

Environmental and Climate change in Mongolia

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Introduction

Mongolia is situated in the East Asia between Russia and China far from Oceans and Sea with a population of 2.8 million and territory of 1.566 million square km. The average altitude is 1580 m above the sea level and it is on average 1000 km distance from the nearest access to a sea. For that reason Mongolia has a continental climate with four distinct seasons. Mongolia is a specific country with sharp continental climate and small precipitation. Vast semi-arid (semi-desert) and Plains Mountains in the west and southwest the Gobi desert in south and southeast. 42.5 percent of Mongolian territory is occupied by the Gobi desert, covered by scattered and short plants, which grow on the semi-desert and Gobi steppe brown soil with weak fertility.

The extreme climate and geography as well as the landlocked condition greatly influence the Mongol's way of life. As far as Mongolia, where more than 40 percent of the population is engaged in livestock breeding, the life of people depends mostly on the weather and natural condition.

The ethnic composition of Mongolia is fairly homogeneous: there are two national majorities representing different ethnic groups and 15 national minorities representing different ethnic groups. The density of the population is extremely low, only 1.7 persons per square km and still many areas remain virtually unpopulated.

Current situation of desertification and its change

Desertification and drought are very important issue in Mongolia, because 90% of Mongolian territory is located in semi-arid and arid regions. Mongolia has been affected by drought and desertification during the whole period of its history and development because of its affiliation with the capricious and semi-arid and arid zones with a shortage of moisture.

Table 1. Grade of desertification, Mongolia

Grade of desertification	1990	2000
Land with weak sign of desertification	760	34.9
Land with average sign of desertification	20.0	38.7
Land with strong sign of desertification	3.0	16.1
Land with severe sign of desertification	1.0	1.8
Desert land with drought	-	8.5
Territory covered by drought	41.3%	44.7%

Table 1 shows, that the territory, exposed to drought has increased by 3.4 percent in the 10 years between 1990-2000 and the square of land with strong sign of desertification has increased by 5.4 times, the land with severe sign of desertification has also increased by 1.8 times.

In 2000, the ecosystem of pasture land in the steppe area, which occupies 33.8 percent of Mongolian area, suffered from improper human activities and 11.6 percent of them suffered very strong, 2.0 percent of the territory was damaged strongly.

In Mongolia 70 percent (126.6 million hectares) of rangeland have been deteriorated at a certain extent and the biomass of grassland was decreased by several times. Therefore, certain part (25 million heads) of livestock has been deprived of fodder, which reduces the number of cattle and their productivity.

In the last years 40 percent of forestland, which covers only 8 percent of Mongolian territory, have suffered badly because of improper human activities and the reserve of forestland has been reduced from year to year as the result of this improper human activities, harmful insects, forest fires and etc.

Local people in the Gobi desert area have cut the saxaul trees, which are principal plant of the Gobi desert area, more frequently as firewood for many years and thus the saxauls of 125.0 thousand hectares of land were exterminated completely. But still the inhabitants of aimag and soum centers in the Gobi desert area use various trees and bushes as firewood.

As a result of climate changes, the process of desertification has increased and the repetition of various natural calamity phenomena has been demonstrated by snow melting in the mountain caps, river drying, bad growth and development of grasses, the soil water salting, degradation and erosion of soils and the loss of its humus and fertility, and the increase of sand move.

Recently in the country 647.0 thousand square km or 41.3% of total area is affected by sand, especially in the Gobi desert area. The size of area, which is covered by sand has increased (with 38000 hectares) during the last 30 years.

Besides the natural factors, the multi-sided human activities have shown negative effect in the increasing trend of desertification. In the early 1990s, due to the privatization of livestock head of private livestock increased by overloading and crumpling the pasture. According to the above mentioned traditions of pastoral livestock breeding have been lost and these factors are became one of the key reasons of desertification.

Current situation of permafrost and its change

Permafrost underlies approximately 63% of Mongolia area, which is located higher than 43°N. Mongolia has 7 kinds of permafrost: continuous, discontinuous, widespread, rare spread, sporadic, peretletka and seasonal.

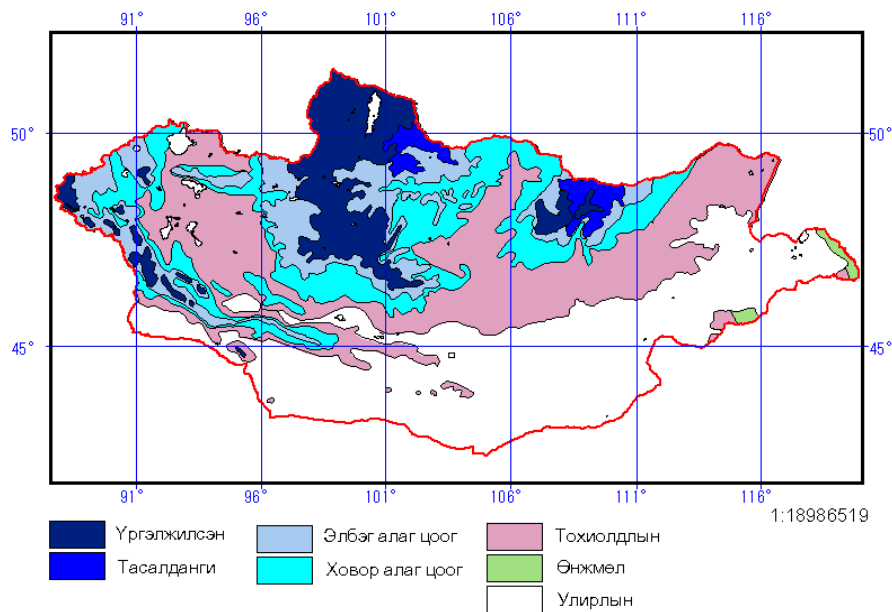


Fig 1. Distribution of permafrost in Mongolia by Dr.Tumurbaatar.D. (1968-1970)

Continuous permafrost underlies 141000 square km, which is 9.4% of the territory. This kind of permafrost mostly distributed in the valleys of Khangai, Khuvsgul and Altai mountains. In this region depth of permafrost is 100-200 meters, the maximum reaches 500 meters. Average temperature of the permafrost is -1.5 degrees and the maximum -3.5 degrees.

Discontinuous permafrost underlies 27000 square km, which is 1.8% of total area and distributed in the valleys of Khentii, Eastern Khuvsgul and Altai mountains. Widespread permafrost underlies 152630 square km, which is 10.2% of Mongolian territory. The distribution of this permafrost starts from 1460-1800 meters. Its depth is 50-100 meters. The mean temperature of this permafrost is -1.0 degrees and the maximum reaches -1.5 degrees. Rare spread permafrost underlies 190930 square km, which is 12.2% of territory of the country. Depth of this permafrost is mostly 10-50 meters. Temperature of the permafrost is -0.5 degrees and the maximum -1.0 degree.

Sporadic permafrost underlies 460110 square km, which is 29.4% of territory. This kind of permafrost mostly distributed in the valleys of the central part of country, Orkhon-Selenge river basin, Great lakes depression and the Northern part of Eastern Mongolia. Depth of this permafrost is mostly 5 meters. Temperature of the permafrost is -0.1 degrees and the maximum -0.5 degrees [D.Tumurbaatar, IG, MAS, Mongolia]. Perireletka permafrost forms in the Eastern Mongolia, depending on winter condition, temperature and snow cover. If snow cover is not depth, then it forms.

Seasonal permafrost forms in the Southern part of steppe region and Govi area, where soil freezing depth is from 1.7 meters to 3.5 meters. Results of scenario of climate change HADCM3 model, version A2 of CO₂ concentration show that continuous permafrost in

Mongolia will decrease by 4.4% in years 2010-2039, by 0.5% in years 2040-2069 and will be not much permafrost in years 2070-2099, such as without permafrost area will increase by 71-80% and only discontinuous, widespread, rare spread, sporadic permafrost area will remain in the valleys of Khuvsgul, Khangai and Khentii mountains [T.Ganbaatar, IMH, Mongolia].

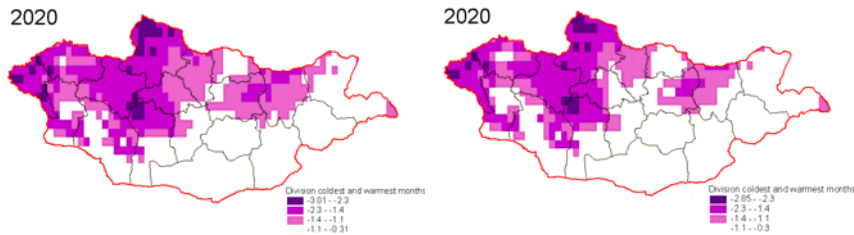


Fig 2. Ratio $F_{jan/jul}$ or distribution of permafrost by versions A2 and B2 of HadCM3 model for years 2010-2039

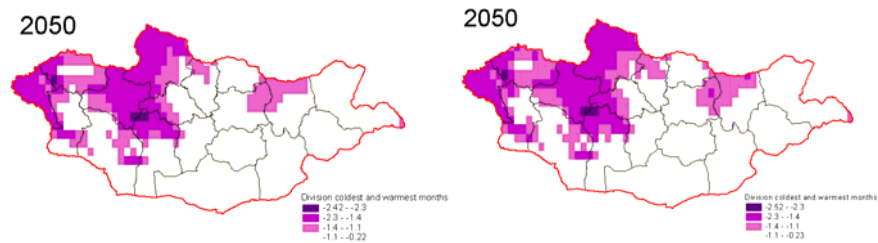


Fig 3. Ratio $F_{jan/jul}$ or permafrost distribution computed by versions A2 and B2 of HadCM3 model for years 2040-2069

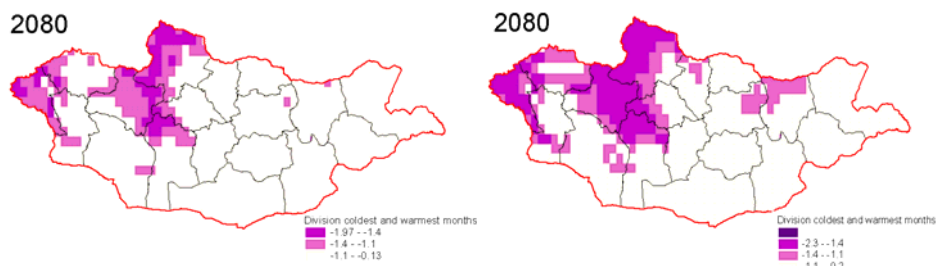


Fig 4. Ratio $F_{jan/jul}$ or permafrost distribution computed by versions A2 and B2 of HadCM3 model for years 2070-2099

Climate and its change

The annual average air temperature in Mongolia has increased in the last 65 years by 1.9 degree Celsius and in a winter by 3.6 degrees, in a spring and autumn by 1.4-1.9 degrees and it has decreased in a summer by 0.6 degrees. According to this the duration of non-frosted period has increased also by 10-19 days. If take the regions of Mongolia, then in the southern and eastern parts of Mongolia annual average air temperature has increased by 1.5-1.6, in the western and central regions by 2.0-2.3 [P.Gomboluudev, IMH, Mongolia].

Precipitation amount for a year in the country various from 300 to 400 mm. Annual precipitation has decreased in the Central and Gobi regions of Mongolia by 8.7-12.5%. It

has increased in the Eastern and western regions by 3.5-9.3%. Annual precipitation amount has increased in autumn and winter by 5.2-10.7%. It has decreased in the spring and summer. Amount of precipitation for the growing period (May-September) has decreased and precipitation amount of the cold period (November-March) has increased by 5%. Wind speed has increased by 0.03 m/s.

There is significant change in land cover due to an increasing of anthropogenic forcing, such as desertification and deforestation may affect climate by changing the hydrological cycle and surface energy balance.

Weather extremes are very important key issues in Mongolia. Before 1990s Mongolia had 25-30 weather extremes in a year, recently it has increased until 40-60 and sometimes it reaches 81. 41% of total weather extremes are dust and snow storms, 29% - rainfall and thunderstorms, 18%- heavy rain and snow and others are like dzud (very harsh winter), drought, forest & steppe fire and flood [L.Natsagdorj, IMH, Mongolia].

Drought, covering 25 percent of Mongolia's territory has been happening once in every 2-3 years and the drought, which covers 50 percent of the country, has been happening once in every 4 to 5 years. The number of days with dust and sandstorms in the steppe and Gobi desert zones has increased by 3 and 4 times by the beginning of the 21st Century in comparison with 1960's. Drought occurred >50% of Mongolian area has been happened 4 cases in a decade (10 years) for the period 1941-1950 and 1981-1990, 3 cases for the period 1991-2000, 1 or 2 cases in a decade for the period 1961-1970 and 1971-1980. Since 2000 drought is more frequent. Mongolia has the drought in years 2000, 2001, 2002, 2005 and 2007. High drought occurrence is in the Gobi desert area and it occurs once in 2-3 years) [J.Tsogt, IMH, Mongolia].

Mongolia has 1.3 million hectares of arable land that can produce environmentally clean and friendly products. Due to climate change almost half million hectares of land has eroded, which has been used for agriculture during the last more than 40 years. Also 70% of Mongolian area is degraded. The yield from severely degraded pasture has decreased by 5 times.

Conclusion

1. Mongolia is warming and becoming drier from year to year.
2. Following the climate change environment in Mongolia will be having some changes, such as desertification.
3. According to this warming frequency of weather extremes is increasing and it will increase in the future. Weather extremes are more severe and carry lot of damages and losses.
4. Due to change of the meteorological elements in the last years permafrost area is decreasing and it will be continue in the future.