

6. Summary, Policy Recommendations and Suggestions for Future Research

6.1 Introduction

This chapter presents a summary of the present study, including objectives, model used and findings. Some limitations of the study are discussed followed by a presentation of policy recommendations. Finally, some suggestions for further research are presented.

6.2 Summary of the study

The main objective of this study was to specify livestock production functions adequate to describe specific conditions in Mongolia, in order to analyse productivity changes in the Mongolian extensive livestock sector over the period 1969 to 1990. To achieve the objective five hypotheses were formulated and tested.

The major characteristic of the Mongolian extensive livestock industry is its high exposure to, and dependence on, a severe natural environment and the resulting low and basically constant yield of products per animal. It was this characteristic which made the modelling procedure quite difficult and dictated the use of some individual approach to specifying production functions. First, the natural growth rate (NGR) of animals was used as a measure of output and basic indicator of performance of extensive livestock production. Second, a two-stage estimation procedure was used to analyse first the impact of weather on production and then the impact of economic inputs on weather-adjusted output.

In the first stage, weather-yield models were estimated and used for deriving the aggregate weather index and the weather pattern of Mongolia in terms of cattle and small stock. The statistical results indicated that the aggregate weather index explained a large proportion of output variability. The estimated weather-yield models suggested that (i) weather in Mongolia is quite heterogeneous at regional and sub-regional levels; (ii) the response of animals to weather variables varied significantly across both districts and animals; (iii) the degree of volatility in the effect of weather on animals significantly

varied across regions and sub-regions; (iv) weather indexes were positively correlated at regional levels pointing out to general similarity of weather at large.

In the second stage, the results of statistical tests indicated that (i) the translog form is the best representation of data; (ii) ordinary least squares (OLS) applied to the specified model is as efficient as seemingly unrelated regressions (SUR); (iii) there was structural change between the periods 1969-1975 and 1975-1985; (iv) agro-ecological regions had different intercepts. Accordingly, further analysis was based on the estimates of the dummy variable model for 1976-1995 data. These estimates suggested that (i) under the socialist regime, the policy of encouraging private ownership of livestock had a positive impact on output of livestock enterprises; (ii) the main factors determining output were capital, supplementary fodder and the share of private animals for cattle, and capital and supplementary fodder for small stock, also, the problem of pasture shortage was more serious for cattle than for small stock; (iii) technical change was significant at an increasing rate in the cattle industry, but it was not significant in the small stock industry; (iv) intensification of production, or increased application of technological inputs per animal, led to an increase in the NGR of animals; (v) the contribution of technical change and the intensification of production to the total growth in the NGR of animals varied across agro-ecological regions and over time.

6.3 Policy Recommendations

The findings of this study suggest that the intensification process undertaken in late 1960s to 1980s led to an increase in the NGR of animals. More importantly, this intensification process was associated with significant technical change in the cattle industry. Therefore it seems safe to say that the sharp decline in the supply of technological inputs, which occurred in the transitional period, led to certain productivity losses. Accordingly, policy makers should aim to seek ways of encouraging the use of technological inputs at a rate to at least match the pre-transitional level.

This study also indicated that output of extensive livestock production in Mongolia is primarily dependent on inputs of the natural environment, weather in particular, which is highly variable over both time and cross-sectional units. It is a well known fact that agricultural development efforts can be improved if the relevant

restraints within agricultural regions of a country are properly identified and development programs are focused on removing them. This is important because (i) controllable inputs such as supplementary fodder, irrigation of pasture and shelters for animals have varying elasticities of supply, (ii) the possibility and cost of expanding the supply of such inputs vary considerably among regions. Although not exhaustive, the present study provides some useful insights into the direction which further development efforts should take in different regions of the country. The following are some suggestions mainly at the national and regional levels.

- because of the strong heterogeneity of weather at higher aggregation levels, addressing the problem of weather constraints should be based on the information at district/meteorological station level. The estimated weather-yield models in the present study are the first attempt in this direction.
- benefits from measures to decrease variability caused by weather on cattle and small stock production (i.e. by providing shelter and supplementary fodder) would be larger if these measures focus on the most volatile regions, as identified in the present study.
- the general similarity of weather at large would mean that we should not expect losses from bad weather in one region to be compensated by benefits from good weather in another. This seems to be important information for general projections of supply of livestock products.
- the policy of increasing the supply of technological inputs would bring more benefits if it focuses on the most limiting factors as identified by the present study. These were capital and supplementary fodder for both animal species. The problem of pasture shortage near urban areas, as indicated by the high negative elasticity of stocking rate for cattle needs to be paid special attention.

6.4 Limitations of the study

The main limitation of this study is the unavailability and inconsistency of some data. The data on economic inputs were not available for 1975, 1979 and 1986 to 1990. These gaps certainly affected to some degree the estimates of the aggregate production function. Data on labour and capital were included not as exact service flows, but as total amounts of these inputs available for use.

As many studies of similar type, the present study used some 'simplifying' methods such as a smooth time trend as a proxy for technical change and a linear function to approximate the weather-yield relationship.

Despite the limitations of this study, the results provide useful information about the nature of extensive livestock production in Mongolia that can be used for devising the policies needed to improve productivity of the cattle and sheep-goat industry.

6.5 Areas of future work

Data problems caused the post-socialist period to be left out of this analysis. An analysis of this period would be vital for identifying the impacts of transitional changes on livestock production.

This study assumed that the degree of technical efficiency was constant over time. Many studies of the socialist economies, however, do not support this assumption. Therefore, it is interesting to test the hypothesis of constant technical efficiency by estimating a frontier production function. This study would entail very important policy implications, because if herders were efficient, it is only through technical change that production will be influenced. A relaxation of the assumption of Hicks-neutral technical change would provide information about biases of technical change in the cattle industry, which is also useful for shaping policies of technological developments.

The present study concluded that the intensification process in 1960s to 1980s led to an increase in the NGR of animals without considering the cost incurred to bring this gain. In particular, in the small stock industry where the growth in the NGR was entirely due to the intensification of production, a cost-benefit analysis might show that the intensification process was not justifiable in terms of cost-efficiency. Such program was possible only in a highly subsidised socialist economy.

Appendix 1 The allocation of the districts between the agro-ecological regions and sub-regions

<i>Agro-ecological Regions</i>	<i>Agro-ecological Sub-Regions</i>	<i>Districts or Meteorological Stations</i>	<i>Administrative Provinces where the districts belong</i>
1. Hangai--Huvsgul	1. Hangai	1. Tsenher	Arhangai
		2. Erdenemandal	Arhangai
	2. Bulnai	3. Bulnai	Zavhan
	3. Southern Hangai	4. Bayanovoo	Bayanhongor
		5. Galuut	Bayanhongor
	6. Taragt	Uvurhangai	
	4. Huvsgul	7. Chandmani-Undur	Huvsgul
	5. Western Hangai	8. Aldarhan	Zavhan
		9. Tudevtei	Zavhan
		10. Zuunhangai	Uvs
2. Selenge-Orhon	6. Selenge	11. Orhon	Bulgan
		12. Teshig	Bulgan
	7. Hentii	13. Tosontsengel	Huvsgul
	8. Ulz-Tuul	14. Binder	Hentii
		15. Bayan	Tuv
		16. Undurshireet	Tuv
		17. Hujirt	Uvurhangai
3. Altai	9. Central Altai	18. Altai	Bayan-Ulgii
		19. Bugat	Bayan-Ulgii
	10. Harhira--Turgen	20. Myangad	Hovd
		21. Umnugobi	Uvs
4. Steppe	11. Southern Altai	22. Bulgan	Hovd
	12. Southern Steppe	23. Saintsagaan	Tuv
	13. Menen-Dariganga	24. Bayandelger	Suhbaatar
		25. Bulgan	Dornod
		26. Halhbol	Dornod
		27. Asgat	Suhbaatar
5. Gobi-Desert	14. Herlen-Hu h Nuur	28. Bayanovoo	Hentii
	15. Basin of Great lakes	29. Durvuljin	Zavhan
		30. Tarialan	Uvs
	16. Gobi-Altai	31. Altai	Gobi-Altai
	17. Umnugob	32. Bulgan	Umnugobi
		33. Gurvantes	Umnugobi
		34. Hanhongor	Umnugobi
	18. Galbiin Gobi	35. Airag	Dornogobi
	36. Urgun	Dornogobi	

Appendix 2a Weather-Yield Models per district, Cattle

	Tsenher		Erdenemanda		Bulnai		Bayanovoo	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
R adj.	0.920	xxx	0.967	xxx	0.995	xxx	0.988	xxx
interc.	27.999	3.382	42.472	4.198	19.061	1.764	68.469	4.625
time	0.123	0.064	0.267	0.043	-0.516	0.032	0.056	0.041
tem1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem2	1.132	0.166	-0.251	0.097	xxx	xxx	xxx	xxx
tem3	xxx	xxx	xxx	xxx	xxx	xxx	0.442	0.129
tem4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem5	xxx	xxx	xxx	xxx	4.004	0.103	xxx	xxx
tem6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	-1.245	0.143	xxx	xxx	xxx	xxx
pre2	0.872	0.095	xxx	xxx	xxx	xxx	xxx	xxx
pre3	xxx	xxx	0.447	0.152	0.448	0.046	xxx	xxx
pre4	xxx	xxx	0.164	0.064	xxx	xxx	0.567	0.052
pre5	-0.104	0.021	xxx	xxx	0.351	0.019	xxx	xxx
pre6	0.031	0.012	xxx	xxx	xxx	xxx	xxx	xxx
pre7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre8	xxx	xxx	xxx	xxx	0.180	0.006	xxx	xxx
pre9	xxx	xxx	xxx	xxx	xxx	xxx	0.233	0.028
pre10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre11	xxx	xxx	-0.644	0.103	xxx	xxx	-0.571	0.110
pre12	xxx	xxx	xxx	xxx	xxx	xxx	0.993	0.106
wnd1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd3	xxx	xxx	-2.468	0.506	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	-2.240	0.336	xxx	xxx	1.422	0.745
wnd5	xxx	xxx	xxx	xxx	xxx	xxx	7.534	0.577
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	4.176	0.481	xxx	xxx	xxx	xxx
wnd8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd9	-7.233	0.828	xxx	xxx	5.882	0.246	xxx	xxx
wnd10	5.578	0.832	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd12	-3.025	0.723	xxx	xxx	xxx	xxx	xxx	xxx
sev1	xxx	xxx	-15.919	2.200	xxx	xxx	xxx	xxx
sev2	xxx	xxx	xxx	xxx	-24.674	1.133	xxx	xxx
sev3	xxx	xxx	xxx	xxx	xxx	xxx	-43.963	3.257
sev4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev10	xxx	xxx	9.947	1.339	-5.902	0.779	xxx	xxx
sev11	11.183	3.400	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	-8.738	1.027
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xxx	xxx	xxx	xxx	3.264	1.538
srain	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
stwind	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sncover	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

coef.=estimated coefficients

s.e.=standard error of the coefficients

Radg.=adjusted R-squared

interc.=the intercept term

Appendix 2a cont.

	Galaut		Taragt		Chandman-Undur		Aldarhaan	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
R adj.	0.940	xxx	0.941	xxx	0.961	xxx	0.974	xxx
interc.	108.145	10.567	6.109	17.996	131.407	11.340	8.069	4.072
time	-0.486	0.103	0.287	0.311	-0.350	0.108	0.538	0.054
tem1	2.156	0.246	xxx	xxx	0.953	0.149	xxx	xxx
tem2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem3	1.115	0.146	xxx	xxx	xxx	xxx	xxx	xxx
tem4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem5	xxx	xxx	xxx	xxx	2.902	0.464	xxx	xxx
tem6	-2.511	0.546	2.618	0.954	xxx	xxx	2.731	0.196
tem7	xxx	xxx	xxx	xxx	-4.093	0.604	xxx	xxx
tem8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem12	-1.080	0.176	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre3	xxx	xxx	xxx	xxx	1.949	0.402	xxx	xxx
pre4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre5	xxx	xxx	0.384	0.083	xxx	xxx	xxx	xxx
pre6	-0.125	0.029	xxx	xxx	0.101	0.018	xxx	xxx
pre7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre8	xxx	xxx	xxx	xxx	0.133	0.019	xxx	xxx
pre9	xxx	xxx	xxx	xxx	xxx	xxx	0.044	0.014
pre10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre11	-1.305	0.239	xxx	xxx	-1.631	0.129	xxx	xxx
pre12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	-5.945	1.239	xxx	xxx	xxx	xxx
wnd5	xxx	xxx	8.083	2.202	xxx	xxx	xxx	xxx
wnd6	-19.102	2.425	-6.516	2.433	3.787	1.617	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	xxx	xxx	-3.018	0.559
wnd8	xxx	xxx	20.803	3.408	xxx	xxx	xxx	xxx
wnd9	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd10	xxx	xxx	xxx	xxx	xxx	xxx	-10.195	0.847
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	4.025	0.779
wnd12	-6.713	1.698	-28.633	4.351	xxx	xxx	xxx	xxx
sev1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev2	25.764	6.260	-14.313	4.327	-17.035	2.659	-27.302	1.990
sev3	xxx	xxx	xxx	xxx	-17.090	3.346	xxx	xxx
sev4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev10	xxx	xxx	xxx	xxx	xxx	xxx	25.595	2.030
sev11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	0.486	0.151	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	4.483	1.764	xxx	xxx	-2.268	0.584
srain	xxx	xxx	xxx	xxx	xxx	xxx	-1.489	0.413
elstorm	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
stwind	xxx	xxx	xxx	xxx	xxx	xxx	-0.808	0.172
hotday	xxx	xxx	-3.883	0.673	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sncover	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

temp=average monthly temperature (1 to 12 refer to months)

time=time trend

prec=average monthly precipitation (1 to 12 refer to months)

Appendix 2a cont.

	Tudevtei		Zuunf angai		Orhon		Teshig	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
R adj.	0.884	xxx	0.953	xxx	0.994	xxx		xxx
interc.	-8.418	10.036	-58.974	4.106	34.412	1.448	4.414	5.999
time	1.737	0.323	1.318	0.050	0.001	0.020	-0.208	0.105
tem1	xxx	xxx	xx	xxx	xxx	xxx	0.325	0.103
tem2	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
tem3	xxx	xxx	xx	xxx	xxx	xxx	1.049	0.101
tem4	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
tem5	-3.103	0.497	xx	xxx	xxx	xxx	xxx	xxx
tem6	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
tem7	xxx	xxx	-0.741	0.212	0.682	0.073	xxx	xxx
tem8	xxx	xxx	xx	xxx	xxx	xxx	1.563	0.214
tem11	0.433	0.211	xx	xxx	xxx	xxx	xxx	xxx
tem12	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	xx	xxx	0.253	0.049	xxx	xxx
pre2	xxx	xxx	xx	xxx	0.113	0.042	xxx	xxx
pre3	xxx	xxx	xx	xxx	xxx	xxx	-0.282	0.113
pre4	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
pre5	xxx	xxx	0.150	0.017	xxx	xxx	-0.160	0.016
pre6	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
pre7	xxx	xxx	xx	xxx	0.004	0.002	xxx	xxx
pre8	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
pre9	xxx	xxx	xx	xxx	0.090	0.004	xxx	xxx
pre10	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
pre11	xxx	xxx	xx	xxx	0.671	0.025	xxx	xxx
pre12	xxx	xxx	-0.312	0.053	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xx	xxx	xxx	xxx	1.499	0.599
wnd3	xxx	xxx	17.938	1.048	xxx	xxx	xxx	xxx
wnd4	17.760	2.378	2.450	0.568	xxx	xxx	xxx	xxx
wnd5	-7.142	1.994	xx	xxx	xxx	xxx	xxx	xxx
wnd6	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd7	-10.111	3.095	xx	xxx	xxx	xxx	xxx	xxx
wnd8	6.595	2.995	xx	xxx	xxx	xxx	2.804	0.935
wnd9	xxx	xxx	4.353	0.448	xxx	xxx	xxx	xxx
wnd10	27.357	3.687	xx	xxx	xxx	xxx	-3.026	0.797
wnd11	11.878	2.977	2.523	0.836	xxx	xxx	xxx	xxx
wnd12	xxx	xxx	xx	xxx	xxx	xxx	10.034	0.828
sev1	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sev2	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sev3	xxx	xxx	10.937	3.057	-5.159	0.364	xxx	xxx
sev4	xxx	xxx	xx	xxx	-12.271	0.460	xxx	xxx
sev10	xxx	xxx	-23.078	1.344	xxx	xxx	xxx	xxx
sev11	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
srain	0.570	0.100	xx	xxx	xxx	xxx	xxx	xxx
elstorm	-1.107	0.202	xx	xxx	-0.123	0.011	0.941	0.095
stwind	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sncover	xxx	xxx	0.351	0.019	-0.062	0.002	xxx	xxx

wnd=average monthly wind velocity (1 to 12 refer to months)

sev=severity index by months

Appendix 2a cont.

	Tosontsengel		Binde		Bayan		Undurshireet	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
R adj.	0.948	xxx	0.979	xxx	0.971	xxx	0.944	xxx
interc.	27.594	7.698	39.053	2.990	98.273	21.652	-50.933	11.002
time	0.953	0.111	-0.725	0.072	-1.180	0.321	0.930	0.126
tem1	xxx	xxx	xx	xxx	xxx	xxx	1.496	0.224
tem2	0.339	0.138	xx	xxx	xxx	xxx	xxx	xxx
tem3	xxx	xxx	0.819	0.126	xxx	xxx	xxx	xxx
tem4	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
tem5	-2.241	0.509	xx	xxx	xxx	xxx	1.170	0.538
tem6	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
tem7	xxx	xxx	xx	xxx	4.238	0.877	2.341	0.550
tem8	-0.967	0.351	xx	xxx	xxx	xxx	xxx	xxx
tem11	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
tem12	1.286	0.174	xx	xxx	1.308	0.457	xxx	xxx
pre1	xxx	xxx	xx	xxx	12.356	1.419	xxx	xxx
pre2	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
pre3	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
pre4	xxx	xxx	-0.312	0.034	xxx	xxx	xxx	xxx
pre5	xxx	xxx	xx	xxx	0.538	0.116	xxx	xxx
pre6	0.055	0.013	xx	xxx	xxx	xxx	xxx	xxx
pre7	xxx	xxx	0.125	0.008	xxx	xxx	xxx	xxx
pre8	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
pre9	-0.043	0.024	xx	xxx	-0.556	0.070	xxx	xxx
pre10	-0.790	0.134	xx	xxx	1.100	0.164	xxx	xxx
pre11	xxx	xxx	-0.315	0.036	xxx	xxx	0.442	0.123
pre12	xxx	xxx	0.910	0.120	xxx	xxx	-0.403	0.225
wnd1	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	1.823	0.322	53.168	4.475	xxx	xxx
wnd3	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd5	xxx	xxx	1.877	0.584	xxx	xxx	1.813	1.608
wnd6	-3.133	1.264	xx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd8	12.131	1.613	9.456	0.314	xxx	xxx	xxx	xxx
wnd9	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd10	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
wnd12	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sev1	xxx	xxx	-12.021	1.227	-34.395	4.731	xxx	xxx
sev2	xxx	xxx	xx	xxx	-94.415	9.497	xxx	xxx
sev3	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sev4	xxx	xxx	-13.627	1.304	xxx	xxx	xxx	xxx
sev10	37.386	3.440	xx	xxx	xxx	xxx	xxx	xxx
sev11	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xx	xxx	xxx	xxx	18.049	3.853
bsnow	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
srain	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
stwind	xxx	xxx	xx	xxx	xxx	xxx	-0.296	0.326
hotday	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xx	xxx	xxx	xxx	-0.098	0.013
sncover	xxx	xxx	xx	xxx	xxx	xxx	xxx	xxx

bsnow=the number of days with blowing snow storms

ordsnow=the number of days with ordinary snow storms

Appendix 2a cont.

	Hujirt		Altai		Bugat		Myangad	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
R adj.	0.966	xxx	0.952	xxx	0.979	xxx	0.972	xxx
interc.	-14.008	9.598	41.743	6.482	27.938	4.473	-22.041	7.029
time	1.910	0.166	0.211	0.137	-0.255	0.102	1.108	0.130
tem1	-0.557	0.161	xxx	xxx	xxx	xxx	xxx	xxx
tem2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem3	xxx	xxx	-2.183	0.208	-1.366	0.147	xxx	xxx
tem4	-1.133	0.210	-0.931	0.240	0.786	0.310	xxx	xxx
tem5	xxx	xxx	xxx	xxx	xxx	xxx	1.104	0.195
tem6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem7	-2.839	0.390	xxx	xxx	xxx	xxx	1.766	0.394
tem8	xxx	xxx	-4.759	0.404	xxx	xxx	xxx	xxx
tem11	xxx	xxx	-1.403	0.183	-0.874	0.146	xxx	xxx
tem12	xxx	xxx	-0.919	0.144	xxx	xxx	xxx	xxx
pre1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre2	xxx	xxx	xxx	xxx	3.130	0.847	1.121	0.237
pre3	xxx	xxx	xxx	xxx	xxx	xxx	-1.436	0.122
pre4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre5	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre6	xxx	xxx	xxx	xxx	xxx	xxx	0.153	0.020
pre7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre9	xxx	xxx	xxx	xxx	-0.079	0.045	-0.037	0.039
pre10	xxx	xxx	xxx	xxx	xxx	xxx	-0.333	0.055
pre11	0.631	0.149	xxx	xxx	xxx	xxx	xxx	xxx
pre12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	14.634	0.951	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd3	18.131	1.010	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd5	xxx	xxx	xxx	xxx	-3.436	0.872	xxx	xxx
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	-15.070	1.392	xxx	xxx	xxx	xxx
wnd8	xxx	xxx	xxx	xxx	xxx	xxx	11.434	1.670
wnd9	2.831	1.146	xxx	xxx	xxx	xxx	xxx	xxx
wnd10	3.569	1.049	-9.317	1.215	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	1.859	0.395
wnd12	xxx	xxx	-7.601	1.088	xxx	xxx	xxx	xxx
sev1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev2	16.020	2.683	xxx	xxx	xxx	xxx	-16.487	2.841
sev3	-18.575	2.825	xxx	xxx	xxx	xxx	xxx	xxx
sev4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	-4.010	0.321	-22.262	1.005	xxx	xxx
srain	xxx	xxx	xxx	xxx	-4.935	0.350	xxx	xxx
elstorm	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
stwind	-9.122	1.465	xxx	xxx	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xxx	xxx	4.187	0.335	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sncover	xxx	xxx	xxx	xxx	-0.184	0.033	xxx	xxx

srain=the number of days with continuous slight rains

elstorm=the number of days with electric storms

Appendix 2a cont.

	Umnugobi		Bulgan		Saintsagaan		Bayandelger	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
R adj.	0.970	xxx	0.964	xxx	0.944	xxx	0.978	xxx
interc.	-89.510	8.773	79.135	5.181	87.749	30.192	17.602	10.110
time	1.033	0.079	-0.161	0.085	0.651	0.339	-0.332	0.159
tem1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem2	-1.056	0.104	0.452	0.068	xxx	xxx	xxx	xxx
tem3	xxx	xxx	xxx	xxx	3.540	0.637	xxx	xxx
tem4	1.683	0.219	xxx	xxx	xxx	xxx	xxx	xxx
tem5	xxx	xxx	xxx	xxx	xxx	xxx	-1.842	0.468
tem6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem8	2.551	0.305	xxx	xxx	xxx	xxx	xxx	xxx
tem11	xxx	xxx	xxx	xxx	xxx	xxx	-1.364	0.262
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	-0.853	0.354	-0.509	0.103	xxx	xxx	xxx	xxx
pre2	4.182	0.588	xxx	xxx	xxx	xxx	xxx	xxx
pre3	xxx	xxx	xxx	xxx	xxx	xxx	-1.781	0.130
pre4	xxx	xxx	0.111	0.053	xxx	xxx	xxx	xxx
pre5	xxx	xxx	xxx	xxx	xxx	xxx	0.622	0.059
pre6	0.135	0.022	xxx	xxx	-0.459	0.100	0.414	0.037
pre7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre8	xxx	xxx	-0.204	0.051	xxx	xxx	xxx	xxx
pre9	xxx	xxx	0.301	0.045	xxx	xxx	xxx	xxx
pre10	xxx	xxx	xxx	xxx	1.472	0.244	0.284	0.087
pre11	xxx	xxx	0.601	0.048	xxx	xxx	xxx	xxx
pre12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	22.432	1.714	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	xxx	xxx	-7.680	2.247	xxx	xxx
wnd5	-4.477	0.691	-5.605	1.164	15.031	2.302	xxx	xxx
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	-37.196	3.542	xxx	xxx
wnd8	xxx	xxx	-11.835	1.180	xxx	xxx	17.342	1.424
wnd9	xxx	xxx	xxx	xxx	7.605	2.170	xxx	xxx
wnd10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev1	18.068	3.758	xxx	xxx	21.660	4.592	-29.062	2.433
sev2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev3	8.668	3.113	xxx	xxx	xxx	xxx	xxx	xxx
sev4	xxx	xxx	-24.733	3.321	xxx	xxx	xxx	xxx
sev10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev11	5.731	3.243	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	0.964	0.123
ordsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
srain	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	xxx	xxx	xxx	xxx	0.529	0.119
stwind	xxx	xxx	xxx	xxx	0.746	0.194	xxx	xxx
hotday	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	-5.510	0.435	xxx	xxx
sncover	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

stwind=the number of days with storm w nds

hotday=the number of hot days

Appendix 2a cont.

	Bulgan		Halhgol		Asgat		Bayanovoo	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
R adj.	0.941	xxx	0.927	xxx	0.949	xxx	0.965	xxx
interc.	-80.180	11.137	59.975	10.880	201.309	21.867	23.340	12.885
time	1.987	0.168	0.319	0.124	0.715	0.132	0.333	0.120
tem1	xxx	xxx	0.908	0.185	1.187	0.252	xxx	xxx
tem2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem5	xxx	xxx	-1.753	0.536	-5.391	0.829	-1.994	0.529
tem6	xxx	xxx	-1.046	0.324	xxx	xxx	xxx	xxx
tem7	1.024	0.306	xxx	xxx	-3.132	0.678	xxx	xxx
tem8	xxx	xxx	xxx	xxx	xxx	xxx	-1.864	0.585
tem11	xxx	xxx	xxx	xxx	-4.083	0.308	xxx	xxx
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	-1.470	0.383	xxx	xxx	xxx	xxx
pre2	xxx	xxx	0.526	0.243	3.034	0.548	xxx	xxx
pre3	1.316	0.217	xxx	xxx	xxx	xxx	xxx	xxx
pre4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre5	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre6	xxx	xxx	-0.077	0.021	xxx	xxx	xxx	xxx
pre7	xxx	xxx	xxx	xxx	xxx	xxx	0.076	0.019
pre8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre9	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre10	-0.589	0.112	xxx	xxx	xxx	xxx	xxx	xxx
pre11	xxx	xxx	xxx	xxx	-4.306	0.388	-0.721	0.110
pre12	2.315	0.382	xxx	xxx	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	0.974	0.364	xxx	xxx	xxx	xxx
wnd3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd5	xxx	xxx	4.0E3	1.219	xxx	xxx	xxx	xxx
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	10.484	1.080
wnd7	2.627	1.628	xxx	xxx	xxx	xxx	xxx	xxx
wnd8	2.026	1.273	xxx	xxx	8.672	1.591	xxx	xxx
wnd9	-3.564	1.326	xxx	xxx	xxx	xxx	xxx	xxx
wnd10	-9.089	2.398	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd12	xxx	xxx	xxx	xxx	-11.188	1.411	xxx	xxx
sev1	xxx	xxx	xxx	xxx	xxx	xxx	-6.346	2.752
sev2	xxx	xxx	xxx	xxx	xxx	xxx	13.712	3.558
sev3	xxx	xxx	xxx	xxx	-34.922	2.940	-8.383	2.220
sev4	xxx	xxx	xxx	xxx	xxx	xxx	-12.704	3.115
sev10	71.418	11.795	xxx	xxx	xxx	xxx	19.566	3.858
sev11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	-8.323	0.923	xxx	xxx	-2.134	1.003	xxx	xxx
srain	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	-0.475	0.203	xxx	xxx	xxx	xxx
stwind	xxx	xxx	2.344	0.328	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sncover	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

shdepth=snow depth

sncover=the duration of snow cover

Appendix 2a cont.

	Durvuljin		Tarailan		Altai		Bulgan	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
R adj.	0.927	xxx	0.953	xxx	0.900	xxx	0.968	xxx
interc.	7.432	6.757	21.202	13.787	-7.543	22.955	0.548	
time	1.339	0.177	1.658	0.130	-0.016	0.137	-0.225	0.272
tem1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem2	0.000	0.116	xxx	xxx	xxx	xxx	xxx	xxx
tem3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem5	xxx	xxx	xxx	xxx	-2.261	0.573	xxx	xxx
tem6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem7	xxx	xxx	xxx	xxx	-2.333	0.763	1.775	0.625
tem8	xxx	xxx	-4.207	0.694	4.713	0.722	xxx	xxx
tem11	xxx	xxx	xxx	xxx	xxx	xxx	-1.180	0.291
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	-1.719	0.331	xxx	xxx	xxx	xxx
pre2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre3	0.001	0.288	xxx	xxx	-0.657	0.171	-1.177	0.145
pre4	0.960	0.229	xxx	xxx	0.150	0.103	xxx	xxx
pre5	-0.426	0.143	0.346	0.116	0.252	0.119	xxx	xxx
pre6	-0.359	0.064	0.030	0.014	xxx	xxx	-0.650	0.074
pre7	xxx	xxx	xxx	xxx	xxx	xxx	0.300	0.033
pre8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre9	xxx	xxx	0.361	0.041	0.261	0.080	-0.326	0.091
pre10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre11	xxx	xxx	-1.502	0.178	xxx	xxx	xxx	xxx
pre12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	10.140	2.332	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	-10.831	1.792	xxx	xxx	-6.246	1.088
wnd5	-5.633	1.468	xxx	xxx	-1.575	1.301	-2.820	1.062
wnd6	xxx	xxx	xxx	xxx	-7.981	1.511	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd9	-0.901	1.778	xxx	xxx	xxx	xxx	1.921	1.099
wnd10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd12	-2.333	1.282	xxx	xxx	xxx	xxx	xxx	xxx
sev1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev2	xxx	xxx	50.847	5.558	xxx	xxx	xxx	xxx
sev3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev10	30.453	3.786	-21.137	2.233	35.456	6.804	xxx	xxx
sev11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	10.371	2.525
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
srain	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
stwind	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sncover	-0.060	0.021	xxx	xxx	xxx	xxx	xxx	xxx

Appendix 2b Weather-Yield Models per district, Small stock

	Tsenher		Erdenemandal		Bulnai		Bayanovoo	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Radj.	0.918		0.876		0.934		0.946	
interc.	17.452	12.267	-71.486	18.936	72.071	12.916	106.863	12.390
time	1.932	0.184	1.488	0.184	-0.412	0.188	-0.114	0.175
tem1	2.133	0.332	xxx	xxx	xxx	xxx	1.144	0.266
tem2	xxx	xxx	xxx	xxx	1.770	0.389	xxx	xxx
tem3	xxx	xxx	xxx	xxx	xxx	xxx	2.707	0.272
tem4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem5	xxx	xxx	xxx	xxx	7.381	0.742	1.849	0.527
tem6	6.342	0.734	xxx	xxx	xxx	xxx	xxx	xxx
tem7	-1.322	1.032	4.667	0.968	xxx	xxx	xxx	xxx
tem8	1.649	0.810	xxx	xxx	xxx	xxx	1.261	0.651
tem11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	xxx	xxx	xxx	xxx	-1.563	0.405
pre2	xxx	xxx	xxx	xxx	1.511	0.226	xxx	xxx
pre3	0.896	0.203	xxx	xxx	xxx	xxx	xxx	xxx
pre4	xxx	xxx	xxx	xxx	0.420	0.137	xxx	xxx
pre5	xxx	xxx	xxx	xxx	-0.630	0.102	xxx	xxx
pre6	xxx	xxx	-0.009	0.028	xxx	xxx	xxx	xxx
pre7	xxx	xxx	-0.010	0.025	xxx	xxx	xxx	xxx
pre8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre9	xxx	xxx	0.388	0.089	xxx	xxx	xxx	xxx
pre10	xxx	xxx	-0.505	0.156	0.539	0.156	xxx	xxx
pre11	xxx	xxx	xxx	xxx	xxx	xxx	-1.085	0.401
pre12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd1	-5.306	1.474	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd3	xxx	xxx	7.384	1.996	8.421	2.106	xxx	xxx
wnd4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd5	xxx	xxx	-12.114	2.440	xxx	xxx	xxx	xxx
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd8	-7.188	1.720	-3.381	2.305	xxx	xxx	xxx	xxx
wnd9	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	-2.556	1.332	xxx	xxx	-5.802	2.260	xxx	xxx
wnd12	xxx	xxx	22.010	2.210	xxx	xxx	xxx	xxx
sev1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev3	-21.844	4.880	xxx	xxx	xxx	xxx	xxx	xxx
sev4	xxx	xxx	xxx	xxx	xxx	xxx	-35.892	4.444
sev10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
srain	xxx	xxx	xxx	xxx	5.040	2.286	xxx	xxx
elstorm	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
stwind	xxx	xxx	xxx	xxx	xxx	xxx	0.984	0.264
hotday	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	-0.604	0.179
sncover	xxx	xxx	xxx	xxx	-0.266	0.051	-0.189	0.031

coef.=estimated coefficients

s.e.=standard error of the coefficients

Radj.=adjusted R-squared

interc.=the intercept term

Appendix 2b cont.

	Galut		Tarag		Chandman-Undur		Aldarhaan	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Radj.	0.977		0.973		0.928		0.971	
interc.	33.817	11.059	-15.181	13.631	249.244	28.561	60.408	5.544
time	0.959	0.098	-0.276	0.235	-1.608	0.326	0.895	0.089
tem1	-0.819	0.261	xxx	xxx	0.981	0.348	3.778	0.228
tem2	2.597	0.249	xxx	xxx	xxx	xxx	xxx	xxx
tem3	2.071	0.161	xxx	xxx	xxx	xxx	xxx	xxx
tem4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem5	1.964	0.426	xxx	xxx	12.304	1.462	-4.018	0.499
tem6	xxx	xxx	7.506	0.933	xxx	xxx	xxx	xxx
tem7	xxx	xxx	xxx	xxx	-12.459	1.929	xxx	xxx
tem8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem11	xxx	xxx	xxx	xxx	xxx	xxx	0.767	0.105
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	2.361	0.993	2.203	1.048	xxx	xxx
pre2	xxx	xxx	xxx	xxx	3.320	0.705	xxx	xxx
pre3	xxx	xxx	1.009	0.216	xxx	xxx	xxx	xxx
pre4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre5	-0.380	0.062	xxx	xxx	xxx	xxx	-0.561	0.046
pre6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre7	xxx	xxx	xxx	xxx	-0.375	0.036	xxx	xxx
pre8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre9	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre11	-1.113	0.181	-2.006	0.325	-1.915	0.260	xxx	xxx
pre12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	xxx	xxx	xxx	xxx	-7.705	0.992
wnd5	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd8	xxx	xxx	xxx	xxx	-50.876	5.177	4.896	0.679
wnd9	3.130	1.596	xxx	xxx	xxx	xxx	xxx	xxx
wnd10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev2	xxx	xxx	-34.436	5.788	xxx	xxx	71.671	5.307
sev3	9.932	4.064	-34.406	5.060	xxx	xxx	xxx	xxx
sev4	xxx	xxx	-10.639	6.066	69.163	9.339	xxx	xxx
sev10	28.903	5.552	43.208	10.155	xxx	xxx	xxx	xxx
sev11	xxx	xxx	16.103	4.347	-21.940	6.816	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	1.140	0.241	xxx	xxx	xxx	xxx	-0.430	0.152
ordsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
srain	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	1.404	0.193	xxx	xxx	0.393	0.060
stwind	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xxx	xxx	xxx	xxx	9.050	0.761
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sncover	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

temp=average monthly temperature (1 to 12 refer to months)

time=time trend

prec=average monthly precipitation (1 to 12 refer to months)

Appendix 2b cont.

	Tudevtei		Zuunf angai		Orhon		Teshig	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Radj.	0.930		0.937		0.937		0.974	
interc.	49.591	18.629	-84.436	22.731	45.417	6.420	11.734	12.056
time	-1.396	0.426	3.075	0.209	-0.216	0.105	0.279	0.163
tem1	xxx	xxx	xxx	xxx	-1.220	0.199	xxx	xxx
tem2	xxx	xxx	xxx	xxx	xxx	xxx	-1.383	0.164
tem3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem4	xxx	xxx	xxx	xxx	1.062	0.263	xxx	xxx
tem5	4.990	0.788	2.148	0.366	xxx	xxx	xxx	xxx
tem6	0.880	0.731	xxx	xxx	-2.803	0.432	xxx	xxx
tem7	xxx	xxx	xxx	xxx	xxx	xxx	-2.176	0.491
tem8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	-0.316	0.164	xxx	xxx	xxx	xxx
pre2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre5	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre6	xxx	xxx	xxx	xxx	xxx	xxx	0.104	0.014
pre7	xxx	xxx	xxx	xxx	xxx	xxx	-0.238	0.016
pre8	0.457	0.062	-0.210	0.037	xxx	xxx	xxx	xxx
pre9	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre11	-1.395	0.187	xxx	xxx	xxx	xxx	xxx	xxx
pre12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	18.215	3.770	xxx	xxx	xxx	xxx
wnd3	6.058	3.510	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	-13.657	3.843	xxx	xxx	xxx	xxx	xxx	xxx
wnd5	-17.950	3.286	xxx	xxx	xxx	xxx	xxx	xxx
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd9	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd10	-14.038	5.303	xxx	xxx	xxx	xxx	12.881	1.225
wnd11	xxx	xxx	19.011	2.696	xxx	xxx	3.547	1.310
wnd12	xxx	xxx	xxx	xxx	xxx	xxx	10.557	1.653
sev1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev2	xxx	xxx	xxx	xxx	8.552	3.011	xxx	xxx
sev3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev4	xxx	xxx	41.410	9.543	xxx	xxx	xxx	xxx
sev10	xxx	xxx	35.912	10.322	xxx	xxx	xxx	xxx
sev11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	1.015	0.278	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
srain	4.804	0.493	xxx	xxx	0.593	0.177	xxx	xxx
elstorm	xxx	xxx	-14.252	2.005	xxx	xxx	2.085	0.192
stwind	-3.372	2.080	-4.617	0.891	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xxx	xxx	1.281	0.266	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	0.159	0.015
sncover	xxx	xxx	xxx	xxx	-0.124	0.013	xxx	xxx

wnd=average monthly wind velocity (1 to 12 refer to months)

sev=severity index by months

Appendix 2b cont.

	Tosontsengel		Binde		Bayan		Undurshireet	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Radj.	0.948		0.977		0.972		0.976	
interc.	51.203	6.163	29.915	6.376	49.815	16.822	5.693	7.065
time	0.093	0.112	0.656	0.053	0.232	0.167	0.812	0.114
tem1	xxx	xxx	xx)	xxx	xxx	xxx	0.526	0.227
tem2	xxx	xxx	xx)	xxx	0.693	0.301	xxx	xxx
tem3	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
tem4	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
tem5	2.116	0.552	xx)	xxx	xxx	xxx	xxx	xxx
tem6	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
tem7	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
tem8	xxx	xxx	-4.478	0.378	-6.712	0.570	xxx	xxx
tem11	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
tem12	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
pre1	-1.242	0.313	xx)	xxx	xxx	xxx	xxx	xxx
pre2	0.856	0.338	xx)	xxx	xxx	xxx	xxx	xxx
pre3	-3.811	0.928	1.051	0.134	xxx	xxx	xxx	xxx
pre4	0.387	0.064	xx)	xxx	xxx	xxx	xxx	xxx
pre5	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
pre6	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
pre7	xxx	xxx	xx)	xxx	xxx	xxx	-0.036	0.013
pre8	xxx	xxx	0.057	0.009	0.297	0.024	xxx	xxx
pre9	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
pre10	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
pre11	xxx	xxx	-0.214	0.047	1.939	0.296	xxx	xxx
pre12	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
wnd1	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	7.153	0.772	xxx	xxx	xxx	xxx
wnd3	5.207	0.838	xx)	xxx	xxx	xxx	xxx	xxx
wnd4	-2.365	0.568	xx)	xxx	-11.958	1.109	xxx	xxx
wnd5	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
wnd6	2.217	1.054	xx)	xxx	xxx	xxx	10.329	1.869
wnd7	xxx	xxx	xx)	xxx	xxx	xxx	10.352	1.167
wnd8	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
wnd9	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
wnd10	xxx	xxx	-25.940	1.439	38.681	2.575	xxx	xxx
wnd11	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
wnd12	xxx	xxx	-13.619	0.492	xxx	xxx	10.610	0.980
sev1	xxx	xxx	xx)	xxx	xxx	xxx	-9.622	2.778
sev2	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
sev3	xxx	xxx	xx)	xxx	16.065	3.395	xxx	xxx
sev4	xxx	xxx	xx)	xxx	xxx	xxx	-15.663	4.449
sev10	xxx	xxx	91.303	5.136	-21.223	6.734	xxx	xxx
sev11	-32.865	3.242	18.620	2.518	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xx)	xxx	xxx	xxx	-6.641	1.185
srain	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
stwind	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xx)	xxx	0.343	0.051	-0.067	0.011
sncover	xxx	xxx	xx)	xxx	xxx	xxx	xxx	xxx

bsnow=the number of days with blowing snow storms

ordsnow=the number of days with ordinary snow storms

Appendix 2b cont.

	Hujirt		Altai		Bugat		Myangad	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Radj.	0.959		0.962		0.975		0.980	
interc.	43.066	10.415	1.173	6.803	-69.137	12.214	-25.576	9.586
time	1.210	0.197	0.310	0.198	-0.178	0.106	-0.867	0.143
tem1	xxx	xxx	xxx	xxx	1.464	0.166	0.921	0.089
tem2	xxx	xxx	xxx	xxx	-2.866	0.244	xxx	xxx
tem3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem4	xxx	xxx	0.716	0.373	xxx	xxx	xxx	xxx
tem5	xxx	xxx	xxx	xxx	-3.627	0.469	xxx	xxx
tem6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem7	xxx	xxx	xxx	xxx	12.464	0.740	3.800	0.344
tem8	xxx	xxx	xxx	xxx	xxx	xxx	2.607	0.462
tem11	xxx	xxx	-1.414	0.300	xxx	xxx	-1.410	0.179
tem12	2.283	0.234	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	xxx	xxx	2.942	0.619	xxx	xxx
pre2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre3	1.955	0.219	xxx	xxx	xxx	xxx	xxx	xxx
pre4	xxx	xxx	1.374	0.250	-0.395	0.164	xxx	xxx
pre5	-0.163	0.073	xxx	xxx	xxx	xxx	xxx	xxx
pre6	xxx	xxx	xxx	xxx	xxx	xxx	0.150	0.020
pre7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre9	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre11	-0.720	0.236	xxx	xxx	xxx	xxx	-2.167	0.211
pre12	2.222	0.278	xxx	xxx	xxx	xxx	-1.125	0.221
wnd1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	-10.137	1.681	xxx	xxx	xxx	xxx
wnd3	7.840	1.413	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd5	-10.126	1.095	xxx	xxx	xxx	xxx	xxx	xxx
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd8	xxx	xxx	xxx	xxx	7.413	1.211	-11.658	1.431
wnd9	xxx	xxx	xxx	xxx	xxx	xxx	-9.587	1.022
wnd10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev1	xxx	xxx	xxx	xxx	-50.174	4.361	xxx	xxx
sev2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev3	xxx	xxx	20.74	4.508	xxx	xxx	xxx	xxx
sev4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev10	31.735	6.289	xxx	xxx	xxx	xxx	xxx	xxx
sev11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xxx	xxx	-21.958	1.858	xxx	xxx
srain	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
elstorm	-0.258	0.094	-0.615	0.244	xxx	xxx	xxx	xxx
stwind	xxx	xxx	-1.411	0.149	xxx	xxx	xxx	xxx
hotday	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	0.504	0.208	xxx	xxx	xxx	xxx
sncover	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

srain=the number of days with continuous slight rains

elstorm=the number of days with electric storms

Appendix 2b cont.

	Umnugobi		Bulgan		Saintsagaan		Bayandelger	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Radj.	0.921		0.964		0.932		0.938	
interc.	22.164	22.853	-79.134	14.984	148.527	42.474	-43.715	15.864
time	0.807	0.215	1.057	0.139	1.200	0.325	-0.151	0.129
tem1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem2	-0.689	0.233	xxx	xxx	xxx	xxx	xxx	xxx
tem3	xxx	xxx	xxx	xxx	xxx	xxx	1.949	0.262
tem4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem5	xxx	xxx	3.960	0.522	-2.492	1.298	xxx	xxx
tem6	-1.364	0.783	xxx	xxx	xxx	xxx	2.324	0.626
tem7	5.966	0.877	xxx	xxx	xxx	xxx	xxx	xxx
tem8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem11	xxx	xxx	xxx	xxx	xxx	xxx	-1.318	0.374
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	-1.511	0.195	xxx	xxx	xxx	xxx
pre2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre3	xxx	xxx	xxx	xxx	-1.708	0.428	-1.101	0.165
pre4	0.436	0.243	xxx	xxx	xxx	xxx	xxx	xxx
pre5	xxx	xxx	0.460	0.377	xxx	xxx	xxx	xxx
pre6	0.063	0.043	xxx	xxx	xxx	xxx	0.288	0.037
pre7	xxx	xxx	-0.143	0.034	xxx	xxx	xxx	xxx
pre8	xxx	xxx	xxx	xxx	-0.406	0.066	xxx	xxx
pre9	xxx	xxx	xxx	xxx	0.339	0.107	xxx	xxx
pre10	xxx	xxx	xxx	xxx	xxx	xxx	-0.374	0.106
pre11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre12	-3.335	0.459	xxx	xxx	xxx	xxx	1.261	0.485
wnd1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	xxx	xxx	xxx	xxx	xxx	xxx	-6.232	1.787
wnd3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	xxx	xxx	-9.717	1.718	xxx	xxx
wnd5	xxx	xxx	xxx	xxx	8.703	2.023	xxx	xxx
wnd6	25.400	2.989	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd8	xxx	xxx	xxx	xxx	xxx	xxx	11.929	1.913
wnd9	-7.736	1.488	xxx	xxx	xxx	xxx	xxx	xxx
wnd10	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	4.215	2.547	xxx	xxx
wnd12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev1	xxx	xxx	21.715	5.495	xxx	xxx	xxx	xxx
sev2	xxx	xxx	-18.343	6.301	xxx	xxx	xxx	xxx
sev3	xxx	xxx	xxx	xxx	-49.118	6.966	xxx	xxx
sev4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev10	xxx	xxx	57.417	8.388	xxx	xxx	xxx	xxx
sev11	-85.221	12.579	xxx	xxx	xxx	xxx	xxx	xxx
sev12	xxx	xxx	xxx	xxx	xxx	xxx	9.045	3.051
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
srain	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
stwind	xxx	xxx	xxx	xxx	0.417	0.149	xxx	xxx
hotday	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sncover	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx

stwind=the number of days with storm winds

hotday=the number of hot days

Appendix 2b cont.

	Bulgan		Halhgol		Asgat		Bayanovoo	
	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.	Coef.	s.e.
Radj.	0.925		0.972		0.967		0.951	
interc.	147.490	24.469	100.599	8.194	91.244	14.202	159.913	18.601
time	1.340	0.191	0.227	0.112	0.914	0.149	0.176	0.113
tem1	xxx	xxx	1.860	0.175	1.758	0.334	xxx	xxx
tem2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem4	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem5	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
tem8	xxx	xxx	xxx	xxx	xxx	xxx	-3.978	0.668
tem11	xxx	xxx	xxx	xxx	-3.630	0.419	xxx	xxx
tem12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre2	xxx	xxx	xxx	xxx	7.988	0.733	xxx	xxx
pre3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre4	xxx	xxx	xxx	xxx	xxx	xxx	-0.266	0.063
pre5	-0.635	0.133	xxx	xxx	xxx	xxx	xxx	xxx
pre6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre7	xxx	xxx	xxx	xxx	xxx	xxx	0.156	0.017
pre8	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
pre9	xxx	xxx	xxx	xxx	xxx	xxx	-0.078	0.035
pre10	xxx	xxx	0.326	0.033	xxx	xxx	xxx	xxx
pre11	-5.592	0.662	0.705	0.093	-4.071	0.507	xxx	xxx
pre12	xxx	xxx	xxx	xxx	5.868	0.720	xxx	xxx
wnd1	-4.514	2.165	xxx	xxx	xxx	xxx	xxx	xxx
wnd2	19.617	2.573	3.751	0.586	xxx	xxx	xxx	xxx
wnd3	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd4	xxx	xxx	xxx	xxx	xxx	xxx	8.287	1.273
wnd5	xxx	xxx	-5.961	0.336	xxx	xxx	-10.404	1.831
wnd6	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd7	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd8	7.533	1.644	xxx	xxx	xxx	xxx	xxx	xxx
wnd9	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd10	-10.884	2.935	xxx	xxx	xxx	xxx	xxx	xxx
wnd11	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
wnd12	xxx	xxx	xxx	xxx	-10.897	1.508	xxx	xxx
sev1	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev2	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sev3	xxx	xxx	xxx	xxx	-56.750	4.387	xxx	xxx
sev4	-83.580	9.475	xxx	xxx	xxx	xxx	-47.317	5.348
sev10	xxx	xxx	-10.416	3.505	28.870	7.469	15.160	4.175
sev11	xxx	xxx	xxx	xxx	xxx	xxx	-8.046	2.221
sev12	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
bsnow	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
ordsnow	-5.243	1.116	-6.560	0.343	xxx	xxx	xxx	xxx
srain	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
elstorm	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
stwind	xxx	xxx	-1.021	0.240	xxx	xxx	xxx	xxx
hotday	-0.508	0.173	xxx	xxx	xxx	xxx	xxx	xxx
sndepth	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
sncover	xxx	xxx	xxx	xxx	0.201	0.036	xxx	xxx

shdepth=snow depth

sncover=the duration of snow cover

Appendix 3a Weather Variability of the Natural Growth Rate by Agro-Ecological Sub-Regions (Cattle)

Year	Hangai	Bulnai	South Hangai	Huvsgul	Western Hangai	Selenge	Hentii	Ulz-Tuul	Central	Harhira	South	Menen	Herlen- ganga	Basin of	Great	Umnu- gobi	Galtai	Gobi	Galbin	
1969	-3.465	-4.140	-10.370	-29.230	6.510	-1.180	-10.320	-23.763	-27.730	0.205	-28.400	-10.555	3.783	-4.040	9.040	-16.570	-2.523	-13.660		
1970	0.295	-6.510	-2.690	-2.370	8.037	-4.107	-2.480	2.500	9.920	1.970	-1.160	-11.180	-2.137	-2.220	10.725	-0.640	-3.547	-8.340		
1971	-3.310	-6.590	-3.590	-2.290	5.297	-5.583	4.740	-3.717	3.015	0.890	-2.030	-29.660	-1.977	0.220	7.590	-3.340	-14.267	-14.725		
1972	-1.005	-0.360	7.497	-1.450	9.817	3.467	-7.440	15.310	3.500	5.160	3.200	24.095	10.173	-3.530	6.455	6.090	0.047	-1.650		
1973	10.870	5.270	4.467	0.680	2.800	2.180	2.800	2.567	2.280	2.055	1.720	14.520	0.002	0.050	7.205	2.610	21.487	16.560		
1974	5.425	3.110	-0.173	6.160	9.033	7.587	-0.710	12.280	1.100	7.010	1.360	14.470	14.610	32.970	28.295	-3.060	17.287	18.510		
1976	-1.255	-4.350	6.423	-3.440	1.503	2.987	2.560	7.760	-10.365	-6.105	-3.510	7.395	8.250	-5.240	-5.445	6.490	10.653	1.440		
1977	-2.155	-16.790	4.390	-11.400	1.963	-1.937	1.330	-13.573	-10.745	0.190	-10.760	7.175	-4.063	2.540	9.015	16.340	9.393	2.225		
1978	-0.880	-4.630	2.463	4.270	0.667	3.333	3.160	0.987	-9.275	-2.620	-5.630	1.175	4.513	0.840	9.030	-0.270	10.433	6.615		
1980	0.660	2.790	-1.017	4.620	1.850	-3.493	-17.190	-1.527	4.865	3.995	9.100	-9.345	-11.470	-25.960	-17.655	1.260	-2.153	-1.780		
1981	-1.140	3.650	-4.520	2.990	-9.943	0.330	3.600	3.287	6.660	4.385	3.400	-24.885	4.863	7.740	6.310	-1.300	8.510	5.875		
1982	0.290	-3.380	1.213	-9.730	-10.883	-0.830	3.230	-0.610	5.555	-1.880	-0.860	5.215	-4.610	1.890	3.030	-0.770	4.453	1.300		
1983	-4.005	-0.310	-11.653	0.630	-1.610	0.293	1.100	-7.253	0.665	-3.720	-8.440	-1.250	-12.853	-8.990	-0.700	-5.000	-18.830	-15.260		
1984	-0.730	4.520	-2.300	2.740	-3.247	-2.783	-3.030	-0.780	8.745	-1.365	-7.390	1.350	-1.477	1.050	5.465	-2.420	3.610	9.595		
1985	-1.605	0.250	-5.000	1.980	-2.190	-3.750	-10.730	2.137	10.790	3.210	14.180	1.845	-2.690	-5.560	-2.815	-0.980	6.090	8.415		
1986	1.440	7.480	6.440	4.550	-1.927	-1.683	7.560	7.823	8.435	-0.205	7.160	8.840	-1.207	0.710	4.905	-6.150	-1.707	6.580		
1987	0.745	10.240	6.477	7.520	-1.647	-0.843	4.580	0.053	9.355	-0.755	5.660	-7.220	-2.080	2.730	6.455	-3.070	7.857	5.990		
1988	-0.745	2.950	-11.100	4.930	-7.420	1.790	0.810	-6.513	1.500	-0.205	7.700	0.265	-2.887	1.910	3.560	4.590	2.323	6.895		
1989	0.545	10.230	5.900	7.180	-3.363	2.443	10.570	1.060	3.705	-6.015	9.660	6.525	-1.880	0.460	0.190	9.180	2.370	8.435		
1990	0.020	7.110	7.143	11.650	-6.267	0.783	12.560	0.957	-21.975	-7.085	8.490	1.215	-6.857	2.510	2.030	-4.010	-8.513	-9.905		
st. dev.	3.269	6.652	6.291	8.860	6.003	3.254	7.317	8.600	10.647	3.874	9.506	12.854	7.109	10.321	8.566	6.725	11.409	9.933		
min	-4.005	-16.790	-11.653	-29.230	-10.883	-5.583	-17.190	-23.763	-27.730	-7.085	-28.400	-29.660	-12.853	-25.960	-17.655	-16.570	-31.487	-16.560		
max	10.870	10.240	7.497	11.650	9.817	7.587	12.560	15.310	10.790	7.010	14.180	24.095	14.610	32.970	28.295	16.340	17.287	18.510		

Appendix 3b Weather Variability of the Natural Growth Rate (Small Stock)

Year	Hangai		Hangai		Selenge		Hentii		Ulz-Tuul		Central		Harhira		South		Menen		Herlen-		Basin of Gobi-		Umnu-		Galbiin	
	South	Hangai	South	Hangai	South	Hangai	South	Hangai	Altai	Turgen	Altai	Steppe	Dari-	Huh	Great	Altai	Umnu-	gobi	Gobi							
1969	16.970	-5.170	3.257	-60.730	7.230	-2.467	-10.460	6.800	-2.340	1.810	-29.830	7.950	5.617	-9.780	-4.235	-7.187	13.860	-3.795								
1970	13.105	-2.240	-3.803	-6.560	5.083	-2.127	4.930	-1.657	-3.755	1.800	0.910	-11.140	0.983	-6.860	-2.050	-5.847	0.270	4.125								
1971	6.895	-4.020	-7.363	-31.100	0.297	-3.347	-5.250	-2.837	-7.990	-5.285	-6.740	-26.745	2.643	1.830	-0.965	-8.157	-10.580	7.505								
1972	5.445	2.410	-1.437	-17.560	2.520	-3.457	-3.530	-2.387	-9.165	-1.055	4.790	21.200	1.490	-5.140	-5.420	-3.527	21.160	-3.855								
1973	14.800	-11.910	2.587	4.600	1.180	2.887	0.660	2.252	0.200	5.520	1.720	12.525	5.020	2.820	1.570	21.072	2.220	2.800								
1974	8.515	2.710	1.493	10.030	9.380	3.497	9.600	8.743	0.850	5.310	9.380	0.760	3.370	13.680	11.220	5.313	36.540	5.520								
1976	-1.405	-14.240	-4.247	-7.080	-5.020	-12.210	2.950	-9.313	-6.340	-8.070	6.810	-2.050	5.463	-5.860	-13.335	7.827	-0.620	-5.535								
1977	-11.775	-8.010	1.317	-12.650	-15.570	-4.283	7.360	-22.007	-6.850	-2.780	-4.940	-6.085	0.840	1.310	-0.905	-0.693	6.070	-9.350								
1978	5.610	9.810	7.293	6.300	10.333	4.757	17.280	4.627	1.555	3.310	9.250	8.165	9.373	15.000	7.165	10.157	13.740	6.020								
1980	-2.570	2.810	-1.823	12.870	-6.833	-4.150	-8.250	1.033	3.135	11.440	5.850	-10.245	-24.403	-22.740	-13.175	-8.693	-14.310	-0.315								
1981	2.720	8.190	4.350	16.830	-8.760	4.673	5.600	8.953	3.795	11.205	5.820	2.505	2.010	12.340	4.100	-1.187	9.410	4.295								
1982	3.130	-2.340	-0.233	1.280	0.657	3.847	-1.060	5.360	7.435	15.885	4.230	12.135	-2.693	-0.670	-3.990	2.750	2.420	0.635								
1983	-11.295	-6.290	-25.807	8.970	-5.777	0.433	-3.160	-14.603	-4.010	-3.125	-15.990	-1.985	-18.753	-14.290	-17.685	-12.173	-38.770	-6.845								
1984	-12.920	2.720	-5.627	-0.450	-7.413	-1.927	-4.570	-1.810	7.600	10.880	1.400	-1.585	-6.680	-2.680	-4.220	1.530	13.400	-3.125								
1985	-14.820	-9.430	-4.757	-14.930	-3.467	-4.567	-18.290	-1.217	6.785	12.290	6.360	2.655	3.730	0.350	-6.070	-2.980	-9.470	-1.560								
1986	-5.460	11.630	13.653	3.610	2.190	0.510	15.590	9.733	7.395	16.675	8.500	8.525	6.217	9.500	1.750	6.957	5.320	3.225								
1987	-3.450	7.550	11.117	6.300	3.997	2.203	5.440	2.967	4.165	17.485	1.460	-8.970	5.520	3.950	-0.455	12.363	4.350	-9.675								
1988	-1.540	-13.270	-17.090	28.360	6.147	12.590	-14.560	-6.453	-3.355	16.720	-22.040	-16.020	3.173	-3.510	-9.720	5.970	-16.270	4.855								
1989	-4.930	20.330	16.707	21.630	2.860	5.857	0.770	7.007	0.975	15.125	7.360	7.565	2.623	6.690	-2.145	13.090	-10.860	4.785								
1990	-7.025	8.760	9.430	30.190	0.967	3.053	0.260	3.817	-41.415	16.870	5.690	0.825	-5.440	4.090	-3.605	5.563	-22.370	-0.995								
st. dev.	9.3365	9.2929	9.9527	20.988	6.6499	5.2827	9.1163	8.2047	10.684	8.3901	10.851	11.139	8.3641	9.4301	6.9076	8.8412	16.742	5.2779								
min	-14.82	-14.24	-25.807	-60.73	-15.57	-12.21	-18.29	-22.007	-41.415	-8.07	-29.83	-26.745	-24.403	-22.74	-17.685	-21.073	-38.77	-9.675								
max	16.97	20.33	16.707	30.19	10.333	12.59	17.28	9.7333	7.6	17.485	9.38	21.2	9.3733	15	11.22	13.09	36.54	7.505								

Appendix 5a Accounting for growth in the NGR of cattle

Year	Whole			Hangai-Huvsgul			Orhon-Selenge			Altai			Steppe			The Gobi Desert		
	NGR	CTG	CTC	NGR	CTG	CTC	NGR	CTG	CTC	NGR	CTG	CTC	NGR	CTG	CTC	NGR	CTG	CTC
1976	19.689	0	0	19.750	0	0	19.110	0	0	20.172	0	0	20.010	0	0	19.651	0	0
1977	19.678	-0.012	0.138	19.511	-0.239	0.137	19.351	0.240	0.135	20.228	0.056	0.141	20.217	0.207	0.141	19.506	-0.146	0.137
1978	17.056	-2.633	0.223	20.256	0.506	0.239	20.043	0.933	0.235	10.036	-10.137	0.192	12.582	-7.428	0.204	19.566	-0.085	0.235
1980	20.445	0.756	0.346	20.569	0.819	0.362	19.671	0.561	0.353	21.202	1.030	0.319	21.197	1.187	0.331	20.060	0.408	0.355
1981	20.672	0.982	0.490	20.684	0.934	0.507	20.584	1.473	0.497	21.207	1.035	0.467	21.121	1.111	0.479	20.143	0.491	0.496
1982	20.953	1.263	0.658	20.891	1.141	0.674	21.007	1.897	0.665	22.980	2.807	0.651	20.966	0.956	0.647	20.026	0.375	0.656
1983	21.149	1.460	0.848	21.624	1.874	0.869	22.056	2.946	0.864	21.118	0.946	0.841	20.548	0.538	0.831	20.276	0.625	0.839
1984	21.486	1.796	1.063	21.675	1.925	1.085	22.361	3.250	1.087	22.026	1.853	1.061	21.139	1.130	1.043	20.518	0.867	1.044
1985	22.167	2.477	1.307	22.684	2.934	1.335	23.532	4.421	1.346	23.477	3.304	1.320	20.786	0.776	1.272	20.843	1.191	1.273

1. NGR=Natural Growth Rate predicted by the model (4.9)

2. CTG=Cumulated Total Growth

CTG in year t was calculated using the formula:

$$CTG_t = (NGR_t - NGR_{t-1}) + CTG_{t-1}$$

3. CTC=Cumulated Technical Change

CTC in year t was calculated using the formula:

$$CTC_t = (TC_t + TC_{t-1})$$

where TC=technical change in a given year

Technical Change in year t was calculated using the formula:

$$TC_t = TC_{t-1} + [(0.002 + 0.001t) * NGR_t]$$

where: $(0.002 + 0.001t) * NGR_t$ = derivative of model (4.9) with respect to time (t)

4. Regional data were calculated as an average of each region

Appendix 5b Accounting for growth in the NGR of the small stock

Year	Whole			Hangai-Huvsgul			Orhon-Selenge			Altai			Steppe			The Gobi Desert		
	NGR	CTG	CTC	NGR	CTG	CTC	NGR	CTG	CTC	NGR	CTG	CTC	NGR	CTG	CTC	NGR	CTG	CTC
1976	33.404	0	no	32.162	0	no	33.688	0	no	34.499	0	no	30.267	0	no	35.937	0	no
1977	33.878	0.474	no	33.122	0.960	no	33.670	-0.018	no	35.998	1.498	no	31.902	1.634	no	35.024	-0.913	no
1978	34.342	0.938	no	32.541	0.379	no	34.481	0.794	no	35.178	0.679	no	33.978	3.710	no	36.358	0.421	no
1980	35.061	1.657	no	33.700	1.538	no	35.598	1.911	no	36.698	2.199	no	33.208	2.941	no	36.508	0.572	no
1981	35.374	1.970	no	34.444	2.282	no	35.440	1.752	no	34.980	0.481	no	34.235	3.967	no	37.324	1.387	no
1982	35.866	2.462	no	35.161	2.999	no	35.796	2.108	no	35.237	0.738	no	34.271	4.004	no	38.012	2.076	no
1983	36.217	2.814	no	35.918	3.756	no	36.347	2.659	no	34.974	0.475	no	36.310	6.042	no	37.077	1.140	no
1984	36.079	2.675	no	35.726	3.564	no	36.131	2.444	no	35.568	1.069	no	37.266	6.999	no	36.148	0.211	no
1985	35.707	2.303	no	35.368	3.206	no	36.628	2.940	no	34.660	0.161	no	38.169	7.901	no	34.692	-1.245	no

1. NGR=Natural Growth Rate predicted by the model (4.9)

2. CTG=Cumulated Total Growth

CTG in year t was calculated using the formula:

$$CTG_t = (NGR_t - NGR_{t-1}) + CTG_{t-1}$$

3. Regional data were calculated as an average of each region

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