relationship with nature, while ensuring the community's well-being, was a central feature of Mongolian pastoralism (Batjargal, 1995; Konagaya, 2024; Fernandez-Gimenez,1999; Humphrey, Sneath,1999)

A key aspect of Mongolian pastoralism was its approach to managing pasture land as a common pool resource. Pasture lands were not privately owned but rather managed collectively by the herding communities. Every member had free access to the land within their administrative jurisdiction, meaning there was no need for a centralized or costly governing structure to oversee its management. This minimized the risk of management distortions or even some sort of corruption, which often arise when external governing bodies control communal resources.

The famous concept of the "tragedy of the commons", which suggests that common resources are inevitably overexploited when used freely by individuals, was not applicable in the traditional Mongolian pastoral system (Batjargal, Enkhjargal, 2013). The natural cycles and the seasonal migrations of herders acted as regulatory mechanisms that prevented the overuse of resources and minimized pressure from seasonal unfavorable

landscape features. Herders' movement between summer and winter pastures allowed the land to recover, ensuring it remained productive for the long term. In this way, Mongolian pastoralism was a harmonized system that worked with nature, rather than against it.

Converting Negative Factors into Positive Ones

The traditional Mongolian approach to pastoralism reflects a smart interaction with nature. The wisdom of people in everyday life allowed herders to convert what would typically be seen as unfavorable or limiting factors into advantages.

For instance, Mongolia's highly fragmented grasslands and variable vegetation, shaped by the country's unique topography and unpredictable precipitation patterns, could make it difficult for herders to maintain consistent grazing areas. In other regions, these conditions might be seen as obstacles to sustainable land use. However, Mongolians leveraged these factors to their advantage, incorporating them into their traditional practice of seasonal migration. The varying grass conditions, while challenging, actually encouraged mobility. Herders could relocate as needed to access better grazing land, spreading their herds, particularly, so called "long leg animals" like camel and horses, across a wider landscape and minimizing the risk of overgrazing specific areas.

This mobility system (Fig.1) became a natural risk management strategy that reduced the impact of natural disasters like droughts or dzud (a severe weather phenomenon that occurs mainly during winter, causing large-scale livestock losses). By continuously moving between seasonal pastures, herders minimized the risks associated with climate variability. The flexibility of their customary seasonal mobility schemes, which allowed adjustments based on climatic conditions, helped reduce stress and manage the spatial and temporal variability of the climate, including extreme weather events.

Turning Constraints into Opportunities

1. *Fragmented Grasslands as a Tool for Resilience:* Rather than being a drawback, the fragmented nature of the grasslands became a tool that fostered resilience. By moving between fragmented grass areas, herders could avoid overusing a single plot of land and ensure that the different micro-ecosystems had time to regenerate. This prevented land degradation and maintained the productivity of the ecosystem.
2. *Adaptation to Climate Extremes:* Mongolian pastoralism's built-in flexibility meant that herders could quickly respond to extreme weather events, like the devastating dzud. The ability to relocate livestock during impending natural disasters allowed them to escape the worst of these events, minimizing the risk of losing their herds and income. Moreover, by utilizing multiple types of animals, from sheep to camels, herders ensured that they could rely on animals more suited to different environmental conditions, making their livelihoods less vulnerable to sudden shifts in weather patterns.
3. *Customary Adjustments and Collaboration:* Seasonal migrations were not carried out in isolation. Communities worked together through customary practices, coordinating their movements and managing resources collectively. The "khot ail" (group of families) and "saahalt ail" (neighboring herder families) systems allowed for efficient use of human and natural resources. Through these collaborations, herders shared duties, such as tending to animals, managing grazing, and providing mutual support, which is essential for regular life routine and critical in times of extreme stress.

Figure 1. Round of year life circles for the Mongolian pastoralists within a given ecosystem service domain

Source: Batjargal, 2012

Efficient Utilization of Limited Resources and Diversification of Income Sources in Traditional Pastoralism

Mongolia's traditional pastoralism is rooted in the efficient use of its vast grasslands and the diversification of income sources through livestock breeding and crop cultivation. Each Mongolian household typically raises five types of livestock—sheep, goats, cattle, horses, and camels. This practice offers several distinct advantages:

- *Optimal use of pastures:* The multi-species approach ensures that different animals graze on a variety of plant species, maximizing the use of diverse vegetation across different terrains and even in the same pasture sites since sheep and goats prefer different plants than cattle or camels, ensuring that the grazing pressure is evenly distributed and needed grazing area is minimized.
- *Reduced risk of overgrazing:* By raising multiple types of animals, herders reduce the risk of fragmented overgrazing on specific parts of the pasture. This helps preserve the land and prevent degradation.
- *Self-sufficiency:* Households benefit from diverse products such as meat, milk, wool, and leather, as well as transportation (from horses and camels). This self-reliance in food, transportation, and basic goods makes the system resilient against external shocks.

Collaborative Systems and Seasonal Land Use

The traditional pastoralist lifestyle revolves around seasonal migration and the efficient use of Mongolia's landscapes. Herders move between different grazing areas based on the seasonal changes in pasture conditions, ensuring the sustainability of the land and reducing pressure on any location.

As illustrated in Fig. 2 herders in the Altai-Khangai region take advantage of diverse land features (Fig.3)—grazing areas, haymaking zones, and croplands—using them at the appropriate times of the year, for efficient use given landscape feature and to prevent overuse of them.

Traditional herding families, as mentioned above, known as "khot ail", operate as collaborative units, often sharing herding duties and coordinating grazing efforts. Another system, "saahalt ail", involves two neighboring groups working together, particularly during tasks like milking animals. These structures ensure that human resources are fully utilized, minimizing unemployment and promoting community cohesion.

The benefits of this system include:

- *Efficient labor allocation:* Duties are distributed among individuals based on their age, experience, and abilities. This allows the community to make the most of its workforce, from the youngest to the eldest members.
- *Simplified logistics:* Traditional regulatory mechanisms, fully adjusted to the local circumstances and customs streamline the organization of daily tasks, reducing the need for complex management systems and additional resources.

Indigenous, Waste-Free Technologies

Mongolia's traditional pastoral lifestyle is also characterized by the use of *waste-free and recycling technologies.* These technologies are designed to work in harmony with natural cycles, allowing herders to remain self-sufficient and resilient to external pressures. Key features of these indigenous technologies include:

- *Local materials:* Herders use locally available raw materials for food processing, clothing production, and construction. For example, **gers** (traditional dwelling) are made from wood, felt, and other materials found in the region, requiring minimal external inputs.
- *Natural energy sources:* Instead of relying on modern electrical appliances, herders make use of natural heat, cold, solar radiation, wind, and other environmental resources for everyday tasks. This reduces dependency on fossil fuels and ensures that their way of life is both energy-efficient and eco-friendly.
- *Biodegradable packaging:* Traditional methods also employ naturally degradable materials for packaging food and goods, ensuring that waste can easily be reabsorbed into the environment without harming ecosystems.
- *Recycling waste:* Organic waste, including animal dung and food scraps, is fully recycled and returned to the land as fertilizer. Wastewater, free of harmful chemicals, is safely released back into the environment.

This system ensures that the materials herders use are fully incorporated into the *biogeochemical cycles* of nature. Mongolians have long understood that to maintain a sustainable relationship with their environment, they must both take from and give back to nature in ways that preserve the ecosystem's balance.

Addressing the Conflict Between Closed and Open Systems

A critical element of Mongolian pastoralism is the ability to balance the closed system of the natural environment (with finite resources, such as pastures) and the open system of

Figure 2. Efficient use of land properties and landscape features for grazing, hay making and cropping (Altai-Khangai region of Mongolia)

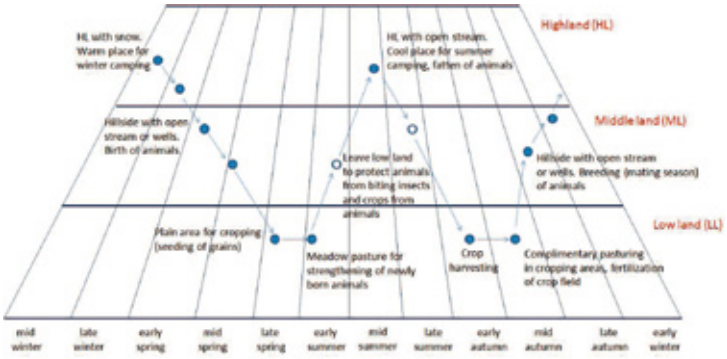
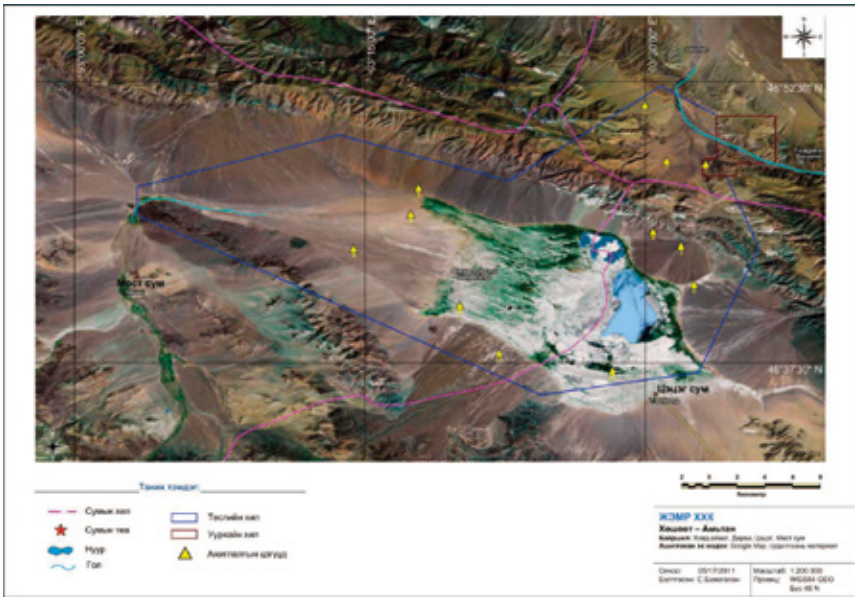


Figure1. Scheme of seasonal use of pasture in combination with crop cultivation in Western Mongolia

Source: Batjargal, 2012

Figure 3. Seasonal feature of landscape and attributed pasture condition, as defining factors for regular migration of herding families



Source: JEMR, 2013

human society, where population growth and consumption can theoretically be unlimited. This balance has been maintained by carefully aligning production and consumption with the natural cycles of the land. Unfortunately, many modern societies, even advanced ones, fail to strike this balance, resulting in unsustainable practices that degrade the environment (Batjargal, Enkhjargal, 2013).

In Mongolia, however, the functioning of individual households—each unit acting as a self-sufficient and responsible part of the larger ecosystem—has been the foundation of a sustainable way of life. This sustainability is rooted in the reliance on renewable resources and a fully recyclable economy, principles that are intrinsic to *Green* and *Circular economy* models. By relying on what nature provides, pastoralists have minimized the use of exhaustible resources while maintaining a low-impact footprint.

Perception vs. Reality: The Unexpected Crossroads

While some may view traditional Mongolian pastoralism as "primitive" or "unproductive," in reality, this system has provided more than enough for human life with minimal input from finite resources. It has also caused very little harm to the ecosystems in which pastoralists operate. However, at present time new *challenges* with uncertain consequences are arising. Today, Mongolian pastoralism faces growing threats from *globalization and climate change.* The rapid changes in climate parameters and the increasing pressures of global economic forces have *exceeded the resilience* of both the ecosystems and the communities that depend on them. Global warming has amplified weather and climate extremes, such as harsher winters (dzud) and hotter, drier summers, putting herders and their

livestock at greater risk.

Traditional Lifestyle: More Than a Cultural Identity

Many views Mongolia's traditional lifestyle as a *cultural symbol* or tourist attraction, but it is far more than that. Pastoralism represents one of the most accessible and sustainable ways to meet Basic Human Needs (BHN). This is due to the vast grasslands and centuries-old knowledge that Mongolians have perfected, ensuring a resilient way of life for thousands of years. However, globalization has introduced new, non-native elements that may disturb this equilibrium. The concerns are raised in relation with globalization impacts from the possible overturned effects of high tolerance of "nomads" to any new elements in life sustaining systems, which might include more disturbing and life changing "cultural" elements.

An innovation as a fashion.

In recent years, the concept of innovation has gained prominence in Mongolia's development discourse. Many associate innovations solely with new technologies, but it is crucial to recognize that forgotten old ideas can sometimes provide the best solutions to modern problems. The concept of "Back to the Future" in terms of sustainable development was first introduced in Mongolia in the early 1990s, during the preparation of the country's first national report on sustainable development (Batjargal, 1995; Batjargal, 1998). Prominent environmental leaders like Achim Steiner (former Executive Director of UNEP) and Maurice Strong (Secretary General of the 1972 Stockholm and 1992 Rio Conferences) have echoed this sentiment, urging, for instance, a return to agricultural models that align with nature's cycles (Steiner, 2010; Strong, 2011). Akim Steiner, in his remark made at the joint Platform-European Commission event (Brussels, 25 June 2009) emphasized that "… our model of agriculture has to be re-thought. And before one can effectively engage an agenda such as climate change, one has to go back to the future of agriculture itself"

Benchmarking Tradition in a Modern Context

Why, then and now Mongolians are reflecting positively on their traditional ways? The answer lies in the *resilience* these practices offer in the face of global challenges like climate change and globalization. During the COVID-19 pandemic, while other sectors of the economy were paralyzed by mobility restrictions, Mongolia's livestock sector continued to thrive, providing essential food and other products. This success highlights the value of a lifestyle rooted in balance with the natural environment and tolerance capability to withstand external shocks.

As an additional atributed specifics can be highlighted the folowing factors:

- Mongolia is one of the sparcely populated country in the world surviving the extreme contininental climate condition with its high amplitude fluactations of meteorological parameters , excersising most exposed to natural hazards life style based on pastoralism.
- Balanced vulnerability and inherited resilience capacity of all biological species, including human beings, could serve as a perfect benchmark of response to external factors like global warming, globalization and other emerging factors like pandemic situation of different origin.
- Mongolia at the crossroad on national development paradigm, particularly on agriculture sector due to the impact of global warming mixed with interference effect of regional and global economy and political turbulences.

Key Takeaways for Sustainable Development

Several factors demonstrate why Mongolia's traditional lifestyle serves as a *benchmark* for sustainable development:

- *Adaptation to Extreme Conditions:* Mongolia's sparse population, extreme continental climate, and nomadic pastoralist lifestyle offer a unique example of survival in harsh natural environments. This lifestyle is particularly resilient to natural hazards.
- *Balanced Vulnerability and Resilience:* The inherited resilience capacity of all biological species in Mongolia, including humans, provides an excellent model for responding to external pressures like global warming and pandemics.
- *A Crossroad for National Development:* Mongolia finds itself at a critical juncture regarding its national development paradigm. In the agricultural sector, especially, the impacts of global warming are compounded by economic policy and political confusion in country and beyond it.

Available options for the Development paradigm

Current model of development in Mongolia is mostly based

on use of the extractive mineral resources like coal, copper, gold and other non-renewable and exhaustible resources. But this way of national development cannot be considered as the best option in line with the modern concepts of sustainable development.

More adequate option should be based on human development since only man with a high intellect can manage with an existing and emerging challenges. A society which is neglecting human development cannot be benefitted properly from the extensive use of resources, even having good enough and high valuable mineral resources. People in that society might experience a situation like even gold can be valued not better than sand while in other societies the regular sand can be turned into high value items, even more expensive than gold. In this regard, human capacity building, enriching it by science and technology, as well as by knowlwedge, both indigenous and modern know how can be an appropriate option for paradigm shift and transformational change in economic and social development (Batjargal,2017). In terms of economic development any alteration from the current paradigm can be oriented predominately on efficient use of renewable resources like pasture for grazing, nature beauty, solar radiation, natural heat and cold, wind property including its power, renewable water resources, open space etc.

Dilemma for Pastoralism in Mongolia: To Be or Not to Be?

A fundamental question arises: *to be or not to be* for Mongolia's traditional pasture-based livestock husbandry (PLH). This dilemma stems from irreversible climate change, emerging socio-economic challenges, and increasing environmental degradation. Although for centuries, pastoralism had been an unquestioned way of life, today it faces existential threats due to external pressures. Climate change, globalization, urbanization, and policy failures are reshaping Mongolia’s pastoral systems (Batjargal, 1998; Humphrey and Sneath, 1999; Upton, 2008; Kamimura, 2012; Konagaya, 2004)

For thousands of years, this question wasn't even discussed, as PLH was the dominant economic sector and the foundation for subsistence for the vast majority of the Mongolian population. However, as Mongolia’s social and economic landscape evolved, especially during the 20th century, pastoralism began facing new and significant challenges. The history of Mongolia during this period offers valuable lessons about how pastoralism has been affected by social turbulence, state policies, and external pressure.

First lesson

The first campaign on nationalization of livestock in the 1930s was initiated and organized in the name of equality. In fact, it was mostly confiscation of assets from rich householders and religious establishments like monasteries. Attempts were made to create cooperative units like khamtral (kholhoz in the Soviet Union) but failed. Total number of livestock had significantly decreased due to over consumption and reduced level of caretaking.

Lessons learned from it was that in order to deal with domestic animals there is need to have an adequate level of skills and experience. Wealthy householders possessed more livestock because of their hard work and management skills.

Second lesson

The second campaign for nationalization of livestock started in the 1950s was completed by the beginning of 1960s. It was some sort of cooperative movement, slightly or indirectly forced by government policy. The motivation was to guarantee sustainable livestock production, livelihood improvement of local people in rural areas and to address unemployment issues.

Cooperative entities or “negdels” were established through contribution of assets as livestock and labor. Almost simultaneously state farms were established for production of crops and forage.

This lesson has a certian positive outcomes as the rural development with Government support. In 1970s the Government was able to manage to create a well-functioning network of water supply systems, covering certain remote areas, construction of animal shelters in winter camping sites and in seasonal transition zones, as well as in areas for common use as the “otriin nutag” (remote pastures without camping sites) and “tuuvriin zam” (soum, aimag transboundary migration routes). These endeavors, coupled with free access and free of charge to all levels of education system and health care services as well as social security network, have enabled people to improve their livelihood. Government sponsored postal and communication services, supply systems and trade networks, and transportation facilities promoted an establishment of settlement sites throughout the country, which was like a starting point of urbanization process in Mongolia. At the same time the Government program prevented, to some degree, a mass migration to settlement areas and related risk of environmental degradation in areas close to settled places.

The new Constitution adopted in 1992 opens the door for free movement of people for residency. In one hand, the market economy opportunities and in the other hand, intensified natural disaster (mostly consecutive dzuds) affect triggered uncontrolled mass migration of local residents to settlement areas. At present, the portion of urban population is already prevailing rural areas’ population. Currently the capital city Ulaanbaatar has 3 times more population than its estimated and planned limit as the half million before the 1990s.

Third lesson

Dismantling of negdels as well as of state farms at the beginning of transition to market economy in the 1990s was another shock for the agricultural sector. Nationwide privatization of livestock was done without needed adequate policy regulation. The number of livestock was actually doubled in a short period of time, exceeding the carrying capacity of pasture in many places. It coincides with the widespread privatization of the state-owned factories and enterprises, most of which were not able to continue production and business activities. It means that the established domestic production capacity for livestock products (like wool, skin, cashmere etc.) was diminished significantly. Several thousands of animal shelters, motorized wells, water distribution facilities, irrigation systems were destroyed and abandoned due to lack of ownership. The rapid increase of livestock number was partly related to the fact that Mongolia lost its international market for livestock products, as the former Soviet and Eastern European COMICON member countries. Traditional individual householder with "hot ail (group of herding families with common routine duties) and saahalt ail (two hot ail with coordinated and shared routine mostly related for milking animals)" arrangement and late cooperative based regulatory approach were preventing overgrazing and intensified land degradation. At this stage an unexpected market distortion and inequality and unproper use of common property like pasture were serious lessons learnt. The right to equal and inclusive access to natural resources, including pasture and water sources declared by the Constitution was questionable and imposed tax in accordance with the number of owned livestock through recent amendment in the Constitution, could not much contributed to the solution of problem.

Failure of the government policy on privatization and people's naive expectations that the free-market economy mechanism will settle everything were leading to rapid increase of livestock number with imbalanced composition of livestock type. Because of that land degradation was intensified with negative feedback like increased vulnerability of the sector to the natural hazards, like cold waves, heavy snow fall, snow and dust storms and prolonged dry weather.

Politicians very late have realized that Mongolia has certain specifics for transition to market economy due to lack of experience in the past and a limited "space" for full functioning of market mechanisms due to weak infrastructure for this sparsely populated waste area.

Fourth lesson

This lesson was associated with the rapid increase of livestock in contrast to the previous shocks which were leading to reduction of livestock number.

Another important feature of this lesson is the structural change in the livestock sector in terms of livestock composition, in response to the market signals, like elevated demand for cashmere. On the other hand, some other products like sheep wool and skin etc. were wasted decreasing profit from the related business activities. Additional and newly emerging pressure on the PLH were associated with competition among economic sectors, as an integrated system sharing common land and water resources.

Crop production: Some portions of grasslands were converted to crop fields during the "Virgin land" campaign in the 1960s. During this period state owned farming entities called "Sangiin aj ahui (State farm)" were established dealing with mostly crop cultivation in different parts of the country, where soil fertility and precipitation amount permitted crop cultivation. It was a risky business and crop yield was not high enough and mostly depended on the spatial and temporal precipitation patterns. With proper management, cultivation of land should not cause a big stress for PLH not only because of the insignificant portion of land used for the crops but also because of the complementarities (see Fig.2) of the two sectors to each other in many ways. In that sense a crop production in Mongolia is risky business due to dominance of rain fed mode of production, but not much, for ecology, if proper management would be applied. The crop field areas can be extended up to 2 million hectares, which is 1.3 % of the national land area or 1.6 % of the agricultural area.

Mining: Another strongly competing competitor with PLH sector for today is a mining sector. Actually, the size of grasslands directly involved in the mineral extraction processes is not a big issue. However, mining activities are spreading, rapidly occupying more and more land for transportation, for new settlements, for water sources etc.

Mining does not offer anything for complementarity with PLH except the limited market opportunities for livestock products in the adjacent to mining site areas.

Climate related stresses

Dzud has a severe impact on Mongolia's livestock population, causing large-scale animal deaths due to starvation, cold stress, and the unavailability of pasture (Natsagdorj et al., 2024). These losses significantly affect household income, food security, and the rural economy. The consequences include massive livestock deaths, as animals are unable to access pasture under snow, leading to malnutrition and freezing. Surviving livestock often suffer reduced productivity, impacting milk, wool, and meat production, which in turn affects herders' incomes. The economic strain on herders can push families into poverty, as many rely entirely on livestock for their livelihoods. Additionally, dzuds contribute to selected overgrazing and land degradation due to forced concentration of animals in less

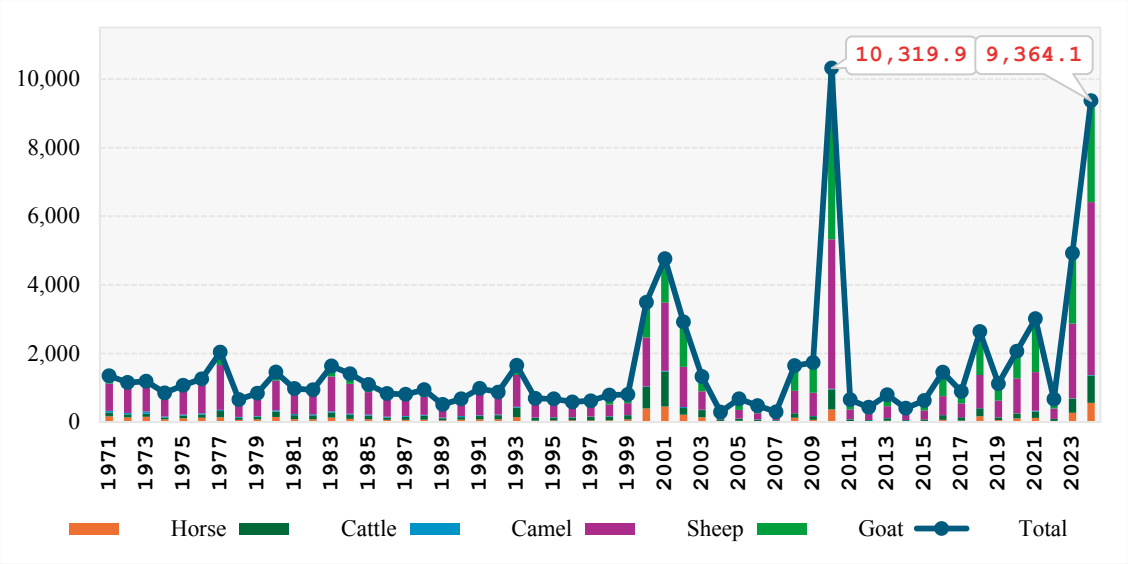
affected areas, which can lead to trigger desertification process in some areas. Severe dzuds may also force herders to migrate to urban areas, as mentioned above, increasing urban poverty and straining city infrastructure. In 1999-2000, 2000-2001 and 2001-2002, Mongolia was hit by three dzuds in a row, in which 3,491.1 thousand heads (10%), 4,758.8 thousand heads (16%), 2,917.7 thousand heads (11%) animals were lost, respectively. The next harsh winter had happened in 2009-2010 and during this dzud over 10,319.9 thousand heads or around 26% of livestock was lost (Figure 4).

According to National Statistics Office of Mongolia, the number of livestock loss reached 9.36 million heads or 14.5% at the national level in 2024.

The dzuds of 2000-2002 led to significant migration as herders, having lost their livestock, moved to cities, especially Ulaanbaatar, where the number of migrants surged to 40,000-60,000 in 2003-2004. Similarly, the 2009-2010 dzud, which resulted in the largest recorded livestock loss, also drove increased migration to urban areas (Figure 5). These disasters have not only devastated herder livelihoods but have also increased unemployment and poverty in rural regions, with poverty rates rising sharply to 43.4% in 2003 and 49.6% in 2010 (Figure 6).

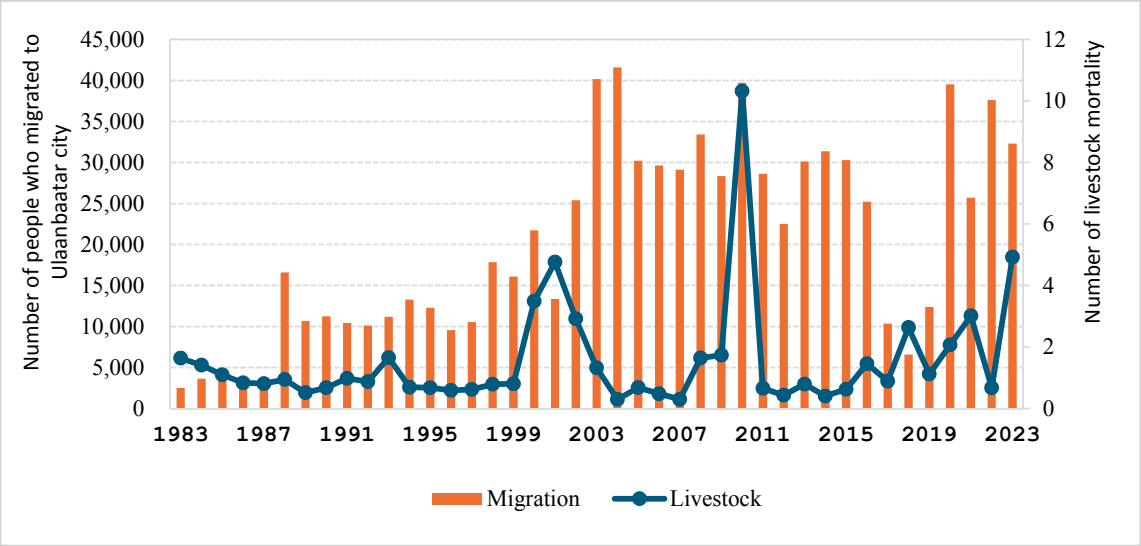
During the 2009-2010 dzud 8,576 herder households lost all of their animals and 32,756 herder households lost half of their animals. After the dzud about 1400 herders who were deprived of their livelihood source migrated to urban areas (MSRM, 2010).

Figure 4. Losses of adult animals during the period 1971-2024



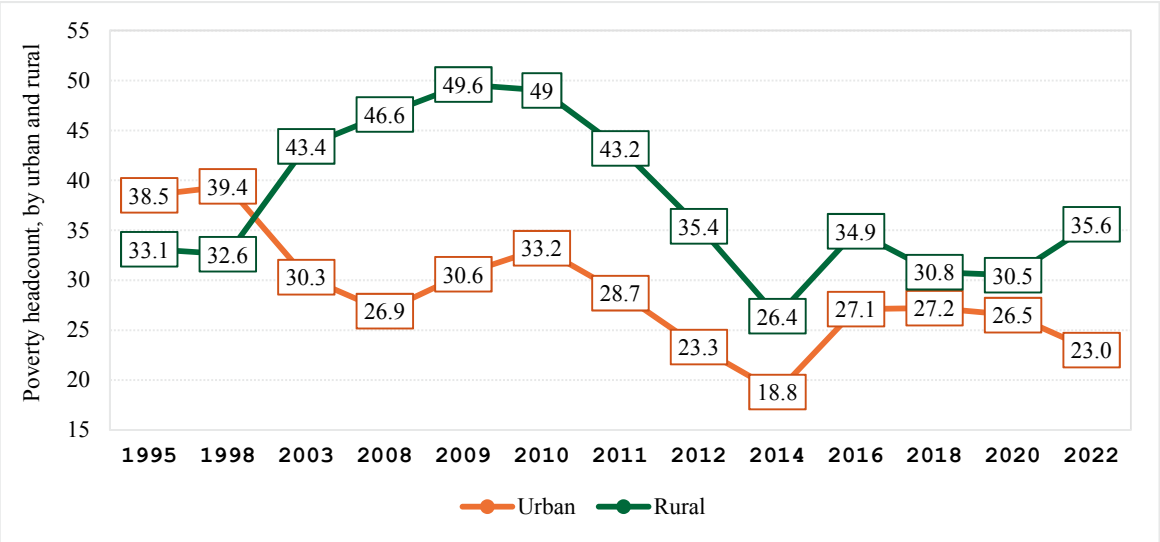
Source: NSO, 2025

Figure 5. The comparison of the number of people who migrated to Ulaanbaatar city and the number of livestock deaths



Source: NSO, 2024

Figure 6. The interannual variation of poverty



Source: NSO, 2024

According to future climate projections, due to the intensity of drought and dzud, the livestock death was estimated to increase by 4.3% between 2011 and 2030, and 10% between 2046 and 2065, (Natsagdorj et al., 2011). Therefore, herder's households with less than 200 animals (42.3% of all herding households) and the middle-income households with 201-500 animals (34.4% of all herding households) have a high risk of poverty during the harsh winter. It is clear that thousands of people left their settlements and migrate to survive and prevent poverty caused by the increasing frequency and severity of natural disasters caused by climate change.

Dzud have far-reaching and complex environmental impacts, profoundly affecting not only domestic livestock but also wildlife, biodiversity (WCS. 2024), land quality, and water resources. One immediate effect is the temporary reduction in competition for resources in overgrazed areas, as livestock die off in large numbers. This may provide short-term relief for wild species that compete for the same food sources. However, this initial benefit is outweighed by the long-term consequences of dzuds. The delicate balance within ecosystems is disturbed, and recovery can take years, especially for species that are already vulnerable.

Principal Messages from Climate Change Studies for platform of the Policy-Making Processes

Recent climate change studies offer several important insights that can guide policy-making processes in Mongolia (Fermendez-Gimenez et al. 2015; FNC 2023; GOM 2023; Marin 2010; Natsagdorj et al., 2024; NCC, 2024; Undarmaa et al., 2018). The following points summarize the major trends and projections for Mongolia's climate and their potential impact on the environment, agriculture, and pastoralism:

- *Shifts in Climate Zones:* In the long run, global warming will cause Mongolia's climate zones to shift. There will be a greater dominance of arid and semi-arid areas, significantly affecting the landscape and ecosystems. As temperatures rise, these dry areas will expand, putting additional strain on land use and reducing the amount of arable land.
- *Vegetation Zones Moving North:* The expansion of semi-desert and steppe zones is expected as a result of warming temperatures. Vegetation zones, particularly in the southern and central regions, probably will move northward. This shift will reduce the availability of high-quality grazing lands and intensify competition for resources in the northern and eastern regions, where conditions remain more favorable for plant growth.
- *Declining Biomass and Deteriorating Pasture Quality:* Aboveground biomass—the total amount of plant material available—will decrease, leading to a deterioration in pasture quality. This decline in biomass will directly impact livestock, as the availability of nutritious forage will become increasingly limited, putting herding communities at risk.
- *Hotter Summers, Milder but Snowier Winters:* Climate models predict that Mongolia will experience hotter and drier summers combined with milder, but more snow-covered winters. These seasonal changes will challenge both livestock and agricultural production. Hot summers will reduce grazing times, while snowy winters may increase the risk of dzud, where livestock struggle to access food under thick snow or snow covered by ice due to periodical warm waves.
- *Increased Evapotranspiration:* As temperatures rise,

evapotranspiration definitely will increase, further drying out the soil. This will outpace the slight projected increase in precipitation, leading to overall drier conditions. Moreover, there will be a seasonal shift in precipitation from the critical summer vegetation period to mid-winter, reducing the moisture available for plant growth during the grazing season. Less frequent but more Intensive rainfall during the warmer season will increase the risk of flood-induced soil erosion, in addition to wind erosion of drying soil, degrading the land further.

- *Unsuitability for Agriculture:* Current climate change scenarios indicate that future climate conditions in Mongolia will be unfavorable for agriculture, both for pasture-based livestock breeding and rain-fed crop production. With less reliable precipitation and increasingly extreme weather conditions, agriculture will become more challenging, especially for herders who rely on the land for grazing. Even those who will try to shift to settled and intensified livestock production will face constraint in respect of hay making and forage for high productive animals.
- *Increasing Areas Unfavorable for Grazing:* By 2050, the area of land unsuitable for animal grazing is expected to increase significantly, leading to the concentration of livestock on smaller, more fragile parcels of land. This will intensify the pressure on remaining pastureland, causing further degradation and potentially rendering large areas unusable.
- *Rising Livestock Mortality:* Without effective response measures, livestock mortality is projected to double by 2050 compared to current levels. Extreme weather events, such as dzud and prolonged droughts, will place livestock at greater risk, making it difficult for herders to maintain sustainable herd sizes and composition.
- *Decreased Animal Productivity:* As heat stress shortens grazing times and reduces forage quality, animal productivity will decrease. Studies project a reduction in ewe weight, a key measure of livestock productivity, which will lower yields in terms of meat, milk, and wool, further undermining herders' livelihoods.
- *Barriers to Sector Development:* The increasing extremes resulting from climate change, such as more intense heat waves, droughts, and dust storms, as well as shocking cold waves and sandstorms will pose significant barriers to the development of livestock. Both rainfed and irrigated crop production would also encounter impediments due to drier climate. These challenges will grow more severe over the next decades unless proactive response measures are taken to address them.

Concluding Remarks and Policy Recommendations:

- ❖ **In general term:** Mongolian pastoralism stands as a rare example of a sustainable, self-regulating system that has endured for generations. Rooted in indigenous knowledge and ecological wisdom, this model offers valuable insights into how societies can balance resource use, community governance, and environmental stewardship in an era of growing climate challenges. As global concerns over land degradation, food security, and sustainable livelihoods intensify, Mongolian herding traditions serve as a powerful case study in resilience, adaptability, and sustainability.
- ❖ **In particular aspect:** These traditional ways of life and their change due to social turbulences and climate stresses partly described here are not just a sentiment or problems without solutions. Certain parameters of these dynamic systems can be predicted using theoretical modeling instruments (Kato et al.2012), which can help simulate future scenarios and guide decision making. To address the highlighted challenges, the following recommendations should be considered:

1. *Designing a Social and Ecological Model:* There is a pressing need to design a model that can simulate networks of social and ecological systems, using modern advanced methodologies based on new instruments like AI. This model would operate on inclusive principles, allowing for the maximum use of ecosystem services while ensuring that human activities remain within sustainable limits. The integration of scientific research with traditional knowledge can enhance the capacity to predict and mitigate the impacts of climate change on both the environment and local communities.
2. *Bridging the Gap Between Decision Makers and Scientific Communities:* It is essential for decision makers to maintain close communication with the scientific community. Policy decisions must be informed by the latest research on climate change and its potential impacts on Mongolia's ecosystems. Equally important is listening to the voices of civil society groups, including herders and rural communities, who are directly affected by these changes. Collaborative efforts between policymakers, scientists, and local communities will ensure that the strategies developed are effective and equitable.
3. *Learning from the Past, Synergizing with Modern Know-How:* The best solutions to Mongolia’s climate and development challenges may lie in combining traditional

practices with modern innovations. As the old adage goes, "look back to move forward". Pastoralist societies have developed resilient systems over centuries that are deeply attuned to their environments. By maximizing the synergy between traditional knowledge and modern technology, Mongolia can create sustainable solutions for the future. For instance, integrating pastoralism with the National Program on Digital Society—which aims to digitize various sectors of the economy—can improve the monitoring and management of natural resources.

4. *National Long-Term Vision 2050:* Mongolia's Long-Term Vision 2050 provides (POM. 2020) a framework for addressing climate change, resource management, and sustainable development. By aligning strategies (NCC 2023; GOM 2023; POM 2024) with this national vision, Mongolia can develop a sustainable model of development that prioritizes the protection of natural ecosystems while enhancing the livelihoods of its people. The outcomes of such a strategy could include:
   - A national development path that is less harmful to the natural environment, which serves as the essential foundation for life.
   - Improved environmental soundness in the livelihoods of local communities, ensuring that economic activities do not degrade the resources they depend on.
   - A more intelligent life-sustaining system that is designed to reduce self-destructive tendencies, addressing the challenges of modern humanity and creating a more balanced relationship between people and nature.

<References>

Batjargal Z.1998, Sustainable Development. The Mongolian Experience. In: book *Sustainable Development in Central Asia,* published by Curzon Press (Printed in Great Britain), pp.93-103.

Batjargal Z.,2012, The livelihood of Mongols and ecosystem. In brochure: " Nomadic pasture based livestock and ecosystem network in Mongolia" Published by ADMON printing(In Mongolian language). Ulaanbaatar. pp. 20-32

Batjargal Z., Enkhjargal B. 2013. Interference Impact of Global Warming and Globalization on the Society and Ecosystem in Mongolia. In brochure: "The Mongolian Ecosystem Network, Environmental Issues Under Climate and Social Change" edited by Yamamura N., Fujita A., Maekawa A. Springer. Tokyo, Heidelberg, New York, Dordrecht, London. pp.295-313.

Batjargal, Z 1995: New Challenges, New Solutions: Back to the Future, In: *Environmental Conference in the Pacific Century.* Proceedings of the Fourth Pacific Environmental Conference 1994, East-West Center, Honolulu, Hawaii, USA, pp.52-60.

Batjargal Z., (2017). The vulnerability of National Security and Natural and Climate Resources. In brochure: The True Value of the Natural and Climate Resources of Mongolia. The Proceeding of the scientific and practical conference (in Mongolian). Ulaanbaatar, 2017, pp.7-29.

Fernández-Giménez M.E., Batkhishig, B., Batbuyan B., and Ulambayar T. (2015). Lessons from the dzud: community-based rangeland management increases the adaptive capacity of Mongolian herders to winter disasters World Development 68, pp.48–65.

Fernández-Giménez, M. E. (1999). *Sustaining the Steppes: A Geographical History of Pastoral Land Use in Mongolia.* Geographical Review, 89(3), pp.315-342.

FNC (2024). Mongolia's Fourth National Communication: Under the United National Framework Convention on Climate Change. MET., UB.

GoM (2023). Mongolia's Voluntary National Review 2023: Implementation of the Sustainable Development Goals, Government of Mongolia., Ulaanbaatar.

Humphrey, C., & Sneath, D. (1999). *The End of Nomadism? Society, State, and the Environment in Inner Asia.* Duke University Press.

Kamimura A. Mobility for grazing field and pasture possession issue in Mongolia. pp.467-487

Konagaya Y." Nomadism" theory Today. Bulletin of JAMS. 2024. 54, pp.11-19

Marin, A. (2010). *Riders Under Storms: Contributions of Nomadic Herding Practices to Climate Change Adaptation in Mongolia.* Global Environmental Change, 20(1), pp.162-168.

MSRM (2010). Report of the Project for Dzud Relief and Prevention., Mongolian Society for Rangeland Management., UB

Natsagdorj L., Sarantuya G. (2011). Extreme cold may result in loss of livestock, Paper of Meteorology and Hydrology, №32/8, UB, pp.7-17.

Natsagdorj L., Sarantuya G., Munkhbat B. (2024). Climate change over the territory of Mongolia: drought and dzud. Admon printing, Ulaanbaatar.

NCC (2024). National Adaptation Plan (NAP) of Mongolia. National Climate Committee`s Resolution No. 01 of March 11, 2024., UB.

NSO (2024). Household Socio-Economic Survey (HSES)- 2022, National Statistical Office of Mongolia., Ulaanbaatar.

NSO (2025). Results of the Livestock Census for 2024. National Statistical Office of Mongolia., Ulaanbaatar.

PoM (2020). Vision-2050. Long-term development plan of Mongolia. Parliament of Mongolia, Resolution No. 52 in 2020. UB., available at: https://legalinfo.mn/mn/detail/15406.

PoM (2024). Law on Mitigating the Negative Effects of Climate Change on Traditional Livestock Husbandry. Parliament of Mongolia. Available at: https://legalinfo.mn/mn/detail?lawId=17140159421231.

Satoshi K., Fujita N., Yamamura N. 2012. Results of the different scenarios modelling results on the economic and ecological sustainability of the Mongolian pasture-based livestock. In brochure: Pastoralism and Ecosystem in Mongolia (in Mongolian), pp.512-522.

Steiner A. 2010 Remarks made at the CBD COP 10, Nagoya, Japan, 18-29 October 2010

Strong M. 2011, the lecture titled" Back to the Future — What Rio +20 must do". Asia Society in New York, 12 December 2011

Undarmaa J., Tamura K., Natsagdorj L., Yamanaka N. (eds) 2018. Rangeland ecosystem of Mongolia. Ulaanbaatar, 528 pages.

Upton, C. (2008). *Social Capital, Collective Action and Group Formation: Developmental Trajectories in Post-Socialist Mongolia.* Human Ecology, 36, pp.175-188.
WCS (2024). Dzud's Devastating Impact: How Mongolia's Wildlife Struggles in Extreme Winters. Available at: https://mongolia.wcs.org/About-Us/News/articleType/ArticleView/articleId/22736/Dzuds-Devastating-Impact-How-Mongolias-Wildlife-Struggles-in-Extreme-Winters.aspx

持続可能な開発に向けた革新としての「後退」：「モンゴルの牧畜」の事例（要旨）

モンゴル国自然環境・気候変動省（MECC）・国家気象環境モニタリング庁（NAMEM）　気象・水文・環境情報研究所
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要　旨

伝統的な遊牧慣習と現代の技術・政策の統合は、今日の環境的および経済的課題に対する革新的な解決策となり得る。

本稿では、モンゴルにおける遊牧畜産の原理が、土地の劣化、気候変動、農村開発といった類似の課題に直面する地域において、より広範なグローバルな持続可能性の取り組みにどのように応用できるかを検討する。

遊牧畜産は土地との深いつながりを通じて、生態学的均衡、適応的な管理、そしてコミュニティ主導のガバナンスのモデルを提示しており、これは世界のさまざまな文脈に適用可能である。

加えて、本稿は、伝統的な生態知識の価値を認識し、それを現代の土地管理に取り入れることを支援する政策や研究のさらなる推進を提言する。

このような取り組みにより、遊牧社会が過酷な環境の中で生き抜いてきた適応力とレジリエンスから世界が学ぶことができる。

結論として、「放牧地と牧畜家の国際年（IYRP）」は、こうした伝統的実践を称え、それを持続可能な開発に向けた現代的な解決策と統合するための重要な機会を提供している。

本稿は、伝統と現代のアプローチが調和して機能し、牧畜民コミュニティの生計と彼らが依存する生態系を支える未来の可能性を強調するものである。

キーワード：牧畜、過去の教訓、未来のパラダイム、振り返り、相乗効果、課題を機会へ転換