

Reviewer' Comments

Manuscript Number: nhess-2018-182

Title: Probabilistic Risk Assessment of Livestock Snow Disasters in the
Qinghai-Tibetan Plateau

Journal: Natural Hazards and Earth System Sciences

General comments:

Natural hazards that lead to disasters can cause tremendous impacts on societies, the environment, and economic wealth of the affected countries. Climate change will exacerbate existing challenges relating to livestock snow disaster risk. Adapting to climate change is a necessity for sensitive areas and those that are vulnerable to climate change such as the Qinghai-Tibetan Plateau. To investigate and better understand the risk of livestock snow disasters in the Qinghai-Tibetan Plateau is critical to towards sustainability of grassland animal husbandry and livelihood of the herdsman. This topic fits well with the mission and scope of Natural Hazards and Earth System Sciences. However, there are still many flaws in the current manuscript.

Special comments:

1. There are many abbreviated symbols in the paper such as QTP, PRA, SDD, BRT etc. Because of too many abbreviations, readers often get confused. It is suggested that a separate symbol page should be set up in front of the manuscript.
2. At present, there are many good quantitative methods for the study of snow disaster vulnerability and risk in alpine pastoral areas in particular on the Qinghai-Tibetan Plateau and Inner Mongolia Plateau. In the literature review in the "Introduction", the authors review this issue incompletely. The literature covered is also very limited. And main viewpoint may be biased. For example:

Page 2, lines 19-20, "The first type employs an ordinal risk assessment

framework in which the risk index is derived by integrating several indices representing different components of risk”;

Page 2, lines 12-13, “The other risk assessment approach is quantitative, often called the probabilistic risk assessment (PRA), in which risk is measured with a probability distribution of socioeconomic losses (consequences)”;

Page 2, lines 24-32, “However, studies applying PRA to livestock snow disasters have been limited. Bai et al. (2011) published one of the first trials in applying the PRA framework to a livestock snow disaster risk assessment. In their study, winter season (November to April of the preceding year) average daily snow depth was used to describe snow hazard intensity. Physical vulnerability, a function of livestock mortality rate in response to snow depth, was fitted using historical case data. Using annual average snow depth computed from satellite-retrieved data, return-period livestock mortality and mortality rates were derived as the final risk metrics. Based on their method, quantitative livestock snow disaster risks were mapped nationwide in China (Shi, 2011). The major flaw of this method was the mismatch between the event-based vulnerability function and annual measure of snow hazard. In another work focusing on Mongolia, a vulnerability function trained from a tree-based model was used, but still on an annual basis”.

3. *Page 3, lines 13-15, “Worldwide, the QTP suffers from some of the highest livestock snow disasters due to its large area of snow cover area, longlasting snow cover days, and nomadic grazing. This region is also a hot spot in climate change. Quantitative risk assessments for the present day will likely be a significant source of information for disaster risk reduction”.* The above sentence should be moved to before line 5 on the second page.

Delete lines 15-16 of the second page, “In addition, the framework can be adapted for livestock mortality in snow disasters in the context of future climate change analysis, and therefore support climate adaptation planning for local government and herding communities”.

4. In the “Materials and Methods” section, the Qinghai-Tibet Plateau as case area, it is necessary to have a more comprehensive description of the geographical,

environmental, social, and economic backgrounds of the QTP, especially the role of livestock in livelihood for local people.

5. We know the positive intervention of humans on the grassland ecosystem and that the grassland carrying capacity could be elevated with a reduction of harmful human activities (adverse effect), an increase of disaster prevention capacity. For example, the proportion of fenced pasture area to the total usable grassland (to show the capacity of grassland biomass to regenerate), the warm shed area per unit of livestock (to illustrate the capacity of livestock to prevent freezing disasters) and the proportion of sown grassland area to the total usable grassland (to describe the capacity of balancing forage supply and demand), accessibility of traffic and information (to depict the capacity of disaster response or prevention), if the above key factors are missing, in other words, if the authors do not emphasize the socio-system intervention for livestock snow disaster assessment, it will be very difficult to objectively assess the risk of snowstorms in livestock.
6. Page 4, line 10, “*prevention capacity as measured by gross domestic production (GDP) of the underlying county*”, GDP as prevention capacity is not a scientific proxy, indeed, local fiscal revenue and the intensity of infrastructure construction in animal husbandry (including alpine grassland) are the key to reducing vulnerability and risk of livestock snow disaster.
7. Page 7, lines 3-6, the authors stated that “*Historical snow disaster event data with the time of each event for each meteorological station were used to train the BRT model. These data were obtained from two sources. Records for 1980–2007 were obtained from W. Wang et al. (2013) while records from 2008–2015 were obtained from the China Meteorological Science Data Sharing Service System (CMSDS, <http://data.cma.gov.cn>).*” However, are the identification criteria of the two snowstorm records sources consistent?
8. Page 8, in “2.3 Exposure”, the herd size as a critical proxy of exposure, although the spatial distribution of livestock size can reflect the extent of snowstorm exposure of livestock, it is well known that the Qinghai-Tibetan Plateau has a vast area with obvious spatial differences, and the distribution density of livestock (the

number of livestock per unit area) may be more scientifically and accurately describe the spatial feature of snowstorm exposure.

9. Similarly, page 8-9, in “2.4 Loss modelling”, as one of loss index, GDP at county level is not consistent with the risk topic of livestock snow disaster. It is suggested that the added value of animal husbandry at county level should be adopted.
10. Page 9, lines 1-4, I don’t understand that *“County level GDP values were assigned to each grid within its boundary. We used constant GDP values for 2015 for two reasons. First, the results can be directly treated as a stationary time series for estimating the probability distribution, as the influence of prevention capacity improvement has been removed. Second, it meets the goal of risk assessment, to estimate the likelihood of potential loss in the near future”*. The GDP of each county changes with time. Dynamic GDP should be used instead of static GDP to predict the probability of loss, which is not consistent with reality.
11. The discussion part only deals with the content of spatial pattern (4.1 Spatial patterns of livestock snow disaster risk in the QTP). As an important part of risk change, the characteristics of dynamic and temporal variation cannot be absent. Moreover, the authors do not pay attention to the causal relationship between risk and its influencing factors.
12. In “4.3 Risk-informed implications”
Page 20, line 22, “Our results imply that the present level of preparedness in local regions are far from sufficient”;
Page 21, line 5, “Due to the difficulty in improving prevention capacity, insurance schemes are needed to provide relief”;
From the perspective of above mentioned sentences, this is not the inspiration of the article analysis, but the main existing problems.
13. The language of the manuscript is rather deficient and requires the re-editing of native speakers.

In summary, I suggest that the manuscript needs a major revision before considering publication.

