DESIGN OF LIVESTOCK MANAGEMENT TOOL FOR CLIMATE CHANGE RISK IN MONGOLIA

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ABSTRACT:

In Mongolia, from 1999 to 2001 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 snow 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. In order to avoid climate risk, it is necessary to manage farming comprehensively and control livestock numbers. Nevertheless it needs to consider about management, we have to research information about each management under different conditions of each area in all Mongolia. Thus, it needs to survey livestock management workflows of regional administration and GIS data about rangeland areas and their attributes in order to evaluate their nomadic life and their livestock objectively. It is essential to use some tools that have the function of processing the spatial data. It could cover wide areas and have different abilities for spatial relations. To solve this problem; we analyzed management workflows of herder and regional administration working in Mongolia, and designed a hierarchical structure of tables and data layers with the relational database. With this structure, we developed the structure of a WebGIS tool on the Adobe Flex platform for livestock management visually. It will be also useful for them to improve the accountability of activities. This system is a versatile WebGIS tool which can interact with various spatial scales.

1. INTRODUCTION

In Mongolia, livestock animals were killed seriously by effects of climate change and it is required to reduce its risk by early adaptation. Selling livestock animals in unusual selling season is one of the early adaptation. Therefore, it is required to simulate when they need to sell their livestock animals and how many animals do herders have to sell. For getting these information, it is significant to evaluate carrying capacity in rangeland. Carrying capacity is different spatially due to relationship beween plant ecologies and livestock animals. Derry(1998, 2009) developed a model that it is possible to simulate carrying capacity. But his model has never been adapted to Mongolia case. In this study, we designed an early adaptation measure by estimating and managing carrying capacity, and evaluated their possibilities through researching databases and test results of simulation.

2. METHOD

2.1 System for Livestock Animals Management

As a system of early adaptation, it is significant to consider about how to manage carrying capacity. In our study, it is constructed from 3 steps. At first, developing a database for modeling. On second, running model and calculating carrying capacity by try and error. At last, developing a system of sending information to herders. In this study, first and second step was tested in small scale area in Mongolia, and evaluated possibility by their results.

2.2 Database

Mainly we used the phygrow data that is composed by Texas AM University and Mercy Corp (Angerer et al., 2009), which is NGO, and they monitors many environmental conditions daily in 502 points in this area. There are also statistical data, GIS data and Physical Data of Animals. Thus it needs to make these data related in spatially by using geo-information systems, and interviewed to herders.

2.3 System Design

We analyzed free and national data sources in all Mongolia and designed a spatial structure of tables and data layers with the relational database. The structure of this system is shown in Figure.1. It was constructed in 3 layers, the bottom was Google Maps, the middle was GIS/RS data, the top was data created by users. In the middle layer, we used WMS (Web Mapping System) that was standardized by OGC (Open Geospatial Consortium). In the top layer, vector data were able to use by using Google Maps API. The data on the top layer were managed in MySQL, so users can update those data on the Google Maps interface by using Web browsers. and Mobile Phones. With this structure, we developed the WebGIS interface on the Adobe Flex platform..

3. RESULTS FOR EVALUATING POSSIBILITY OF ADAPTATION DESIGN

As a system of early adaptation, it is significant to consider about how to manage carrying capacity. In our study, it is constructed from 3 steps. At first, developing a database for modeling. On second, running model and calculating carrying capacity by try and error. At last, developing a system of sending information to herders. In this study, first and second step was tested in small scale area in Mongolia, and evaluated possibility by their results.

Table 1. Data List for the System

Class		Data Name	Data Source	Term	Interval	Spatial Range	Accuracy	Numbers
Large	Small							
RS Data	Satellite Image	DEM	SRTM(NASA)	–	–	All Mongolia	90m	1
		MODIS	NASA	2006	Daily	All Mongolia	1 km	365
		Landsat	NASA	2001～	Seasonal	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 Implimenting Agecy 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	Atmosphere Pressure	NIES	2009	Daily	2 Transects	Point	13
		Precipitation	Mercy Corp(PHYGROW)	1958～	Daily	All Mongolia	Point	809
		Temperature	Mercy Corp(PHYGROW)	1958～	Daily	All Mongolia	Point	809
		Weather	Mercy Corp(PHYGROW)	1958～	Daily	All Mongolia	Point	809
		Solar Radiation	Mercy Corp(PHYGROW)	1958～	Daily	All Mongolia	Point	809
Nature Data	Soil	Fertility	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Field Capacity	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Wilting Point	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Moisture	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Depth	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Ratio of Root Volume	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Ratio of Vetation Area	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Infiltration	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Permeability	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Soil Type	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
	Vegetation	Forage	Mercy Corp(LEWS)	1970～	Daily	All Mongolia	Point	809
		Pasture	Mercy Corp(LEWS)	1970～	Daily	All Mongolia	Point	809
		Wet Biomass	Mercy Corp(LEWS)	1970～	Daily	All Mongolia	Point	809
		Dry Biomass	Mercy Corp(LEWS)	1970～	Daily	All Mongolia	Point	809
		Annual	Mercy Corp(PHYGROW)	2001～	Summer	All Mongolia	Point	809
		Perennial	Mercy Corp(PHYGROW)	2001～	Summer	All Mongolia	Point	809
		Suruba	Mercy Corp(PHYGROW)	2001～	Summer	All Mongolia	Point	809
		Trees	Mercy Corp(PHYGROW)	2001～	Summer	All Mongolia	Point	809
		Height	Mercy Corp(PHYGROW)	1970～	Daily	All Mongolia	Point	809
		Dry Rate	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Forage Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Coverage	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Leaf Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Dead Leaf Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Stem Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Living Stem Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
		Dead Stem Ratio	Mercy Corp(PHYGROW)	2001	–	All Mongolia	Point	809
Statistics	Livestock Animals	Mass of Mature Male	Texas A&M University Libraries	1990～	Yearly	All Mongolia	Sum	
		Mass of Mature Female	Texas A&M University Libraries	1990～	Yearly	All Mongolia	Sum	
		Fat	Texas A&M University Libraries	1990～	Yearly	All Mongolia	Sum	
		Mortality	Texas A&M University Libraries	1959～	Yearly	All Mongolia	Sum	
		Newborn Morality	Texas A&M University Libraries	1959～	Yearly	All Mongolia	Sum	
		Livestock Animals	Texas A&M University Libraries	1959～	Yearly	All Mongolia	Sum	
		Adult Mortality	Mongol Year Book	1959～	Yearly	All Mongolia	Sum	

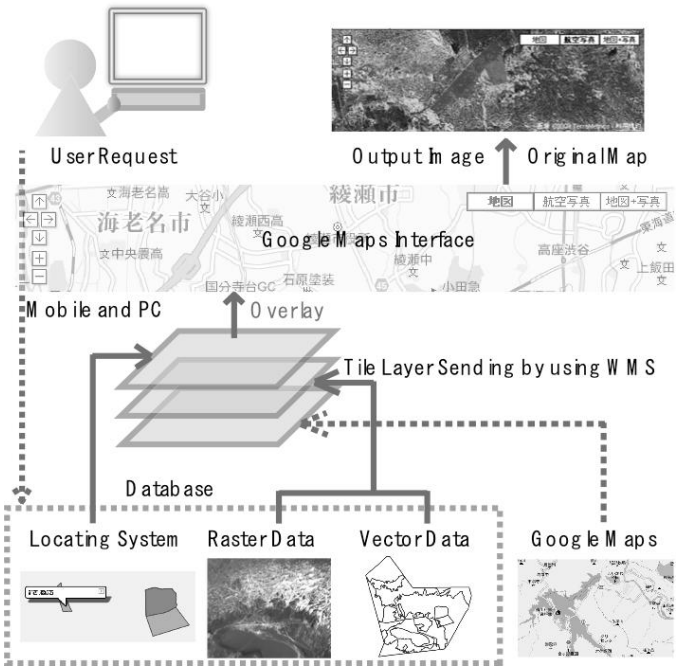

Figure 1. System Architecture

CONCLUSION

In this study, we made a design of early adaptation measures in response to climate change in Mongolia by 3 steps, and tested 2 steps. Test results showed positivly as the design, particularly vegetaion model was better from Angere et al.(2009), but also showed some subjects. For complete our design, we have to consider about other data sources and how to improve model for calculating livestock animals.

References from Journal Articles

Angerer, J., Sean, G., Doug, T. (2009) Technology Transfer Part I: Implementation of the Livestock Early Warning System in Mongolia. *Global Livestock CRSP, Research Brief 09-01-GOBI*, Univ. of California-Davis.

Derry J.F. (1998) Modelling ecological interaction despite object-oriented modularity. *Ecological Modelling*, 107, 145-158.

Derry J.F. (2009) Piospheres, *Vdm Verlag*, p.32