

# Stakeholders' perspectives towards effective climate change adaptation on the Mongolian livestock sector

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**Abstract.** Climate change is one of the greatest threats that world is facing today, and having significant deleterious effects on natural and human systems. Recent climate-induced extreme events and their impacts demand timely adaptation actions to the changing odds of their occurrence. The great phenomenon is already being felt in the Mongolian plateau, especially on the livestock sector. The sector provides the main income and livelihood for one-third of the population of about three million people. A high number of livestock is lost due to a unique phenomenon is known as a “dzud”. This paper examines the key stakeholders' perspectives in the implementation of climate change adaptation and identifies its barriers, with a focus on the livestock sector. In order to meet the objectives, this research used a semi-structured interview with organizations related to the livestock sector and climate change. The extent of stakeholders' perspectives might be depending on the way they share information, stakeholder engagement, and their experiences with extreme events, as well as their location and level in government. The research findings will indicate an understanding of climate change perspectives, adaptation, and level of capacity of organizations, which can be used as a guideline for organizations to develop climate change adaptation policies related to the livestock sector in Mongolia.

## 1. Introduction

The Earth's climate is changing in profound ways, while there has been growing debates on, that have addressed the risk and vulnerability of affected systems, and have issued Declarations that have been endorsed by most countries. Among the climate science community, there is a growing consensus that climate change is not just an unfortunate phenomenon, but indeed it is an anthropogenic tragedy by emitting greenhouse gas (GHG) into the atmosphere. Nevertheless, this trend is still not completely approved [1]. However, it is certain that the phenomenon has created uncertainty in, and a threat to, the future of sustainable development. The increasing number of extreme events has gained massive attention from a scientist, questioning how and what is the connection of those events to climate change. The following are several extreme events occurred over the past few years; 1) the 2013 typhoon Haiyan in Southeast Asia (especially in the Philippines), considered as one of the deadliest cyclones ever recorded [2], 2) the disastrous flooding in 2011 in Thailand [3], and countries bounding the Bay of Bengal is the most exposed to cyclones and flooding that have resulted in the loss of thousands of lives, displacement, damaged infrastructures and economic crisis, and 3) the 2008



catastrophic cyclone Nargis that resulted in enormous destruction of socio-economic sectors and more than 130.000 mortalities [4].

As a result of climate change, millions of people are suffering from scarce natural resources, unsanitary living conditions, insufficient health services, and insufficient or non-existent social services [5]. Most tragically, affluent industrialised nations have the biggest role to release GHG into the atmosphere, whereas the world's poorest communities mostly located in the Asian and African continent, who solely depend on agriculture and livestock as their livelihood and income, are suffering most from harmful effects of climate change, yet they are least responsible for causing it [6]. The recent science tells us that impacts of climate change will become more harmful in a myriad of ways including more frequent and widespread of extreme events, accelerating the extinction of biodiversity and destroying ecosystems, infrastructures, economic losses, and diminishing natural resources. Therefore, many countries have been trying to diminish such adverse effects through developing climate change adaptation approaches and related policies at all levels and sectors. The livestock sector is now and will inevitably be affected by climate change. Adverse effects felt in the livestock sector can threaten other sectors, including the economic sector, through the loss of livestock for herders. It means that they have less income to buy goods, which impacts the sales and income of providers, or the shortage of produce; meat, milk, milk products that lead to increasing prices of these foodstuffs. Therefore, it will cause economic hardship and hunger, even starvation, to many, as well as affecting the food security of countries.

Since no country is immune to climate change, Mongolia has not been left from the harmful effects of climate change. Developing adaptation strategies to climate change with the focus on the livestock sector is important in Mongolia. Thus, this paper aims to explore the key stakeholders' perspectives on climate change impacts on the livestock sector, identify adaptation approaches and barriers, identify stakeholders' capacity to overcome those barriers, and conclude with a summary of the discussion and some suggestions for further work.

### *1.1. Climate change adaptation*

The higher average global temperature and variations of precipitation are projected to have a wide range of impacts on natural resources including fresh water, agricultural and grazing areas, and such natural resources likely to become more limited so that livestock, of significant importance in economies, will find it harder to survive in certain areas with harsh and deteriorating conditions [7]. The livestock sector provides livelihoods for approximately 2 billion people and uses the largest land surface areas of drylands that covers more than 40% of the total surface areas of the Earth. Since the sustainability of the livestock sector is a subject susceptible to climate change, it is crucial to implement an appropriate form of adaptation [8].

According to the Intergovernmental Panel on Climate Change, adaptation is “the process of adjustment to actual or expected climate and its effects” [5]. A variety of adaptation has been developed by stakeholders; such as capacity building (e.g., education and training), management (e.g., livelihood diversification), policy (e.g., implementation or revision of regulations and policies, integrating adaptation into development policies), financing (e.g., livestock insurance, contingency fund) and technology (e.g., enhance water access technologies) [9]. Numerous factors are being and will influence the effectiveness of adaptation, which can create sudden or dramatic changes in adaptation. Consequently, it is important that adaptation should appropriately target a certain level, location, and duration. Sometimes, success in the short-term adaptation may turn out to have little or no benefit in the long-term process and vice versa. Thus, we need more viable adaptation to the increased risk and vulnerability of the future.

## 2. Climate and the livestock sector in Mongolia

### 2.1. Mongolia’s climate

Mongolia is a landlocked country situated between Russia to the north and China to the south, which experiences a continental climate. A long-lasting harsh cold winter, dry hot summer, with an annual average temperature of minus 0.8°C, with the temperature dropping below -45°C in winter and reach up to more than 40°C in the summer season for each year. The significant changes have been observed on the Mongolian plateau. Climate change brings ever drier and hotter conditions, and average temperature has been risen by 2.1°C in the 1940-2007, and future climate scenarios indicating that annual average temperature will be increased by 0.4-1.6°C in the coming next 30 years [7 10 11]. The increased average temperature in the winter season is estimated as 3.6°C. The trend of increasing temperatures in winter has been accompanied by several adverse events such as strong wind storm and heavy snowfall. This temperature is sometimes rapidly rising over a short period of 3-7 days and then abruptly dropping again to sub-zero temperatures. This situation has led to the ice-sheet coverage of grassland areas in some years, making it harder for livestock to find and access feed [12]. Snow is one of the main sources of water for livestock during winter, but an excessive amount of snowfall that accompanies low temperatures creates unfavorable conditions for herders and livestock. This unique phenomenon is usually called as a “dzud”. According to Mongolian Second Assessment Report on Climate Change in 2014, drought and dzud are the most catastrophic extreme events due to their impacts on socio-economics [10].

2.1.1. *Dzud*. It is a Mongolian term for a complex and long-lasting natural disaster consisting of summer drought followed by cold and harsh winter that result in a high number of livestock losses due to hunger, exhaustion, and exposure to freezing air temperatures. There is also a potential for loss of human life and damaging impacts on herder livelihoods and infrastructures [13]. Currently, Mongolia has experienced 5 types of dzud: tsagaan, khar, tumer, khuiten and khavsargan (table 1). The duration of a dzud continues from the beginning of November; possibly little earlier, lasting to the end of March [14]. In the last two decades, Mongolia has faced with four devastating dzuds. First, three consecutive dzuds in 1999-2000, 2000-2001 and 2001-2002 that resulted in the impoverishment of thousands of herder households and livestock losses estimated at 30% of total livestock. Then, a severe dzud in 2009-2010, with temperatures dropped below -53°C in some areas in January, resulted in widespread livestock losses of some 20% of the total livestock, with an estimated 28% of the Mongolian population being harshly affected in 17 out of 21 provinces [13].

**Table 1.** Typologies of dzud.

Types of dzud	Description
Tsagaan dzud or White dzud	The higher amount of snowfall with low air temperature.
Khar dzud or Black dzud	Lack of snowfall which leads to insufficient water availability for livestock and herders.
Tumer dzud or Iron dzud	Mixed temperatures, sudden temperature drop after a short-term warming resulted in ice sheet on grazing areas.
Khuiten dzud or Cold dzud	Low precipitation with strong stormwind.
Khavsargan dzud or Combined dzud	Combination of two or more of the above-mentioned dzuds.

2.1.2. *Drought*. In Mongolia, drought occurs ever longer periods, and its intensity and frequency are significantly increased since the end of the last century [11]. As a result, more than 880 out of 5138

rivers and approximately 1200 out of 3747 lakes are dried up at the beginning of 21<sup>st</sup> Century [15]. Along with the three consecutive dzuds, there were three consecutive summer droughts considered as the worst drought that Mongolia ever faced with, which affected 50-70% of the total territory. The growing season for livestock forage and agricultural crops in Mongolia is relatively short, between May and September, and the growth of grasses is heavily dependent on the weather condition. If there has been insufficient forage and hay, livestock will fail to fully fatten and gain the necessary strength for the coming winter [12]. When the drought is followed by dzud, a huge number of livestock losses are experienced. Particularly, a combination of drought and white dzud has a higher risk and impact than drought and other types of dzud. Thus, drought is considered as one of the triggers that intensify dzud [16].

### *2.2. The livestock sector in Mongolia*

Mongolia has a traditionally nomadic society and the livestock sector or animal husbandry as a principal component of culture and identity, a primary means of livelihood and income for herders, and the main food for the rest of the population. Accordingly, climatic conditions are of primary importance in the success of that significant sector of the Mongolian economy and society [12]. The total number of livestock is approximately 61.5 million, consisting of horse, cattle, camel, sheep, and goat. The sector is dependent almost solely on forage productions, hence, is highly vulnerable to natural hazards. Mongolia is divided into six ecological zones that experiences more localized conditions such as high mountains, steppe, forest-steppe, desert-steppe, desert, and taiga. The herding in the high mountains, forest-steppe, steppe and arid grassland areas are highly sensitive to extreme climatic conditions that pose a higher risk of dzud and drought [17].

## **3. Research method**

This research conducted semi-structured interviews with the key stakeholders from public and private, and international organizations at all levels, to gather their experiences with, and perspectives of climate change, impacts and adaptation, and identify barriers encountered in developing adaptation approaches. Stakeholders for the interview were identified firstly, through eliciting the organizations related to disaster management and climate change and the livestock sector. Secondly, in order to collect reliable information and select rightful stakeholders, this research is based on the possible criteria for selection of stakeholder participation. The selected stakeholders are those who have the most appropriate information, knowledge, and expertise, the capability to influence adaptation process, and an envisaged pluralistic of perspectives. In addition, they should be willing to give information and available for the interview [18].

### *3.1. Developing interview questions*

The interview, with pre-developed 21 questions, is divided into four sections: (i) stakeholders' perspective on climate change, (ii) adaptation approaches (iii) barriers of adaptation (iv) organizational capacity.

*3.1.1. Section 1: Stakeholders' perspectives on climate change.* This section aims to draw out stakeholders' perspectives and understanding on impacts of climate change and identify the main drivers of changes in the livestock sector. The number of drivers of climate change to the livestock sector is identified: quantity and quality of feeds; heat stress; water availability; livestock diseases; and biodiversity [6].

*3.1.2. Section 2: Identification of adaptation approach.* This section is aimed to identify specific examples of adaptations and potential responses to climate change based on stakeholders' experience and knowledge. First, this section will analyze the efficiency of previously implemented adaptations related to the livestock sector. Then, the selection of adaptation approaches, which they consider as the most necessary or required, is implemented. All identified distinct adaptations will be grouped into ten

categories including capacity building, management and planning, practice and behavior, policy, information, physical infrastructure, warning and observing systems, green infrastructure, financing, and technology [9].

*3.1.3. Section 3: Identification of barriers.* This section is aimed to identify common barriers that exist within the development of adaptations and how stakeholders overcome those barriers. Every adaptation approach has a challenge of how to handle the diverse barriers, so defining the adaptation scope must include the identification of the barriers that are likely to be encountered. Several researchers categorized adaptation barriers such as institutional governance issues, financial, politics, leadership, and communication [19]. Nevertheless, this research focuses primarily on politics, and institutional and governance related to the barriers so that it can explore the strategies that they used to overcome such barriers.

*3.1.4. Section 4: Capacity of organizations.* The aim of the section is to assess the organizational capacity of stakeholder. The purpose of this assessment is to recognize the capacity and resources that they have in order to develop effective adaptation approaches. The capacity of organizations includes highly educated human resources, sufficient and reliable scientific information, sufficient financial resources, and effective cooperation with other related organizations [20]. As well, this section is also used to identify their enhancement strategies for improving their capacities.

#### **4. Discussion**

As a global phenomenon, the effects of climate change are experienced differently in every region. Since climate change is persistently broadening its negative effects, stakeholders' involvement in the adaptation to climate change will be more important to reduce the risk of vulnerable systems. The frequency and intensity of dzud and drought are predicted to increase the more scarce availability of natural resources and threaten more population, mostly in local areas, properties and other sectors across Mongolia over the next coming decades.

The sustainability of the livestock sector is directly influenced by herders' livelihoods. It is interesting to note that herders are not only become vulnerable due to loss of their livestock but also vulnerable to some other non-climatic factors. For instance, most of the herders have little or no formal education, somehow its influence being not able to access loans from the bank to diversify their income or source of livelihoods. The diversification of income source of herder households is important as a safety net in times of dzud and drought occurrence. There is a growing number of adaptation on the sustainability of livestock sector and herders' livelihood in Mongolia, yet it is not clear that all of these adaptations would be successful due to underlying barriers. Sharing scientific information, partnership and qualified perspectives of stakeholder has the potential influence to the successfulness of adaptation approaches.

#### **5. Conclusion**

Mongolia is the nomadic society and has the dependency on natural resources. It makes the country more vulnerable to extreme events. Thereby, this research intends to explore the most appropriate adaptation approaches to the impacts of climate change, which is inspired by the series of the historic dzud and drought events. A broad perspective of stakeholders is important to enhance the quality and quantity of adaptation that can provide sustainability of herders' livelihood, of the livestock sector and pastoralism.

For further research, this research recommends that the focus is on the climate change communication and how information sharing and engagement of stakeholders could be improved for the rational decision making, for possible actions in response to climate change. As well, one of the most important needs is mainstreaming climate change adaptation into sustainable development policy. The ultimate climate change adaptation needs to involve all potential stakeholders and be viable targeted at specific context and spatial so that it can increase the capacity of affected sectors and

sustainable development. Overall, the Government of Mongolia's support should focus on formulating climate change adaptation policies and programmes related to the livestock sector that improve the capacity of livestock and herder community.

## References

- [1] Cook J, *et al.* 2013 Quantifying the consensus on anthropogenic global warming in the scientific literature *Environ. Res. Lett.* **8**(2) p 7
- [2] Dai K, Chen S E, Luo M and Loflin G 2017 A framework for holistic designs of power line systems based on lessons learned from Super Typhoon Haiyan *Sustain. Cities Soc.* **35** pp 350-64
- [3] Saito N 2014 Challenges for adapting Bangkok's flood management systems to climate change *Urban Clim.* **9** pp 89-100
- [4] Tasnim K M, Shibayama T, Esteban M, Takagi H, Ohira K and Nakamura R 2014 Field observation and numerical simulation of past and future storm surges in the Bay of Bengal: a case study of cyclone Nargis *Nat. Haz.* **75**(2) pp 1619-47
- [5] IPCC 2014 *Climate Change 2014: Synthesis Report* (Geneva, Switzerland: IPCC Press)
- [6] Thornton P K, van de Steeg J, Notenbaert A and Herrero M 2009 The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know *Agric. Sys.* **101**(3) pp 113-27
- [7] Wang J, Brown D G and Agrawal A 2013 Climate adaptation, local institutions, and rural livelihoods: A comparative study of herder communities in Mongolia and Inner Mongolia, China *Glob. Environ. Change* **23**(6) pp 1673-83
- [8] Martin R, Müller B, Linstädter A and Frank K 2014 How much climate change can pastoral livelihoods tolerate? Modelling rangeland use and evaluating risk *Glob. Environ. Change* **24** pp 183-92
- [9] Biagini B, Bierbaum R, Stults M, Dobardzic S and McNeeley S M 2014 A typology of adaptation actions: A global look at climate adaptation actions financed through the Global Environment Facility *Glob. Environ. Change* **25** pp 97-108
- [10] Ministry of Environment and Green Development of Mongolia "Mongolia second assessment report on climate change" <http://www.jcm-mongolia.com/> 2014 [Online] Available: <http://www.jcm-mongolia.com/wp-content/uploads/2015/11/MARCC-Final-Bk-2014-book-1st.9.17-ilovepdf-compressed.pdf> [Accessed: 04-10-2017]
- [11] Batima P "Climate Change Vulnerability and Adaptation in the Livestock Sector of Mongolia" <http://start.org/> 2006 [Online] Available: [http://sedac.ciesin.columbia.edu/aiacc/progress/FinalRept\\_AIACC\\_AS06.pdf](http://sedac.ciesin.columbia.edu/aiacc/progress/FinalRept_AIACC_AS06.pdf) [Accessed: 04-10-2017]
- [12] Batima P, Bat B and Tserendorj T "Evaluation of adaptation measures for livestock sector in Mongolia" <http://start.org/> 2006 [Online] Available: [http://www.start.org/Projects/AIACC\\_Project/working\\_papers/Working%20Papers/AIACC\\_WP41\\_Batima.pdf](http://www.start.org/Projects/AIACC_Project/working_papers/Working%20Papers/AIACC_WP41_Batima.pdf) [Accessed: 04-10-2017]
- [13] UN Mongolia Country Team "Mongolia: Dzud Appeal" <http://www.unocha.org/> 2010 [Online] Available: [https://docs.unocha.org/sites/dms/CAP/2010\\_Mongolia\\_DzudAppeal\\_SCREEN.pdf](https://docs.unocha.org/sites/dms/CAP/2010_Mongolia_DzudAppeal_SCREEN.pdf) [Accessed: 05-10-2017]
- [14] Begzsuren S, Ellis J E, Ojima D S, Coughenour M B and Chuluun T 2004 Livestock responses to droughts and severe winter weather in the Gobi Three Beauty National Park, Mongolia *J Arid Environ.* **59**(4) p 785-96
- [15] Szumińska D 2016 Changes in the surface area of the Böö'n Tsagaan and Orog lakes (Mongolia, Valley of the Lakes, 1974–2013) compared to climate and permafrost changes *Sediment.*

*Geol.* **340** pp 62-73

- [16] Tachiiri K and Shinoda M 2011 Quantitative risk assessment for future meteorological disasters *Clim. Change* **113(3-4)** pp 867–82
- [17] Sternberg T 2008 Environmental challenges in Mongolia’s dryland pastoral landscape *J Arid Environ.* **72(7)** pp 1294-304
- [18] Hage M, Leroy P and Petersen A C 2010 Stakeholder participation in environmental knowledge production *Futures* **42(3)** pp 254-64
- [19] Ekstrom J A and Moser S C 2013 Institutions as key element to successful climate adaptation processes: results from the San Francisco Bay Area *Successful adaptation to climate change: linking science and policy in a rapidly changing world* pp 97-113
- [20] Measham T G, *et al.* 2011 Adapting to climate change through local municipal planning: barriers and challenges *Mitig. Adapt. Strategies Glob. Chang.* **16(8)** pp 889-909