SOCIO-ECONOMIC AND CLIMATE CHANGE IN MONGOLIA - EFFECTS ON GRASSLAND ECOSYSTEMS

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ABSTRACT
In Mongolia, in combination with strong changes of the whole society during the past 76 years, from the feudal system to socialism and from the socialist system of planned development to the market economy, there are a lot of changes in the use of natural resources all over the country. In consequence of this a lot of effects on grassland ecosystems, caused by socio-economic and climate driving factors, were observed and studied in different scales: zonal, regional, local.

KEYWORDS
Socio-economic transformation, climate change, grazing, degradation

INTRODUCTION
Before Mongolia became a socialist country the large-family nomadic grazing economy was the common kind of land use of the Mongolian forest steppe, steppe and desert steppe grassland ecosystems. During the socialist period of the Mongolian Peoples Republic, from 1921 to 1991, intensive livestock breeding in co-operative and state farms became dominant. There was no private ownership of pasture land. Since 1993 the complete reprivatization of livestock became reality. But the governmental ownership of pasture land is going on. Beside changing socio-economic factors there are also changing natural factors, which affect Mongolian grassland ecosystems. Among them features of a changing climate were observed. Thus, the purpose of this study was to analyze effects of these two driving factors on grassland ecosystems in different scales and sites of Mongolia.

METHODS
Field investigations before (1989, 1990) and after (1991, 1994) the transformation of the Mongolian society were carried out with the help of landscape-ecological methods (cf. Barsch et al., 1994, Opp and Barsch, 1993; Opp, 1996) to analyze

- spatial pattern and
- degradation processes and sequences (cause-effect-mechanisms)

of grassland ecosystems in the forest steppe zone, in the steppe zone and in the desert steppe zone in different regions and at different parts of Mongolia.

In addition to usual methods of analyzing vegetation and soil cover, soil samples were taken to determine soil standard data (grain size distribution, soil density, total pore volume, pore size distribution, saturated vertical water conductivity) which allow statements about natural and man-made soil degradation processes. Apart from this an analysis of statistics of the national economy and of the meteorological survey of Mongolia from the past 70 years was carried out. In addition, a lot of consultations with Mongolian farmers and an analysis of literature were realized.

RESULTS AND DISCUSSION
The use of pasture land was and is the kind of land use most often occurring in Mongolia (cf. Table 1). Mongolia's people have had a long tradition in nomadic large-family grazing. Between 1921 and 1991, when Mongolia was socialist, the government pushed ahead a systematic replacement of the large-family grazing economy by intensive livestock breeding. During this time a private ownership of animals did not exist. Big co-operative and state farms became dominant. Although the number of livestock was more or less the same during the socialist period, the quality of the animals, for example height and weight, was decreasing, because herdsmen had to look after a greater number of animals. On the other side the breeding of special species became easier, because of the specialization of the large farms.

In consequence of the radical transformation processes to market economy, started since 1991, in 1993 nearly all livestock was private. The new private ownership of livestock on the one side and the, until now, non existent market structures on the other lead to a continuous increasing number of livestock. The increasing number of livestock and the lower mobility of herdsmen are responsible for the ongoing degradation of the grassland ecosystems. Such degradation processes were already known during the socialist period. Overgrazing, trampling and biting led to stress of the pasture land. In consequence of these, damages to vegetation and soil cover such as thinning out of plant cover, water erosion, increasing evaporation, loss of moisture and deflation of the humic soil layer are often observed effects in Mongolian grassland ecosystems. But these plant and soil degradation processes are not only caused by socio-economic factors in Mongolia. Strong climatic fluctuations during the past decades, for example the wet fifties and sixties, and the dry seventies and eighties, led to completely different effects. During the same period the mean annual temperature is continuously going up at most of the Mongolian meteorological stations.

Because of the interacting socio-economic, land use, and climate changes different patterns of higher and lower degradation values were observed. Among the natural zones of Mongolia, desert steppes and dry steppes were estimated as the most degradated grasslands. The high level of grassland degradation depends on the low resilience capacity of degradated plant cover in these zones. At the regional scale most degradated grasslands were found in the western parts of Mongolia, especially in the so-called Valley of the great lakes. This is a consequence, as well as of the lower carrying capacity, of the higher population density of the western parts of Mongolia. At the local scale there are on the one hand the pediments which represent the most degradated sites of the mountains. The pediments or foothills of the mountains are the most used migration ways of the herds on their way to the mountain pastures. On the other the strip-like pastures along the main roads (cf. Müller and Bold 1996) represent a special degradation pattern. The main roads until now function as the only market. That's why many herdsmen graze their animals along the roads.

Because of the large occurrence of grassland ecosystems in Mongolia, because of the special indicator value of extreme continental climate to climate change, and because of the strong changes both socio-economic and climate during the past decades, studies of Mongolian grassland ecosystems show very clearly the main causes and driving factors of grassland degradation.

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Table 1
Land resources and land use in Mongolia, 1970, 1980 and 1990 (1 000 ha)

	1970	1980	1990
Farmland	124,930	129,040	125,577
Arable land,[a]	720	1,040	1,347
Cropped land, of which	650	960	1,200
Cereals	420	576	653
Wheat	348	424	532
Potatoes	3	7	12
Vegetables	1	2	3
Green fodder	37	104	.....
Hay-producing land	1,210	2,000	2,000
Pasture land	119,300	125,800	122,200
Other land[b]	3,700	200	30
Forest land[c]	11,400	15,200	15,200
Water bodies[d]	1,450	1,620	1,620
Protection areas/reserves	450	5,250	5,200
Others (settlements, special purposes)	17,770	5,490	9,003

a Of this, about 34,000 ha was irrigated in 1987.
b Includes glaciated and rocky areas.
c Mongolian sources describe this figure as tentative. The figure for 1980 is probably an underestimate, partly reflecting inclusion of some forests into “Others”, while the 1970 figure may well be an overestimate.
d The increase after 1970 is possible due to reclassification of some areas previously listed under “Others”.

Sources: Ministry of Agriculture and State Committee for Environmental Planning, from Mongolia 1992