Thesis Abstract

No.

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Title of Thesis:

Impacts of Climate Change on Livestock-grassland Systems in Mongolian Plateau and Development of Information Tools for Early Adaptation

Summary of Thesis:

Climate change, including seasonal weather extremes, annual climate variations, and long-term global warming, is seriously affecting ecological environment and human society, particularly in semi-arid areas. Mongolian Plateau had repeatedly experienced massive livestock-loss in recent decades, which have been considered as climate impacts of drought, and freezing or snowstorm. Such losses are spatiotemporally heterogeneous even though the spatial distribution of weather conditions changes gradually. Previous studies clarified that this spatiotemporally heterogeneous severity of livestock loss in Inner Mongolia was caused by the difference of the severity of land degradation, which directly affects insufficiencies of forage for grazed livestock. However, the cause of the spatiotemporally heterogeneous severity of land degradation itself is still unclear. Meanwhile, serious livestock loss in Mongolia, which is called as dzud, had been also primarily considered climate-driven, due to severe winter condition after the summer drought in particular. However, the cause of the spatiotemporally heterogeneous severity of a dzud is also not clarified yet. The purpose of this study is to clarify the cause of spatiotemporal difference of the severity of livestock loss in Mongolian Plateau through the analysis of land degradation in Inner Mongolia and dzud in Mongolia.

Although substantial studies examined the factors contributing to livestock loss so that climate-extremes and overgrazing were noted as the common factors in both cases of Inner Mongolia and Mongolia. However, the limit of data quality and data availability made its investigation difficult. The spatial characteristics of the variables in these two regions are essential at multiple spatial scales. This study applied GLEWS (Global Livestock Early Warning System) data to correct forage and meteorological data in Mongolia, and Palmer Drought Severity Index (PDSI) index to show the severity of drought in Inner Mongolia. Landscape Ecological Zoning (LEZ) approach was applied at fine scale for the assessment of forage availability in Inner Mongolia, and Geographically Weighted Regression (GWR) modelling at the county scale in major dzud areas of Mongolia. The results of this study concluded that the severity of droughts had little contribution to the spatiotemporally heterogeneous severity of land degradation in Inner Mongolia, at the same time, severe weather conditions were not a main contribution factor to the spatiotemporally heterogeneous severity of dzuds in Mongolia. In particular, the degree of contribution on factors with regards to the severity of dzud was not spatially nor temporally uniform, and also that they could be categorized within some regions. This study concludes the spatiotemporal patterns of the severity of livestock loss in Mongolian Plateau were primarily caused by an overgrazing-driven social factors.

As a practical solution, this study developed information tools for mitigation of land degradation and adaptation to dzuds by demand-driven and science-informed approach. The Web-based GIS tool for NPO's rangeland management in Inner Mongolia and SMS communication tools, which had provided weather forecast and forage distribution and shared users' comments, were tested in the specific study areas. Visualized information from the developed system realized rangeland-management planning by corporation with local governments and companies' CSR activities in Inner Mongolia, in addition, SMS based information successfully supported the decision for traditional seasonal migration of local herders and their fodder preparation sites. In both cases, local partnerships such as NPO and national institute realized demand-driven and science-informed approach. Not only the system development, but also the analytical method on this study might be applicable not only for whole Mongolian Plateau but also other countries where overgrazing contributed severe livestock loss on grassland.

Keywords: Weather Extremes, Overgrazing, Massive Livestock Loss, Demand-driven and Science Informed Approach, Mongolian Plateau