

GRASSLAND MANAGEMENT: CASE STUDY OF VEGETATION CHARACTERISTICS AND GRAZING SYSTEMS IN MONGOLIA PLATEAU

D.Bolormaa^{1*}, B.Batbuyan²

1-Research Institute of Animal husbandry, MULS

2-Research Institute of Geography and Geo-Ecology

*-Corresponding author, Email: bolormaa_d@yahoo.com

ABSTRACT

Mongolian Plateau is an important component of the Eurasian steppe biological communities, located in the eastern inland plateau in Central Asia. Results of pearson correlation analysis of biomass, coverage, litter, perennial grasses proportion and excellent forages proportion showed aboveground biomass had positive correlation with litter, perennial grasses and excellent forages proportion ($P < 0.05$) in main types in Mongolian Plateau. According to the investigation of soil and vegetation basic characteristics, proportion of grasses in Mongolia, and Inner Mongolian steppe is similar, respectively Buriad. The optimization for grassland vegetation refreshment and pasture animal husbandry becomes complex due to self-frangibility and severe damage of typical grassland ecosystem. The traditional patterns of movement remained in Mongolia where the open access grazing systems allows having long distance of movement and using large grazing land. While in Buriatia with kolkoz and Inner Mongolia under the private property right the grazing area is limited. The Eastern Mongolia still holds the traditional nomadic herding and seasonally grazing grassland utilization ways which has not change in a wide range of grassland degradation yet. The research results shows indicate that high benefit of management pattern should be on the basis of nomadic system.

KEY WORDS: grassland, soil, vegetation cover, biomass, nutrition value, nomadic livestock

INTRODUCTION

Mongolian Plateau has important grassland ecological value and economic value, which plays the irreplaceable role to maintain ecological balance and protect ecological security, which is also the material basis for the development of grassland animal husbandry and the survival of farmers and herdsman in the basic production.

The interactions of humans and rangelands, one that included people as a vital component within the system, might be a more realistic approach to

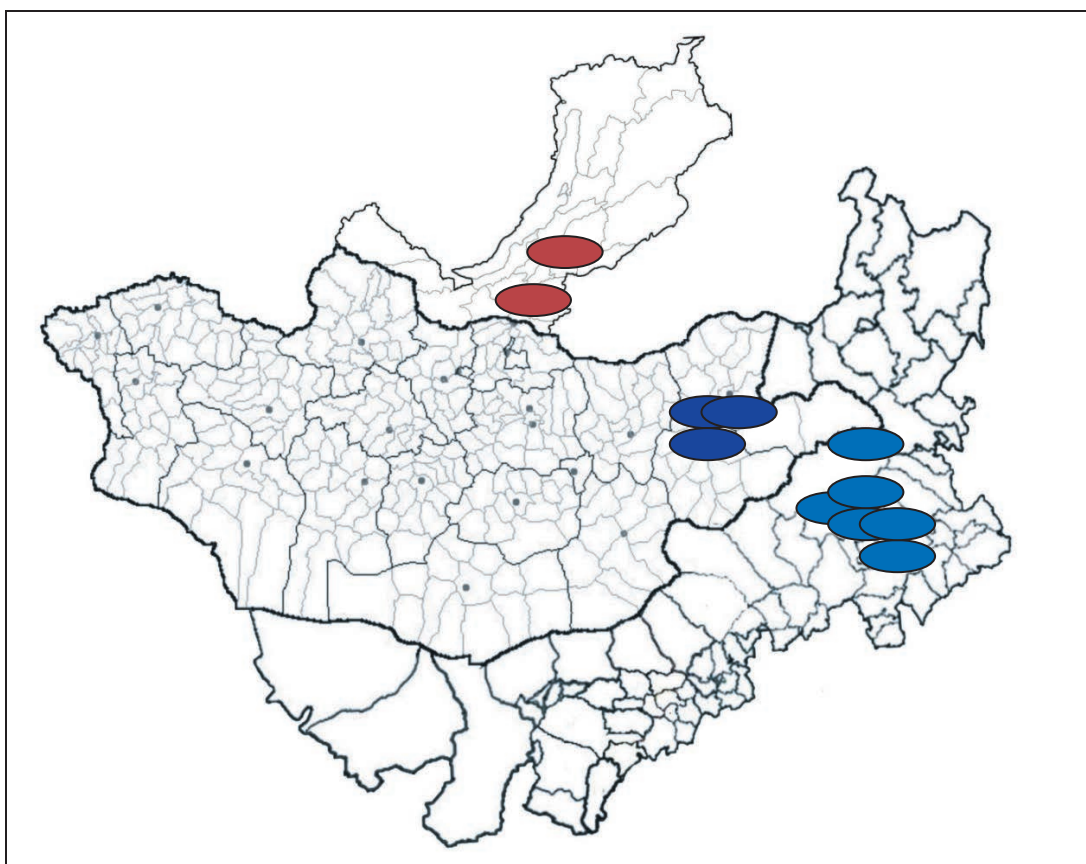
achieving economic, ecological and social sustainability (Brown et al, 2008). Reverse succession of grassland eco-production function have happened year by year because of climate changes, the change of national and regional socio-economic function, the imperfections of grassland animal husbandry policies, imbalance of market demand and other factors (Xu Zhu, 2010). The studies addresses these issues and organized several countries, departments, multidisciplinary to launch

cooperative research, and choose the investigation plots based on the similar natural conditions and socio-economic conditions, especially the similar historical background of grassland animal husbandry management in China, Mongolia and Russia. Scientific problems of Mongolia plateau steppe eco-productive function area were discussed and explored further on the basis of previous researches and accumulation.

Research contents include the production and ecological function of grassland (soil, vegetation biodiversity, grassland productivity, etc.), mode of animal husbandry management, direction of grassland use. Ultimately, a scientific basis will be provided for develop and implementation of

grassland livestock policy, laws and regulations in three countries.

Study area: The northern part of Mongolian Plateau where Buriatia (Russia) is located the elevation is 680 m above sea level and the annual precipitation varies between 300-400 mm. Mongolian steppe is located at elevation of 1000-1200 meter above sea level. The annual precipitation varies between 250-300 mm. The southern part where Inner Mongolian steppe is located, elevation is at 1250 meter above sea level. The annual precipitation varies between 320-400 mm. The study areas were selected in trans boundary territory along the state boundary of 3 countries. (Map 1) In total 11 study sites.



Picture 1. Study sites

The sites were chosen based on principle of similar ecological environment, where a main type is needle grass-forbs pasture.

METHODS

We used mixed-methods approaches, for social study participatory observation, informal and formal interviews. About socio-economic survey, in the vicinity of sample survey of grassland resources, the combined method was done by selecting the herdsman households, randomly selecting from the

local administration of surveys and collection agencies data. The basic situation of main herdsman households in different regions were understood, including mode of operation herdsman husbandry, herd structure, income and expenditure of pastoralists, nomadic routes and distances, grassland

utilization status and grassland area, status and trends of vegetation change, environment change, measure of grassland protection, direction of husbandry development, experience and lessons of grassland animal husbandry management learned and ideas of future development in three countries.

The investigation method was carried out to obtain professional data about typical steppe vegetation and soil including grass-based conditions, current grassland data with historical data, differences of grassland ecological function zone and soil-related

information. Based on these data we measured pasture foliar, basal cover and bare ground measured by line point intercepts method. Rangeland health assessment have evaluated based on quantity data from main indicators (clay contents, soil compaction, soil stability, bare ground, litter amount, species reaches, abundance, species frequency, yield, proportion of grasses in the yield). The evaluation process used additional indicators such as foliar cover, basal cover and basal gap.

RESULTS

Soil characteristics: The soil texture of the selected plots in ecological site was described loamy. The clay content was 14.2-23.4% in A horizons and depth of 16.5-29 cm and B horizons have 14-22.5% of clay and depth of 38-54 cm in Mongolia. The clay content in Russia (Buriatia) and in Inner Mongolian steppe was lower percentage than in Mongolia. Average amount of humus is between 2.48-5.8% in 0-20cm and 1.89-2.94% in 20-40 cm and the content of humus appears to be higher in Russian sites.

The average rate of soil stability contains 3.1-4.4 point on surface, 4.2-4.8 on subsurface layer. Soil

stability rate indicates from 6 point, if the rate decreases it may significantly affect on surface soil and increased run-off and erosion. In Inner Mongolian where the pasture was in rest the soil stability is 15-30 percent more than other sites because after rest the vegetation coverage increased and decreased soil erosion.

Vegetation cover characteristics: The needle grass-forbs types registered 17-28 (22) species in Mongolian steppe, 15-21 (18) species in Russian steppe and 10-29 (20) species in Inner Mongolian steppe (table 1).

Table 1

		Characteristics of vegetation types		
Country		Mongolia	Buriatha	Inner Mongolia
Species richness		22	18	20
	Foliar coverage	75.4	68.9	70.3
Coverage of soil surface,%	Bare ground	5	6.1	4.7
	Basal cover	9	20.8	11.6
	Litter	83.4	64.3	67.8
Yield, kg		1310	880	1412
		(grass 88,5 %)	- (grass 38.3 %)	- (grass -85 %)

The typical steppe dominated by *Stipa krylovii* by 27.4-57.8%. The total foliar coverage is 68.9-75.4% of the soil surface, bareground is 5-6.1%, and litter is increased by rest in the selected sites. These data are seen as an important contribution to the Asian Plateau development of the standard indices for the monitoring and Rangeland assessment.

The plant community structure is closely related with the grazing pressure. The relationships between plant population and grazing pressure have been related of increaser species. The results shows that *Artemisia frigida*, *Carex duriuscula*, *Leymus chenensis* most efficient quantitative indicator to the

grazing pressure in Mongolian steppe, while *Carex duriuscula*, *Potentilla acaulis* in Russian (Buriatia) and Inner Mongolian steppe increased *Cleistogenes squarrosa*, *Leymus chinensis* *Artemisia frigida*.

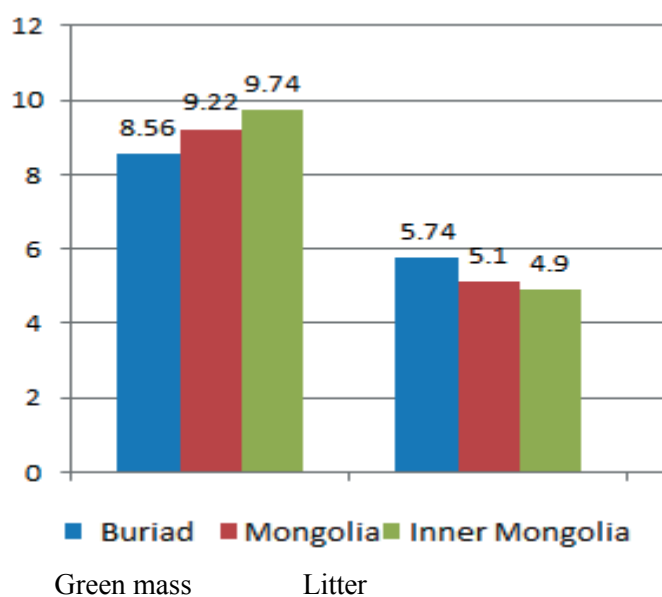
Yield: Above-ground biomass varies annually depending on precipitation and temperature. The biomass of needle grass-forbs types in averages is 1310 kg ($P=0.013$), per hectare. In Russian (Buriatia) aboveground biomass was lower than others. This year was drought in Buriatia. 43.1 % of biomass made up by grasses in Buriatia, where in Mongolian and Inner Mongolian steppe was 68.3-73 % of grass proportion in biomass. Comparing

with grass proportion data, it shows low amount of grass proportion of biomass in Buriatia but previous studies noted that following longitude increased grass proportion in the biomass.

Biodiversity and grass yield in Inner Mongolia typical steppe was slightly higher than Mongolia, while vegetation coverage in Mongolia typical steppe was slightly higher than Inner Mongolia. The differences of these indices between the two countries were not significant. Typical steppe yield,

vegetation coverage and biodiversity in the two countries were similar.

Nutrition value: The main needlegrass - forbs types have the following composition on average: water 5.5-11.7 percent, crude protein 5.7-13.4 per cent, crude fiber 26.3-37.4 per cent and ash .1-9.2 percent. The needle grass-forbs types have absolutely dry for 1 kg of grass in summer equals ME-8.56-9.74 MJ and for standing dead it is ME 4.9-5.7 MJ (Pic.1).



Picture 2. Nutrition value of needlegrass-forbs type, by metabolize energy, MJ

Crazing livestock can get sufficient feed from needle grass-forbs type in summer, but in winter pasture provides only 40-60 percent animal feed therefore, need to supplementary feed during the time to survival and productivity.

Rangeland health assessment: According to the soil, vegetation, yield studies results shows the process and pattern of interaction between the factors and threshold for rangeland degradation. Based on above data were evaluated rangeland degradation rate.

Result of assessment of the rangeland health in Mongolian steppe founded none to slight, slight to moderate. Russia (Buriatia) had been heavily degraded before 20 years and now recovering from long time rest but still sub dominated increaser plants such as *Potentilla acaulis*, *Carex duriuscula*. Inner Mongolian steppe protected from overgrazing and it is recovered but decreased number of plant species and still dominated *Cleistogenes squarrosa*, *Artemisia frigida*. Result of questionnaire of pasture degradation from herders shows approximate with above mentioned.

Pasture use: Mongolia, Buriatia and Inner Mongolia are sharing a similar history of changes in pattern of pastureland management where the collective time /socialist system declined mobility of herders.

In Buriatia the process started early. Since 1940s the *kolkhoz* (collectives) were established, where herders herded the *kolkhoz*-owned animal and allowed to have a few private animals. Each *kolkhoz* has own defined territory where most of land is used for crop cultivation. The collective/state regimes exist. However, there are some farmers with small size of private land where running intensive animal husbandry.

The economic reforms that started in early 1980's and by 1985 the Household Production Responsibility Systems (HPRS) or Double contract responsibility systems were introduced In Inner Mongolia (PRChina). This system aimed to establish the private property rights for herders and mobilize them to intensification their livestock production (to optimize production within limited space). Implementation varies from region to region of Inner

Mongolia. The locations of plot were spread or the sizes of plot were different from region to region.

The main changes In Mongolia started after de-collectivization in 1990 where the state-owned livestock was privatized. Herders become entirely responsible for their own herd management decisions including seasonal movements, veterinary services and maintenances of wells. The traditional

patterns of movement remained in Mongolia where the open access grazing systems allows to have long distance of movement and large grazing land. While in Buriatia with *kolkoz* and Inner Mongolia under the private property right the grazing area is limited and pasture is divided into part for winter / spring and summer/fall seasons.

DISCUSSION

Disasters of grassland occur frequently, and as a result, the integrated ecological system has been severely deteriorated and ecological safety has been seriously threatened. Grassland ecosystem of Mongolian Plateau is frangible and fluctuating. The vegetation cover in the needle grass-forbs type found to be depend on the plots of pasture ranging at 68.9-75.4% of foliar cover of the soil surface, bare ground is 5-6.1%, that seemed not comparable with data by

other researchers (Dashnyam 1974, Buyantiva et all, 2013, Li Yonghong,1990) who used a different technique - a vegetation cover (quadrats method).

Our data on the summer yield of selected pasture is lower than studies of other researchers (shown in table 2) in Mongolian Plateau. Study shows the intensified process towards to recovery of the plant community in response to a diminished grazing pressure and light utilization.

Table 2

Compared with previous studies result of biomass			
Pasture type	Biomass, kg	Selected site	Researchers
	1160	Buriad steppe	Buyantiva et all, 2013
Needle grass- forbs type	880	Ulaan-ud, Russia	Our team 2010
	1620	East Mongolian steppe	B.Dashnyam, 1974
	1310	East Mongolian steppe	Our team 2010
	1550	Shiliin gol, Inner Mongolia	Li Yonghong. 1990
	1412	Shiliin gol, Inner Mongolia	Our team 2010

The declination of grassland productivity is a worldwide problem, and accordingly, the countries all over the world emphasize on natural grassland vegetation protection and refreshment of the degradation pasture. America established the laws such as Husbandry Government Law to protect natural vegetation resources after black storms happened in the 1920s and 1930s. The enclosed area of grassland in America arrived at 99.1%. Canada and Australia restricted the livestock population to keep the balance for pasture ecology. New Zealand has almost realized enclosure and rotational grazing rules as a result of emphasizing the ecological protection of natural grassland (Xu Zhu, 2010). Buryat and Mongolia have a high consciousness on pasture environment protection. Mongolia is a natural gene bank for the grassland. The harmonious and uniform production mode between traditionally nomadic culture and ecological environment of Mongolian nationality is the model for the present economical society, which attracts the attention of the scientists all over the world. Generally 50% is the reasonable standard in grassland utilization

according to the Mongolian grassland management system.

Open access provide flexibility of herders and provide access to different grazing area including remote pasture area in Mongolia, when in then in Buriatia and Inner Mongolia increases pressure to grazing pasture area around of own fence pasture under the private property right system. Observation indicate that herders focusing adaptation strategy toward to collective group action in all three countries.

Mongolian Plateau has a weak bearing capacity of environment for human use, and the ecosystem is easily breakable and hard to restore. The protection and reasonable use of natural grassland vegetation, the improvement of unit production value of grassland animal husbandry, and some key problems for optimal model of great significance should be tackled intensively. Therefore, to speed up the investigations on the ecological protection and yielding function for semiarid grassland, and optimal model of comprehensive management for Mongolian Plateau is the significant strategy

demand for the national economy and society development in the new period. The investigations surely promote the ecosystem refreshment and

benign cycle of Mongolian Plateau positively to guarantee a sustainable development for pasture animal husbandry accordingly.

CONCLUSIONS

1. Pasture condition depend from utilization rate and difference grassland management police in each country. Study indicate that Mongolia under the seasonal rotation system the pasture condition is normal, while in Buriatia pasture is recovering from intensive utilization and in

Inner Mongolia was degraded and now recovering stage in rested area.

2. The rangeland condition and socio – economic analyses indicate that mobility of herder is a key strategy for sustainable grassland management for long term.

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