Modeling Grazing System in Bayan Sum of Tuv Aimag, Mongolia

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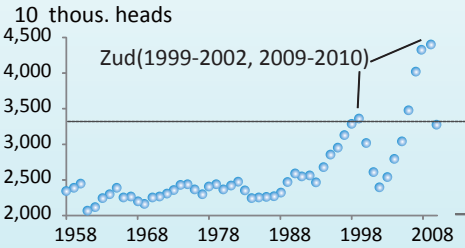
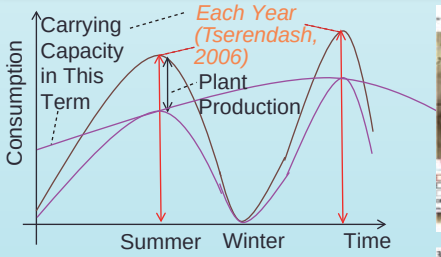
Introduction

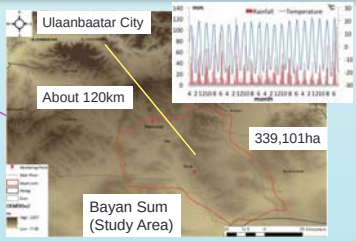
Fig. Livestock Animals in All Mongolia (1958-2010)



Our Goal

Materials and methods





$$growth = r(V+d)\left[1-\frac{V+d}{k+d}\right]$$

r : the intrinsic rate of increase,
V : vegetation biomass
k : the peak vegetation abundance in the absence of grazing
d : an offset to allow growth from reserves when V=0

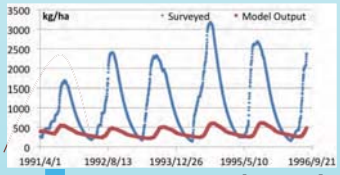


Fig. Livestock animals and First Outputs

Amount of Snow melting(30cm) Is included to ΔV

Illius, A.W. Derry, J.F. & Gordon, I.J. (1995).

Results

Relationship between Model output of vegetation biomass and ground vegetation biomass became right figure. Multiple regression coefficient between model output and vegetation biomass in monitoring data was 0.71, thus model accuracy of vegetation biomass was statistically high.

Relationship among our model and existing method output of livestock animal, and statistical data became right figure. In our simulation result, carrying capacity within this term was much less than the result of existing method's, about 100 times from our model. Additionally, the trend saw exactly the opposite due to the reason of forage trend.

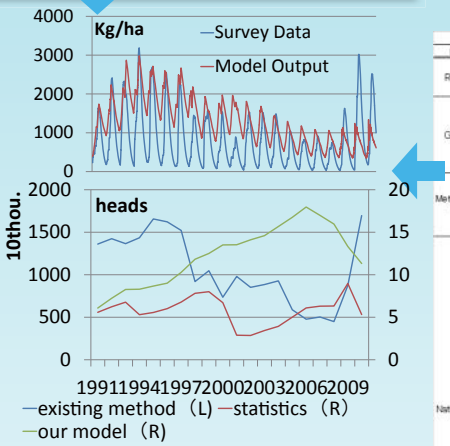


Fig. Test Results of Modeling Vegetations (upper) and Livestock Animals (below) in Bayan Sum, Mongolia

Conclusion

In this study, we calculated carrying capacity in Bayan Sum of Tuv Aimag, Mongolia. The result was lower than the result of existing study. From our model outputs we show that existing management, which only sets the carrying capacity, is not effective for managing socio economic risks. We suggest that herders and local government have to rethink their policies for their sustainable grazing.

In Mongolia, from 1999 to 2002 and 2009 to 2010, about 10 million livestock animals were seriously died due to starvation and the cold by effects of overgrazing and Zud: extreme dies by heavey snow and extreme cold in winter season. Thus, it is required to reduce its risk by controlling number of overwinter livestock animals. In order to do that, it is required to simulate how many animals do herders have to sell followed by carrying capacity. Despite recent advance in the method for estimating carrying capacity, it is not established the methodologies how to collect and use data. SimSAGS that is based on biosphere model is one of models for estimating carrying capacity. Here we tested to estimate carrying capacity in Bayan Sum (city) of Tuv Aimag (province), Mongolia by using SimSAGS(Derry, 1998).

In this study, we calculated ecological carrying capacity that is the limit number of grazing livestock animals due to able to simulate in 20 years from 1991 to 2010 daily. Any off takes in the market were not considered in the model, thus ecological conditions were only defined. If the stocking rate, which means density of livestock animals (unit: converted sheep heads ha–1) (Derry 2004), becomes limit number and the livestock animals can not increase in the simulation, that limit number is defined as a carrying capacity in this study. Vegetation condition basically depends on the effect of livestock animals and climate conditions. Thus model accuracy also depends on the vegetation conditions. In this study, we compared model outputs of vegetation biomass with ground biomass. We calculated multiple regression coefficient between them due to compare with the result of previous study in the same study area.

We made a model of grass biomass by using SimSAGS for evaluating accuracy of this model. Left graph is a grass biomass changing; Blue one is the survey data and red line is the first model output. As a result of model outputs, it accuracy was unsuitability due tolack of data in precipitation data.It was not included amount of snow. Thus in this study, it needs to include it to improve.

Table. Researched Result about Existing Database for Modeling

Class Large	Class Small	Data Name	Data Source	取得期間	Term	Spatial Range	Accuracy	Numbers
RS Data	Satellite Image	DEM	SRTM(NASA)	–	–	All Mongolia	90m	1
		MODIS	NASA	2006	Daily	All Mongolia	1km	365
		Landsat	NASA	2001～	不定期	All Mongolia	30m	10
GISData	Province	Aimag	Mercy Corp	2010	–	All Mongolia	Polygon	1
		Sum	Mercy Corp	2010	–	All Mongolia	Polygon	1
	Nature	Well Point	The Government Implementing Agency of Mongolia	2003	–	3Aimag	Polygon	1374
		Landscape Zone	Mercy Corp	2009	–	All Mongolia	Polygon	7
		River	Mercy Corp	2009	–	All Mongolia	Line	
Meteological Data	Meteorological Survey	Atomosphere Pressure	NIES	2009	Daily	2 Transects	Point	13
		Precipitation	Mercy Corp(PHYGROW)	1958～	Daily	All Mongolia	Point	803
		Temperature	Mercy Corp(PHYGROW)	1958～	Daily	All Mongolia	Point	803
		Weather	Mercy Corp(PHYGROW)	1958～	Daily	All Mongolia	Point	803
		Solar Radiation	Mercy Corp(PHYGROW)	1958～	Daily	All Mongolia	Point	803
Nature Data	Soil	Fertility	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Field Capacity	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Wilting Point	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Moisture	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Depth	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Ratio of Root Volume	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Ratio of Vetation Area	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Infiltration	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Permeability	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Soil Type	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
	Vegetation	Forage	Mercy Corp(LEWS)	1970～	Daily	All Mongolia	Point	803
		Pasture	Mercy Corp(LEWS)	1970～	Daily	All Mongolia	Point	803
		Wet Biomass	Mercy Corp(LEWS)	1970～	Daily	All Mongolia	Point	803
		Dry Biomass	Mercy Corp(LEWS)	1970～	Daily	All Mongolia	Point	803
		Annual	Mercy Corp(PHYGROW)	2001～	Summer	All Mongolia	Point	803
		Perennial	Mercy Corp(PHYGROW)	2001～	Summer	All Mongolia	Point	803
		Suruba	Mercy Corp(PHYGROW)	2001～	Summer	All Mongolia	Point	803
		Trees	Mercy Corp(PHYGROW)	2001～	Summer	All Mongolia	Point	803
		Height	Mercy Corp(PHYGROW)	1970～	Daily	All Mongolia	Point	803
		Dry Rate	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Forage Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Coverage	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Leaf Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Dead Leaf Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Stem Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Living Stem Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
		Dead Stem Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	803
Statistics	Livestock Animals	Mass of Mature Male	Texas A&M University Libraries	1990～	年	All Mongolia	Sum	
		Mass of Mature Female	Texas A&M University Libraries	1990～	年	All Mongolia	Sum	
		Fat	Texas A&M University Libraries	1990～	年	All Mongolia	Sum	
		Mortality	Texas A&M University Libraries	1959～	年	All Mongolia	Sum	
		Newborn Morality	Texas A&M University Libraries	1959～	年	All Mongolia	Sum	
		Livestock Animals	Texas A&M University Libraries	1959～	年	All Mongolia	Sum	
		Adult Mortality	Mongol Year Book	1959～	年	All Mongolia	Sum	

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