THE STUDY FOR IMPROVEMENT PLAN OF LIVESTOCK
FARMING SYSTEM IN RURAL AREA
FINAL REPORT

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Abbreviations and Acronyms

ADB	Asian Development Bank
A.S.L	Above Sea Level
COMECON	Council for Mutual Economic Assistance
GDP	Gross Domestic Product
GIS	Geographic Information System
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit (German Technical Cooperation Enterprise)
JICA	Japan International Cooperation Agency
MFA	Ministry of Food and Agriculture
NAMHEM	National Agency for Meteorology, Hydrology, and Environment Monitoring
NGO	Non Governmental Organization
O/M	Operation and Maintenance
PCM	Project Cycle Management
PO	Plan of Operation
PDM	Project Design Matrix
PRSP	Poverty Reduction Strategy Paper
RRA	Rapid Rural Appraisal
s.u.	Sheep Unit
TEM	Time Domain Electromagnetic method (Transient Electromagnetic Method)
TDS	Total Dissolved Solid
Tg	Togrogs : Mongolian Currency
UNDP	United Nations Development Programme
USGS	United States geological Survey
WHO	World Health Organization

Mongolian Term

Aimag	A following administrative unit of country : Province
Soum	A following administrative unit of *Aimag* : District
Bag	A following administrative unit of *Soum*, but it has only a governor as staff. : Village
Dzud	It means climatic condition issues lots of died livestock in winter or early spring by cold or snow. or it also means such situation, too.
Khot Aile	Minimum unit of pastoral farming in Mongolia, consist of a few families.
Ger	A tent house normally used in Mongolia. It consists of felt sheets in Gobi zone.
Otor	Migration. It means both one is long-term migration from winter/spring camp and the other is a short trip for several days to feeding.
Negdel	Agriculture cooperative in Socialist era.
Khorshoo	Genetic term of "Cooperative" at present.

CHAPTER 1 INTRODUCTION

1.1 BACKGROUND OF THE STUDY AND OBJECTIVES OF THE STUDY

In Mongolia, the Agricultural sector employed 40% of the labor force and contributed 21% to GDP as of 2004. Approximately 80% of agricultural production came from the livestock products sub-sector. In 2004, livestock products (mainly cashmere, wool, etc.) accounted for about 5 % of all exports.

The calamity of "*Dzud*" occurred continuously in the period 1999 and 2000, causing loss of about 10% of the livestock every year that died from hunger or frost. The total number of livestock that died from this calamity reached 5.75 million heads, and as a consequence, agricultural output dropped by about 30%.

In order to mitigate the damage from *Dzud*, the Government of Mongolia decided to implement "The National Programme To Protect the Livestock From Drought and *Dzud*" and intended to implement construction, rehabilitation and maintenance of wells. Various projects of these action plans have already been carried out by World Bank and/or UNDP.

Under these circumstances, the Government of Mongolia (hereinafter referred to as "GOM") made a request to the Government of Japan (hereinafter referred to as "GOJ") to extend its technical cooperation for the construction and rehabilitation of wells in order to improve the rural water supply in 7 *Aimags* (provinces) of Gobi and Steppe zone. GOJ, however, considered that the content of this request only for construction and rehabilitation of wells would not be adequate to mitigate the damage of *Dzud*. Therefore, GOJ proposed to modify the Study plan to suit a comprehensive study plan that was initiated for the purpose of pasture management system, with consideration of regulations for pastoral livestock and the improvement of well management system.

Basically GOM accepted this idea and made a request to GOJ for (i) the formulation of this comprehensive plan aiming at the establishment of a pasture management system incorporated with the construction, rehabilitation and management of wells, as well as (ii) technical skill transfer to counterparts and concerned personnel.

1.2 METHOD OF THE STUDY

First of all, methods and measures shall be clearly explained that are effective to contribute to ascertain the causal correlation of factors leading to *Dzud* and reduce the damage by *Dzud*. Then systematic pasture use plan and well improvement plan shall be studied so as to be effective to reduce damage by *Dzud*.

Effectiveness of the projects shall be confirmed through specific Pilot Projects. Therefore, selection of the Pilot Projects is very important in the Study. These Pilot Projects shall be monitored and evaluated, and outcomes gained through this process shall be guidelines when similar projects would be carried out in Mongolia, which is an aim of the Study.

Since both of the Study to identify the projects effective to reduce the damage by *Dzud* and the Study to select the areas suitable for the Pilot Project to be implemented have to be studied in parallel to select the Pilot Project, the Study was carried out through the following three phases;

- Phase 1: Formulation of General Plan in the three *Aimags*

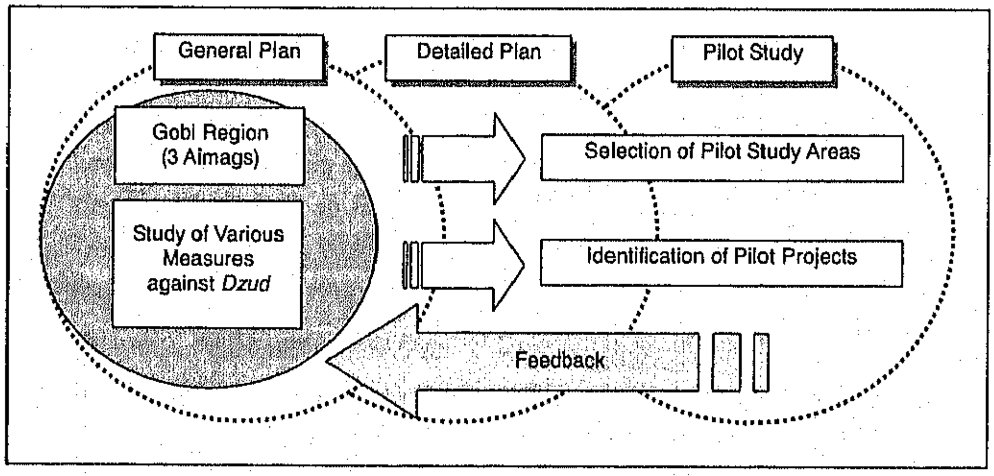
  Formulation of the general plan for Improving the Livestock Farming System in rural areas was carried out for the Study area of the three *Aimags* of *Dundgobi*, *Dornogobi*, and *Umnugobi* which are located in the Gobi-Steppe region in the southern part of Mongolia. Through the Study, *Dornogobi Aimag* was selected for the detailed study area.

- Phase 2: Formulation of Detailed Plan for *Dornogobi Aimags*

  Formulation of the detailed plan for Improving the Livestock Farming System in rural areas was carried out for *Dornogobi Aimag*. Through the Study, three *Soums* of *Erdene*, *Ulaanbadrakh* and *Khuvsgul* were selected as the Pilot Study areas. In addition, the Pilot Projects were identified and policy of implementing was planned.

- Phase3: Pilot Study in *Soums*

  The Pilot Study has been carried out over about two years. Outcome of the Pilot Study gained through a sequence of these studies was fed back to the General Plan, and this report summarizes the results of these outcomes.



1.3 STUDY AREA

The Study area consists of the three *Aimags* of *Dornogobi*, *Dundgobi*, and *Umnugobi*, that are located in the Gobi and Steppe zone of the southern part of Mongolia.

1.4 REPORTS DELIVERED THROUGH THE STUDY

No.	Title	Submittal Time	Contents
1	Inception Report	March, 2003	Description of Policy of the Study
2	Interim Report (1)	August, 2003	General Plan
3	Progress Report (1)	December, 2004	Description of Policy of the Detailed Plan
4	Interim Report (2)	January, 2004	Detailed Plan
5	Progress Report (2)	July, 2004	Description of Start-up plan of the Pilot Study
6	Progress Report (3)	December, 2004	Description of Midterm Evaluation (1) and Monitoring of the Pilot Study
7	Progress Report (4)	September, 2005	Description of Midterm Evaluation (2) and Monitoring of the Pilot Study
8	Draft Final Report	January, 2006	Description summarized based on the result of the above mentioned studies

CHAPTER 2 ACTUAL CONDITION OF STUDY AREA

2.1 GENERAL CONDITION

The Study area consists of the three *Aimags* (provinces) of *Dornogobi*, *Dundgobi*, and *Umnugobi*, where are located in the Gobi and Steppe zone of the southern part of Mongolia, with area of 349,600 km^2 and population of about 150,000. The outline of the area is as follows:

- Low population density

  The population density of Mongolia is extremely low. *Umnugobi* has the lowest density for a populated *Aimag* in Mongolia, with one family living in an area of 3.6 km on average.

Table 2.1.1 General Information of the Study Area

Name of *Aimag*	Name of *Aimag* Center	Number of *Soum*	Number of *Bag*	Area (1,000 km^2)	Population (1,000)	Density (person /km^2)	Number of Household (1,000)	Distance from Capital (km)
Dornogobi	*Sainshand*	14	57	109.5	52.5	0.48	13.3	450
Dundgobi	*Mandagobi*	15	64	74.7	49.9	0.67	12.5	275
Umnugobi	*Dalanzadgad*	15	53	165.4	46.8	0.28	12.5	575
Country		340	1,662	1,564.1	2,533.1	1.62	596.4	-

Source: Mongolian Statistical Yearbook 2004

- Extremely severe weather conditions

  Because the temperature varies widely from 25°C or more in summer, to -20 °C in winter, the yearly average temperature is about 0 °C. Although the amount of the rainfall is relatively low as an inland area, it rains in proportion to the altitude of the region, so that there is about 300 mm a year in the northern part of Mongolia and about 100 mm in the Study Area.

- Number of livestock per household exceeded the country average and smaller number of herder households

  The average number of livestock owned by one household was about 214 heads in 2004, one of the largest in the country which was more than the country average of about 166 heads. On the other hand, the number of herder households of the *Khot Aile* 2 to 3 in the Gobi region, which is fewer than the country average of 3 to 4 households.

Table 2.1.2 Number of Livestock and Herder Households

2004	Number of Livestock (1000 heads)	Number of herder Households	Livestock per Household (head)
Dundgobi	1,781	7,803	228
Dornogobi	1,019	3,936	259
Umnugobi	1,070	6,313	169
Country	28,028	169,024	166

Source: Mongolian Statistical Yearbook 2004

2.2 NATURAL CONDITIONS

2.2.1 CLIMATE

The difference between maximum temperature in summer and minimum temperature in winter in three *Aimags* is as large as 80°C. As for precipitation, the annual value is so related to elevation that it reaches more than 200 mm/year in a limited area of the Altai Mountains; however, it is about 120 to 160 mm in the other areas. Precipitation is 70 to 120 mm in summer which is roughly equivalent to 80% of annual precipitation.

Table 2.2.1 Climate Features in Study Area

	Annual Average Precipitation (mm)	Max. Temperature °C	Min. Temperature °C	Annual Average Temperature in Jan. °C	Annual Average Temperature in Jul. °C
Dundgobi	156.0	35.6	-38.3	-17.5	18.7
Dornogobi	116.7	40.8	-41.8	-17.8	22.8
Umnugobi	127.1	37.5	-36.5	-14.9	21.1

Source: Mongolian Statistical Yearbook 2001

Based on the trend of annual precipitation in each station (shown in Fig. 2.2.1) there is no common trend; however, all values were markedly low after 1999, so it may be guessed that large *Duzd* disaster occurred because of low pasture production.

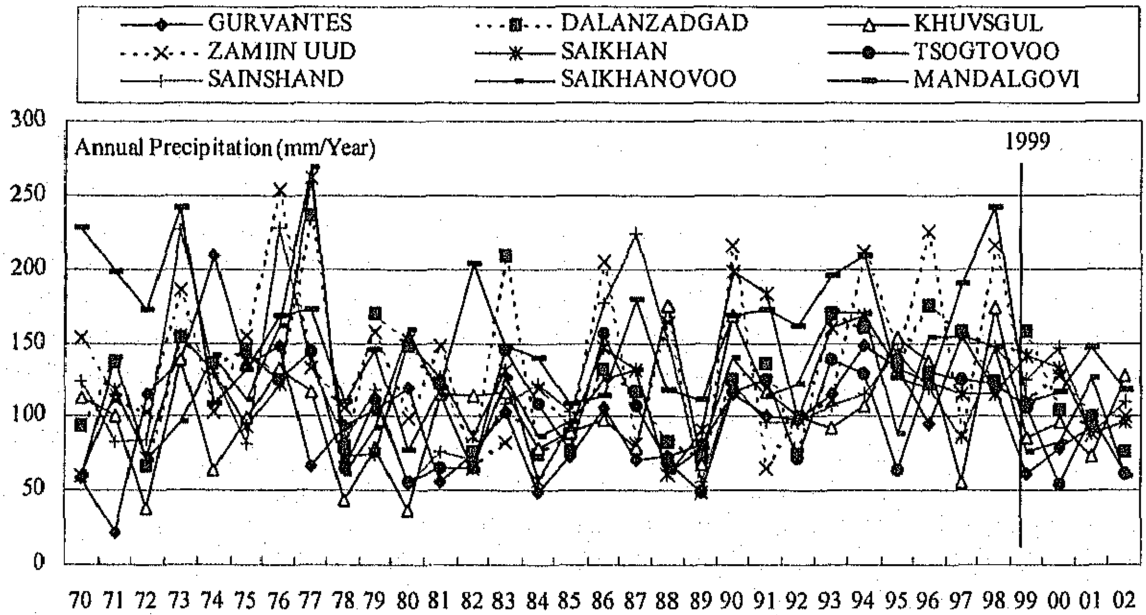


Fig. 2.2.1 Annual Precipitation in the Study Area

2.2.2 TOPOGRAPHY

Mongolia is entirely a mountainous country. The elevation range is from 4,374 m A.S.L of the Altai Mountains to 552 m A.S.L in the southern part of the Gobi, with the average 1,580 m. Nine big rivers are located in the northern part of Mongolia, but there is no rivers in the Gobi. Topography of the Study Area is illustrated in Fig.2.2.2.

Mountain areas or plateaus in three *Aimags* consist of igneous rocks mainly composed of granitic rocks or well consolidated Paleozoic sedimentary rocks and metamorphic rocks, and flat-lowlands are composed of cretaceous or quaternary non-marine sedimentary rocks formed in the continental basin. The figure which presents the distribution of faults and springs implies that many springs have fissure type groundwater because of their alignment. Concentration of springs around the Altai Mountains in *Umnugobi* seems to originate in considerably plentiful rainfall and melting snow.

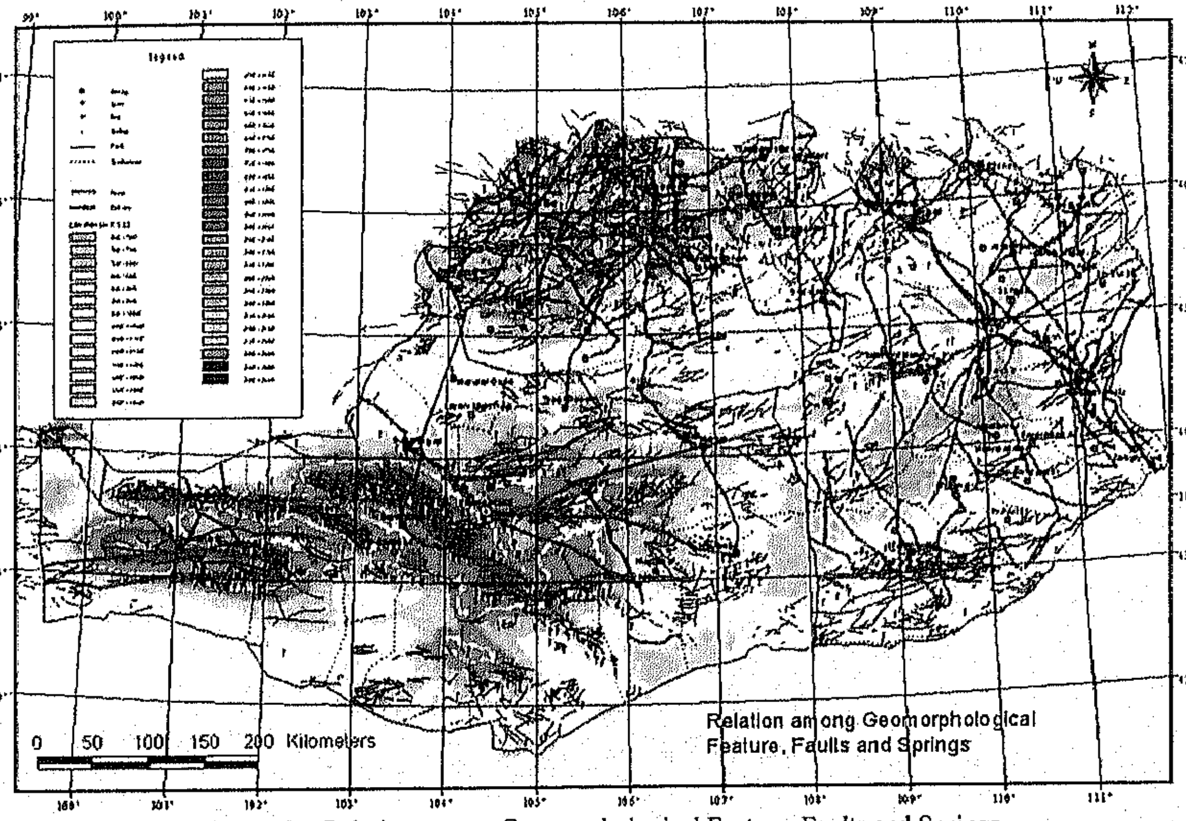


Fig. 2.2.2 Relation among Geomorphological Feature, Faults and Springs
(Source: USGS, Geological Map of Mongolia)

2.2.3 GEOLOGY

(1) Outline of Geology

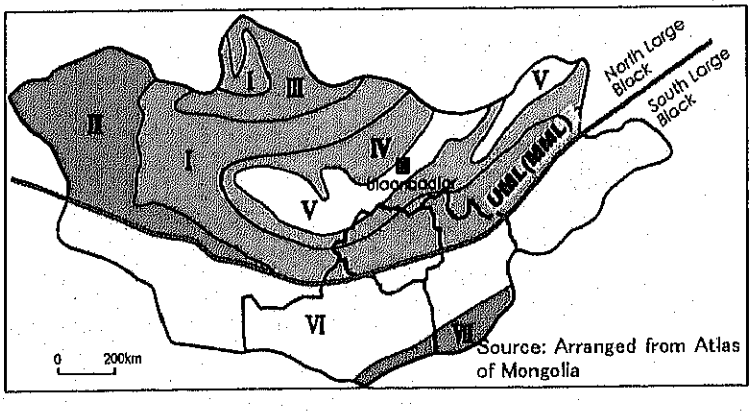


Fig.2.2.3 Geological Structure of Mongolia

The basic geological structure of Mongolia was formed in the Paleo-Asian Sea that was situated between the Siberian Platform in the north and Tarim-North China Block in the south from the late Precambrian to the early Mesozoic by the gathering and scattering of micro continents (small mass of continental crust) and sedimentation and igneous activity coming up with it. (*Tseden* et al.(1992))

The geological structure of Mongolia which consists of the North Block and the South Block is divided by the geological tectonic line called Ural-Mongolia Lineament (UML) or Mongolia Main Lineament (MML) as shown in Fig. 2.2.3. The most of the Study Area belongs to the South Block, the northern part of *Dornogobi* and almost of *Dundgobi* belong to the North Block.

(2) Geology in the Study Area

The geology of *Dornogobi Aimag* is illustrated in Fig.2.2.4 as editing of the Geological Map of Mongolia (1:1,000,000). T The cretaceous distributes in the Study Area which belongs to the South Block including the studded Precambrian to Paleozoic formations. On the other hand, igneous rocks mainly composed of granitic rocks are widely outcropped in northern part of *Dundgobi* and the southern part of *Dornogobi*. The Carboniferous and Devonian in the Paleozoic are distributed in the Altai Mountains in *Umnugobi*, the northeastern part of *Umnugobi* and the western part of the central *Dornogobi*. The faults in them nearly run along MML. The younger formations after the Cretaceous which are regarded as the main aquifer the Study Area cover the flat lowlands in three *Aimag*. In particular, the quaternary is widely developed in *Umnugobi*.

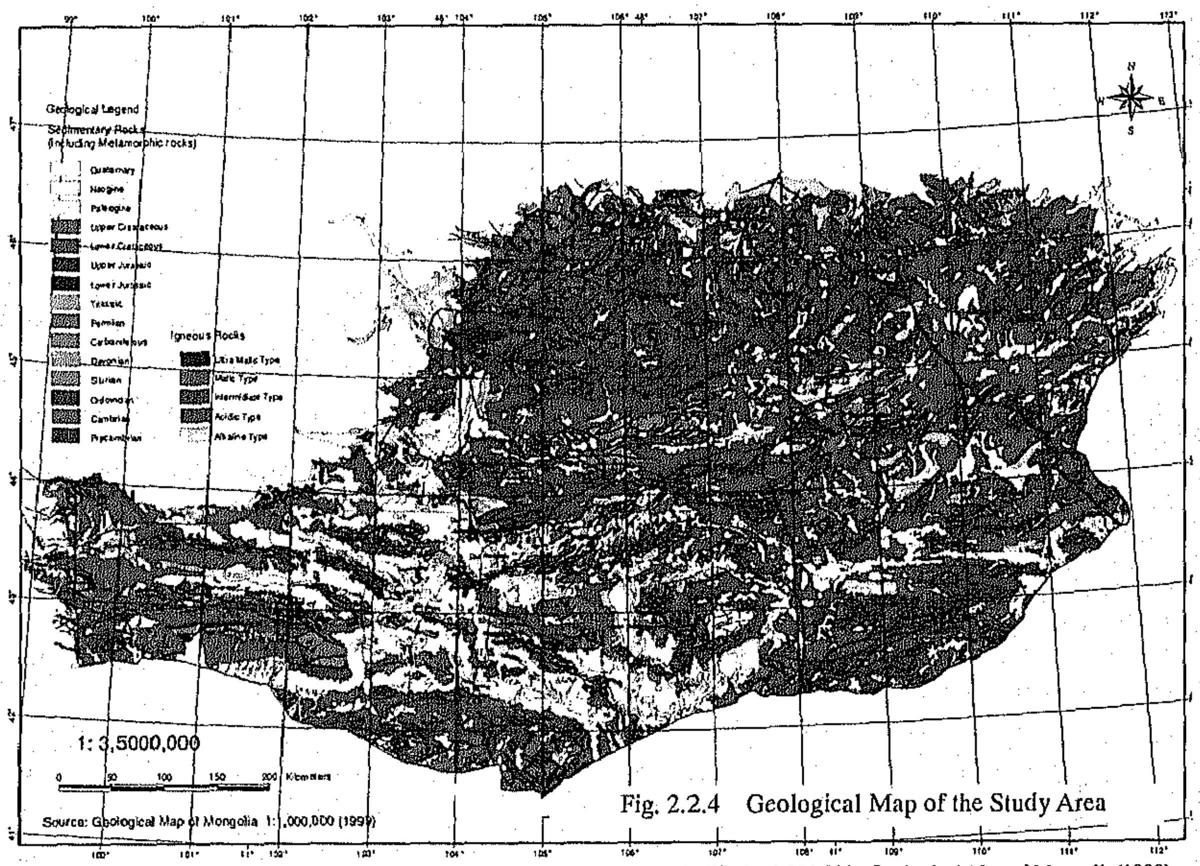


Fig. 2.2.4 Geological Map of the Study Area

Source: Modified 1:1,000,000 Geological Map of Mongolia(1999)

2.2.4 HYDROGEOLOGY

(1) Outline of Hydrogeology

In general, groundwater aquifers can be divided into two types: Granular Aquifer and Fissure Aquifer. The former coincides with the Cretaceous distributed in the low lands of the Study Area and the latter coincides with the Paleozoic or igneous rocks in various geological ages in mountainous or hilly area. The Quaternary beds along wadis are also important as the Granular Aquifer as well as the Cretaceous.

The aquifer types in the Study Area are categorized below.

Granular Type

1) Fluvial deposits, mountain basin deposits, fan deposits
2) Weathered surface deposits on plains
3) Cretaceous sandstone and conglomerate

Fissure Type

4) Fissures and weathered part of Paleozoic sedimentary rocks and igneous rocks

Total number of wells in the Study Area in 2000 amounts to more than 10,000. Traditional Wells which account for approximately 75% of them were mainly dug into aquifer types 1) or 2). According to the Hydrogeological Map of Mongolia (1996), an artesian zone of aquifer type 3) is distributed in *Dornogobi.*

In general, the water quality in three *Aimags* of the Study Area is bad; average TDS of each *Aimag* is 710 mg/*l* in *Umnugobi*, 1,373 mg/*l* in *Dornogobi* 2,240 mg/*l* in *Dundgobi* by water resource database obtained by Institute of Geoecology. Most exceed the WHO's Drinking Water Standard of 1,500 mg/*l* except for *Umnugobi*. On the other hand, Average withdrawal volume is 2.48 *l*/sec in *Umnugobi*, 2.43 l/sec in *Dornogobi* and 1.5 *l*/sec in *Dundgobi*. *Umnugobi* has more than 500 springs which is different from other *Aimags* that have more or less only 100 springs.

(2) Hydrogeological Features of Study Area

The well database of whole Mongolia was created in 1996 by UNDP. JICA improved the well database of three *Aimags* adding new data in 2000. Hydrogeological analysis in this study was done on the basis of this database.

Table 2.2.2 shows actual conditions of the well in three *Aimags* and Fig.2.2.5 shows range of drilling depth by well type. For two types of engineering wells (Production Wells and Shallow Wells), rate of usable wells is low (7% - 24%); moreover, well construction has recently stopped. In general, the aquifer of Shallow Wells is unconfined shallow aquifer that belongs mainly to the Quaternary and the aquifer of deep wells is confined deep aquifer that belongs to the Cretaceous or igneous rocks in variable geological ages.

Table 2.2.2 Actual Condition of Wells in Three *Aimags*

		Dundgobi	*Umnugobi*	*Dornogobi*
Total number of wells		About 3,700	About 3,700	About 2,800
Area covered by one well (km^2)		20.3	44.5	39.1
Production Well	Number	437	357	321
	Usable rate	16.2% (71)	23.8% (85)	18.1% (58)
	Rate possible to rehabilitate	36.6%	35.6%	About 60%
	Construction date	Mainly 70's to 80's	Mainly 70's to 80's	Mainly 70's to 80's
Shallow Well	Number	285	469	85
	Usable rate	7.4%	23.2%	7.4%
	Rate possible to rehabilitate	61.4%	31.3%	64.7%
	Construction date	Mainly 70's to 80's	About 70% in 80's	Starting from 60's and concentrating in 80's
Shaft Well	Number	About 1,500	About 900	1,068
	Usable rate	About 80%	17.7%	36.4%
	Rate possible to rehabilitate		About 60%	About 60%
	Construction date	Continuously from 60's to 90's	Continuously from 60's to 90's	Continuously till 80's. More than 100 wells even in 90's.
Traditional Well	Number	About 1,500	About 2,000	About 1,300
	Water quality (Salinity)	Salinity is probably high in 33% of wells.	Salinity is probably high in 37% of wells.	Salinity is probably high in 37% of wells.

(*Structure and its features by each well type are referred to " 2.5.3 Water Supply Facilities for Livestock")

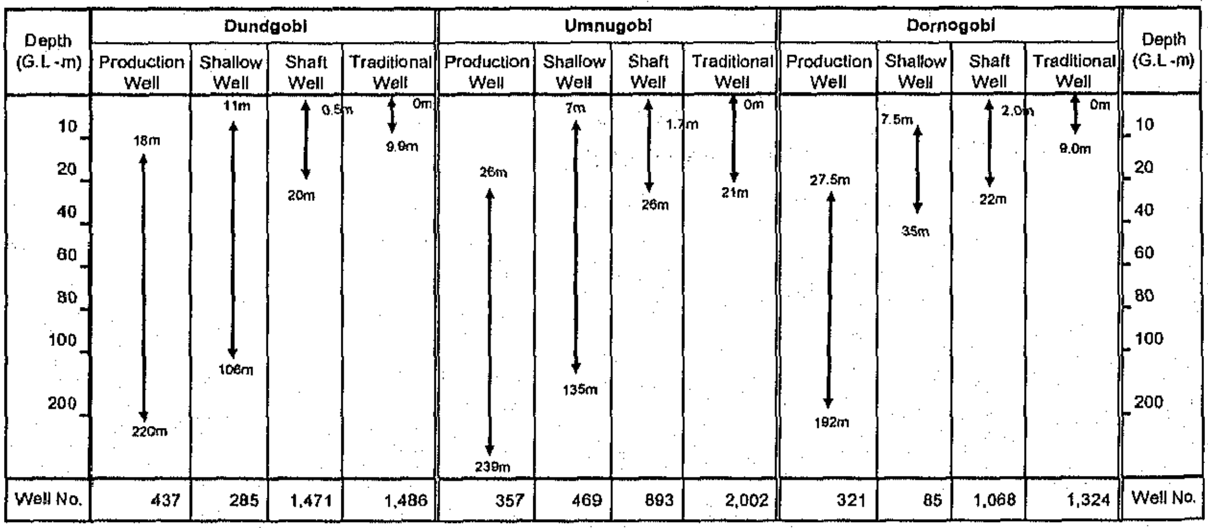


Fig. 2.2.5 Range of Drilling Depth by Well Type

Source: "Technical Report on the Distribution of Livestock and the Pastureland Capacity," JICA, 2000

(3) Investigation of Water Resources

In order to investigate water resources, the time domain electromagnetic method (also called Transient Electromagnetic Method or TEM) was introduced to measure the underground resistivity. Then data to describe the geological and hydro-geological structure was obtained.

TEM method has several advantages over convenient electrical and electromagnetic methods as follows:

i) Sensitive to the difference of underground resistivity.
ii) No need to increase the transmitter-receiver separation for the deep sounding.
iii) For the deeper sounding, it is necessary to measure over a period of time, and this can be done through the increase of the transmitter currents and increase the number of the averaging time to improve the S/N ratio.
iv) The influence of the near surface structures and the terrain are not significant for the deeper sounding.
v) The measurements are carried out without direct contact to the earth, and can be used in the desert and in the area covered with rocks where the set up of the electrodes is difficult.
vi) Measurement is rapid and efficient.

Summary of the 215 investigated points and its location are shown in Table 2.2.3 and Fig. 2.2.6. List of estimated drilling depth to aquifer of 215 points is shown in Table 2.2.5. The investigated points, which are 215 in the whole *Aimag*, were selected in consideration of request from each *Soum*, points to supplement blank of the present data among the unused pasture, and confirmation of the well depth dug in the Pilot Study.

Out of 215 points, the drilling depth to the aquifer of 159 points (74%) could be estimated and the distribution of the depth is shown in Table 2.2.4. Range of the depth of 70 to 140 meter occupies 75% and the one below 60 meter occupies only 16%, which implies that drilling depth of the well should be deeper in the future.

Table 2.2.3 Investigated Points and Its Possibility

Name of *Soum* (Abbreviation of *Soum*)	Investigated points	High Possibility	Possibility	Uncertain	low possibility, not enough data
Airag (AR)	14		5	8	1
Altanshiree (AS)	11		4	4	3
Dalanjargalan (DJ)	11		2	5	4
Delgerekh (DG)	10		6	2	2
Erdene (ER)	29	2	8	17	2
Ikhet (IH)	10		1	6	3
Khatanbulag (KT)	17		3	9	5
Khuvsgul (KV)	21		2	8	11
Mandakh (MD)	18		4	8	6
Saihandulaan (SD)	13		1	10	2
Sainshand (SS)	9		3	4	2
Urgun (OR)	11		3	5	3
Ulaanbadrakh (UL)	38		7	19	12
Zaminuud (ZU)	3		2	1	
Total	215	2	51	106	56

Table 2.2.4 Distribution of Estimated Drilling Depth to Aquifer

Depth (m)	No.	Ratio (%)
< 30m	7	4.3%
40～60m	19	11.7%
70 ～80m	32	19.8%
90～100m	43	26.5%
120～140m	46	28.4%
150～160m	14	8.6%
200m <	1	0.6%
Total	162	

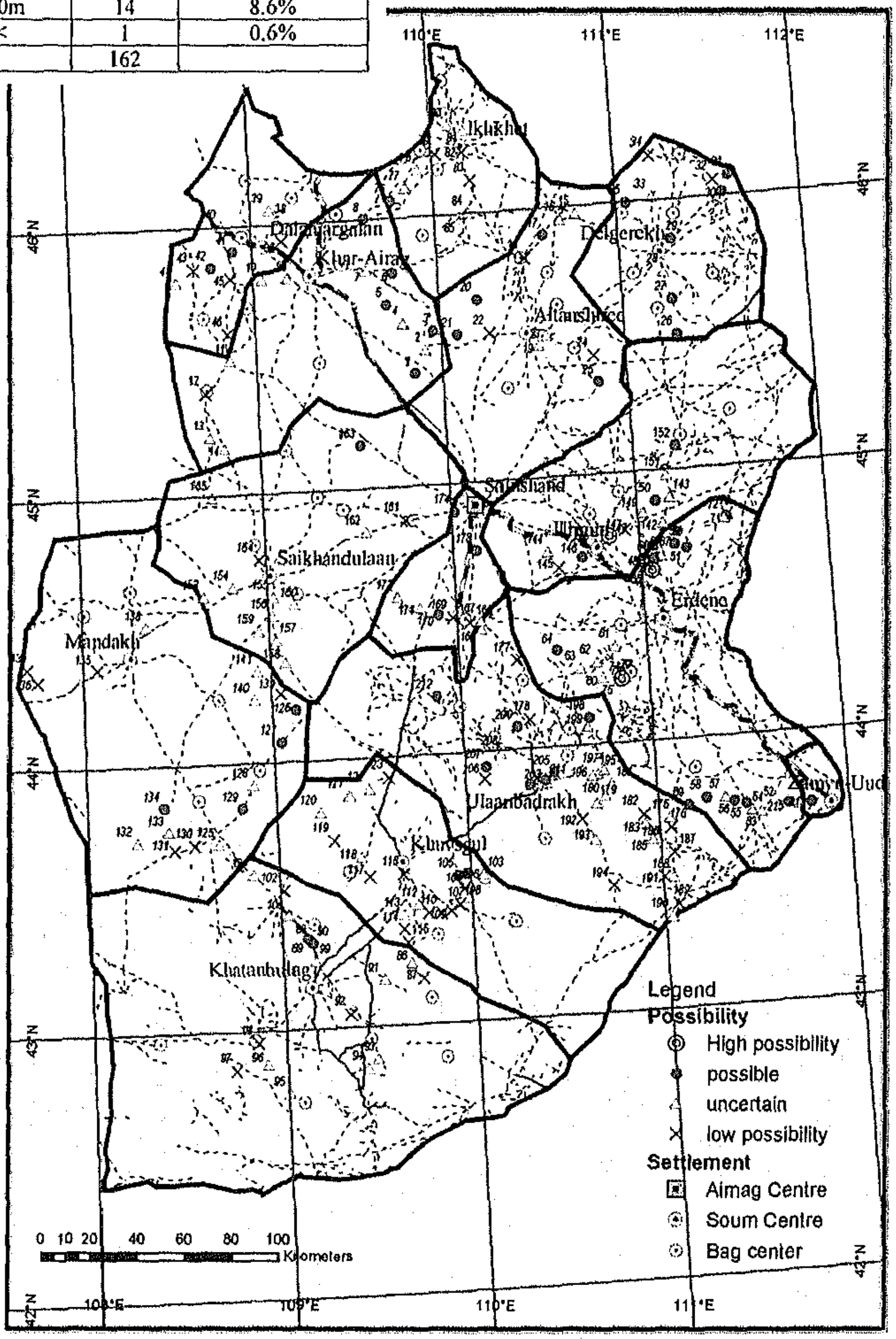


Fig. 2.2.6 Location Map of Water Resource Potential Investigation

Table 2.2.5 List of Estimated Drilling Depth to Aquifer (1/2)

No.	Station	N.L(deg)	E.L(deg)	Level(m)	Depth(m)	Possibility
1	AR-1290	45.41577	109.84779	1002	120	O
2	AR-1300	45.50202	109.91034	952	60	Δ
3	AR-1310	45.57269	109.95946	956	100	O
4	AR-1320	45.60673	109.79776	986	100	Δ
5	AR-1330	45.67798	109.71126	980	150	O
6	AR-1340	45.79464	109.75520	968	120	O
7	AR-1350	45.80947	109.61151	1004	100	Δ
8	AR-1360	46.00076	109.61222	1019	150	O
9	AR-1560	45.79727	109.18378	1085	120	Δ
10	AR-1570	45.79624	109.04978	1169	150	Δ
11	AR-1600	45.50096	108.85896	1124	160	Δ
12	AR-1610	45.38073	108.71236	1093		×
13	AR-1620	45.21745	108.72394	1062	80	Δ
14	AR-1630	45.17483	108.80409	1061	80	Δ
15	AS-2030	45.97090	110.77431	1096	160	Δ
16	AS-2040	45.95161	110.69037	1052	100	Δ
17	AS-2050	45.89861	110.59255	1007	100	O
18	AS-2060	45.81926	110.47957	993		×
19	AS-2070	45.49346	110.52796	953	40	Δ
20	AS-2080	45.67658	110.20752	989	100	O
21	AS-2090	45.55143	110.09147	955	120	O
22	AS-2100	45.54868	110.27207	979		×
23	AS-2110	45.52497	110.57530	983	40	Δ
24	AS-2120	45.43994	110.82436	934		×
25	AS-2130	45.34032	110.84201	868	120	O
26	DG-1930	45.49876	111.27565	1042	100	SO
27	DG-1940	45.63009	111.26016	1024	80	SO
28	DG-1950	45.73328	111.22646	1026	100	Δ
29	DG-1960	45.85282	111.27922	1055	100	SO
30	DG-1970	46.01311	111.57266	1074	90	SO
31	DG-1980	46.07287	111.61214	1011	80	SO
32	DG-1990	46.05884	111.52845	1048		S×
33	DG-2000	46.01160	111.19482	1134	80	SΔ
34	DG-2010	46.16322	111.19580	1137		S×
35	DG-2020	45.99789	111.05508	1133	50	SO
36	DJ-1470	45.93481	109.16516	1075		×
37	DJ-1480	45.97883	109.20371	1086	70	Δ
38	DJ-1490	46.01164	109.14083	1120	140	Δ
39	DJ-1500	46.05443	109.10210	1202	160	Δ
40	DJ-1510	46.00291	108.83917	1255	140	Δ
41	DJ-1520	45.90620	108.89645	1155	80	O
42	DJ-1530	45.85021	108.77189	1167	100	O
43	DJ-1540	45.84236	108.67837	1157		×
44	DJ-1550	45.79877	108.58083	1068	90	Δ
45	DJ-1580	45.80573	108.88030	1179		×
46	DJ-1590	45.59979	108.85516	1145		×
47	ER-0010	44.62754	111.05519	961	10	S◎
48	ER-0020	44.64559	111.01901	994		×
49	ER-0030	44.68233	111.10766	988	120	Δ
50	ER-0040	44.71986	111.18008	1029	100	O
51	ER-0050	44.70417	111.24231	1030	40	O
52	ER-0090	43.72466	111.62914	977	80	Δ
53	ER-0100	43.70649	111.53719	992	100	Δ
54	ER-0110	43.71369	111.48649	1000	80	Δ
55	ER-0120	43.74010	111.45738	990	30	O
56	ER-0130	43.75191	111.39532	969	100	O
57	ER-0140	43.77062	111.35000	968	60	Δ
58	ER-0150	43.77118	111.24839	976	60	O
59	ER-0160	43.75015	111.15708	956	50	O
60	ER-0190	44.24123	110.75658	1009	80	Δ
61	ER-0200	44.35530	110.83398	959	100	Δ
62	ER-0210	44.30254	110.73004	944	150	Δ
63	ER-0220	44.28337	110.64594	949	100	Δ
64	ER-0230	44.35368	110.52750	907	140	O
65	ER-0830	44.62875	111.03007	964	30	SΔ
66	ER-0840	44.66927	111.06823	970	30	SO
67	ER-0850	44.68517	111.06794	981	30	SΔ
68	ER-0860	44.71062	111.09529	1004	50	Δ
69	ER-0890	44.62878	111.03008	964	30	Δ
70	ER-1230	44.81661	111.47228	985	80	×
71	ER-1240	44.81000	111.46550	986	80	O
72	ER-1250	44.80617	111.45301	987	80	SΔ
73	ER-1260	44.23984	110.88066	978	40	Δ
74	ER-1270	44.23525	110.85834	979	40	◎
75	ER-1280	44.22518	110.83969	981	50	Δ
76	IH-1370	46.06362	109.76788	1033	60	O
77	IH-1380	46.10723	109.85073	1039	80	SΔ
78	IH-1390	46.17094	109.91777	1104	100	Δ
79	IH-1400	46.22690	110.02536	1123		×
80	IH-1410	46.33096	110.10093	1139	140	Δ
81	IH-1420	46.30499	110.18875	1151	120	SΔ
82	IH-1430	46.22539	110.17935	1191		×
83	IH-1440	46.11935	110.21283	1090		S×
84	IH-1450	46.00010	110.19016	1001	140	SΔ
85	IH-1460	45.90217	110.13861	962	200	SΔ
86	KT-0560	43.22977	109.66804	1143	80	Δ
87	KT-0570	43.16826	109.72135	1172		S×
88	KT-0660	43.32575	109.14496	1134	100	O
89	KT-0670	43.33569	109.12690	1038	100	O
90	KT-0680	43.31945	109.15570	1042	100	O
91	KT-0690	43.17115	109.51801	1141	120	Δ
92	KT-0700	43.04772	109.33932	1194		×
93	KT-0710	42.87893	109.46916	1104	120	Δ
94	KT-0720	42.84591	109.41402	1093	100	Δ
95	KT-0730	42.76506	109.00510	1057	140	Δ
96	KT-0740	42.87445	108.89870	1098	80	SΔ
97	KT-0750	42.85499	108.73361	1088		×
98	KT-0760	42.95474	108.85501	1091		×
99	KT-0770	43.25285	109.16827	1103	140	Δ
100	KT-0780	43.34882	109.12663	1009	100	Δ
101	KT-0790	43.42767	109.03862	925	100	Δ
102	KT-0800	43.51946	109.01751	913		×
103	KV-0430	43.54240	110.06734	1036	100	Δ
104	KV-0440	43.55040	109.98175	1089	100	O
105	KV-0450	43.54411	109.93232	1029	120	O
106	KV-0460	43.49511	109.96100	1047		×
107	KV-0470	43.46151	109.98184	1043	120	Δ
108	KV-0480	43.43786	109.93532	1089		×
109	KV-0490	43.41307	109.88774	1101		×
110	KV-0500	43.40680	109.83378	1074		S×
111	KV-0510	43.40976	109.76596	1071		×
112	KV-0520	43.44433	109.71422	1044	100	Δ
113	KV-0530	43.40774	109.64200	1097	50	Δ
114	KV-0540	43.35599	109.63401	1128		×
115	KV-0550	43.30510	109.65081	1111		S×
116	KV-0580	43.55874	109.64900	953		×
117	KV-0590	43.55643	109.46974	910		×
118	KV-0600	43.63149	109.43038	918	100	Δ
119	KV-0610	43.69723	109.29289	847		×
120	KV-0620	43.80567	109.22846	804	100	Δ
121	KV-0630	43.86202	109.38267	856	100	Δ
122	KV-0640	43.88337	109.48847	869	100	Δ
123	KV-0650	43.92129	109.59188	869		×

Depth : Estimated drilling depth to the aquifer

Possibility :
- ◎ : high possibility
- O : possible
- Δ : uncertain
- × : low possibility, not enough data
- S : possible shallow well

Table 2.2.5 List of Estimated Drilling Depth to Aquifer (2/2)

No.	Station	N.L(deg)	E.L(deg)	Level(m)	Depth(m)	Possibility
124	MD-0810	43.58310	108.86394	832	100	△
125	MD-0820	43.70110	108.68613	851	120	△
126	MD-0990	44.19017	109.11983	810	150	○
127	MD-1000	44.07352	109.04321	821	100	○
128	MD-1010	43.91861	108.88402	786	140	△
129	MD-1020	43.83240	108.82251	834	140	○
130	MD-1030	43.69924	108.55824	932		×
131	MD-1040	43.68350	108.45243	972	80	×
132	MD-1050	43.71745	108.25657	870	140	△
133	MD-1060	43.75494	108.42644	949	100	△
134	MD-1070	43.84385	108.40498	919	120	○
135	MD-1080	44.36618	108.07262	1348		×
136	MD-1090	44.32548	107.76176	1206		×
137	MD-1100	44.37442	107.70785	1230		×
138	MD-1110	44.52091	108.34164	1270	120	△
139	MD-1180	44.25353	109.04837	873		×
140	MD-1190	44.23474	108.90819	884	140	△
141	MD-1200	44.34187	108.92783	926	140	△
142	OR-0870	44.80111	111.12604	990	40	△
143	OR-0880	44.89644	111.17121	942	80	△
144	OR-0900	44.72202	110.50854	968	80	△
145	OR-0910	44.65830	110.56385	997		×
146	OR-0920	44.69508	110.69307	977	100	○
147	OR-0930	44.76536	110.84341	967	80	◎
148	OR-0940	44.78439	110.92590	974		×
149	OR-0950	44.84209	111.02969	952	100	△
150	OR-0960	44.88526	111.09775	939	150	○
151	OR-0970	44.97893	111.16095	1005	120	△
152	OR-0980	45.08507	111.21780	975	150	○
153	SD-1120	44.62496	108.65646	1225	50	△
154	SD-1130	44.65656	108.82022	1155	80	△
155	SD-1140	44.61556	109.03228	1170	120	△
156	SD-1150	44.54440	109.02140	1090	150	△
157	SD-1160	44.45256	109.03794	952	140	△
158	SD-1170	44.36684	109.07835	902	150	△
159	SD-1210	44.49025	108.94566	1019	140	△
160	SD-1220	44.58255	109.13837	1085	30	S△
161	SD-1720	44.87328	109.75420	961		×
162	SD-1730	44.83680	109.53896	993	140	△
163	SD-1740	45.16102	109.53146	907	80	○
164	SD-2140	44.75245	108.96537	1193		×
165	SD-2150	44.99251	108.72224	1073	100	△
166	SS-0240	44.45324	110.13110	706	80	△
167	SS-1640	44.48255	110.12911	736	100	△
168	SS-1650	44.47671	110.06995	748		×
169	SS-1660	44.50087	109.97713	808		×
170	SS-1670	44.51665	109.89864	882	140	○
171	SS-1680	44.54346	109.80523	952	80	△
172	SS-1690	44.58961	109.68955	1051	140	△
173	SS-1700	44.74361	110.12873	844	140	○
174	SS-1710	44.89427	110.02083	961	100	○
175	UL-0170	43.70858	111.05564	948	140	△
176	UL-0180	43.67236	111.06069	988		×
177	UL-0250	44.32742	110.30347	774		×
178	UL-0260	44.10521	110.35384	868		×
179	UL-0270	43.78094	110.68314	954	80	△
180	UL-0280	43.80543	110.72698	929	80	△
181	UL-0290	43.84726	110.76933	933	80	△
182	UL-0300	43.72628	110.92720	950		×
183	UL-0310	43.69050	110.92853	948	120	△
184	UL-0320	43.66403	110.95098	980	100	△
185	UL-0330	43.63043	110.96092	1013	140	△
186	UL-0340	43.61167	111.01958	1046	140	△
187	UL-0350	43.57801	111.06486	1052		×
188	UL-0360	43.48788	111.05722	1058	140	△
189	UL-0370	43.38633	111.07028	1031		×
190	UL-0380	43.34136	111.03717	1110	160	△
191	UL-0390	43.48937	111.01004	1070		×
192	UL-0400	43.72484	110.60471	963		S×
193	UL-0410	43.64656	110.66541	981	140	△
194	UL-0420	43.46840	110.74726	1171		×
195	UL-1750	43.88993	110.70059	984	140	△
196	UL-1760	43.88358	110.67188	963	140	△
197	UL-1770	43.90029	110.73123	1006	150	S△
198	UL-1780	44.09852	110.67365	992	140	S○
199	UL-1790	44.06642	110.66120	996	140	△
200	UL-1800	43.88737	110.37621	996		×
201	UL-1810	43.86531	110.33735	995	100	○
202	UL-1820	43.86330	-110.40494	968	80	△
203	UL-1830	43.87974	110.42311	985	80	○
204	UL-1840	43.88675	110.42322	1000	100	△
205	UL-1850	43.90400	110.47083	1003	40	S○
206	UL-1860	43.89612	110.10270	1042		×
207	UL-1870	43.94130	110.11324	990	140	○
208	UL-1880	43.98857	110.19515	969	80	△
209	UL-1890	44.08171	110.28637	874	60	○
210	UL-1900	43.90360	110.46883	993		×
211	UL-1910	43.86977	110.42842	985	100	△
212	UL-1920	44.21164	109.86819	722	60	○
213	ZU-0060	43.72935	111.79708	967	140	○
214	ZU-0070	43.72543	111.73767	962	80	△
215	ZU-0080	43.72979	111.68179	960	80	○

Depth : Estimated drilling depth to the aquifer
Possibility : ◎ : high possibility
○ : possible
△ : uncertain
× : low possibility, not enough data
S : possible shallow well

2.2.5 WATER QUALITY

(1) Groundwater Quality

The total dissolved solids (TDS) as a representative of water quality is an important factor for water quality standard, treatment cost for drinking water, productivity of livestock and agricultural crops, and so on. WHO prescribes TDS standard for drinking water is less than 1,000 mg/*l* (ppm). Table 2.2.6 serves as a useful reference for livestock water standards.

Table 2.2.6 TDS and Species Variation

Species	Total Dissolved Solids (ppm)				
	Excellent	Good	Fair	Poor	Limit
Humans	0-800	800-1,600	1,600-2,500	2,500-4,000	5,000
Horses, Working	0-1,000	1,000-2,000	2,000-3,000	3,000-5,000	6,000
Horses, Others	0-1,000	1,000-2,000	2,000-4,000	4,000-6,000	10,000
Cattle	0-1,000	1,000-2,000	2,000-4,000	4,000-6,000	10,000
Sheep	0-1,000	1,000-3,000	3,000-6,000	6,000-10,000	15,000
Chicken & Poultry	0-1,000	1,000-2,000	2,000-3,000	3,000-5,000	6,000
Swine	(Young pigs and marked pigs appear to tolerate less than cattle)				

Source:" Analysis of Water Quality for Livestock" (Utah State University, 1997)

Table 2.2.7 shows TDS extracted from the database of the three *Aimags*, which is controlled by Institute of Geoecology. More than about half water resources are beyond the standard of portable water. Data over 15,000 mg/*l* (ppm), which is limit value for sheep, is almost nil.

Table 2.2.7 TDS Distribution in Each *Aimag*

TDS (mg/*l*)	<1000	<3000	<6000	<10000	<15000	Over 15000	Total
Evaluation	Excellent	Good	Fair	Poor	Limit		
Dornogobi	272	166	28	6	2		474
Dundgobi	280	570	68	6			924
Umnugobi	186	102	12	3	2	1	306
Grand Total	738	838	108	15	4	1	1704

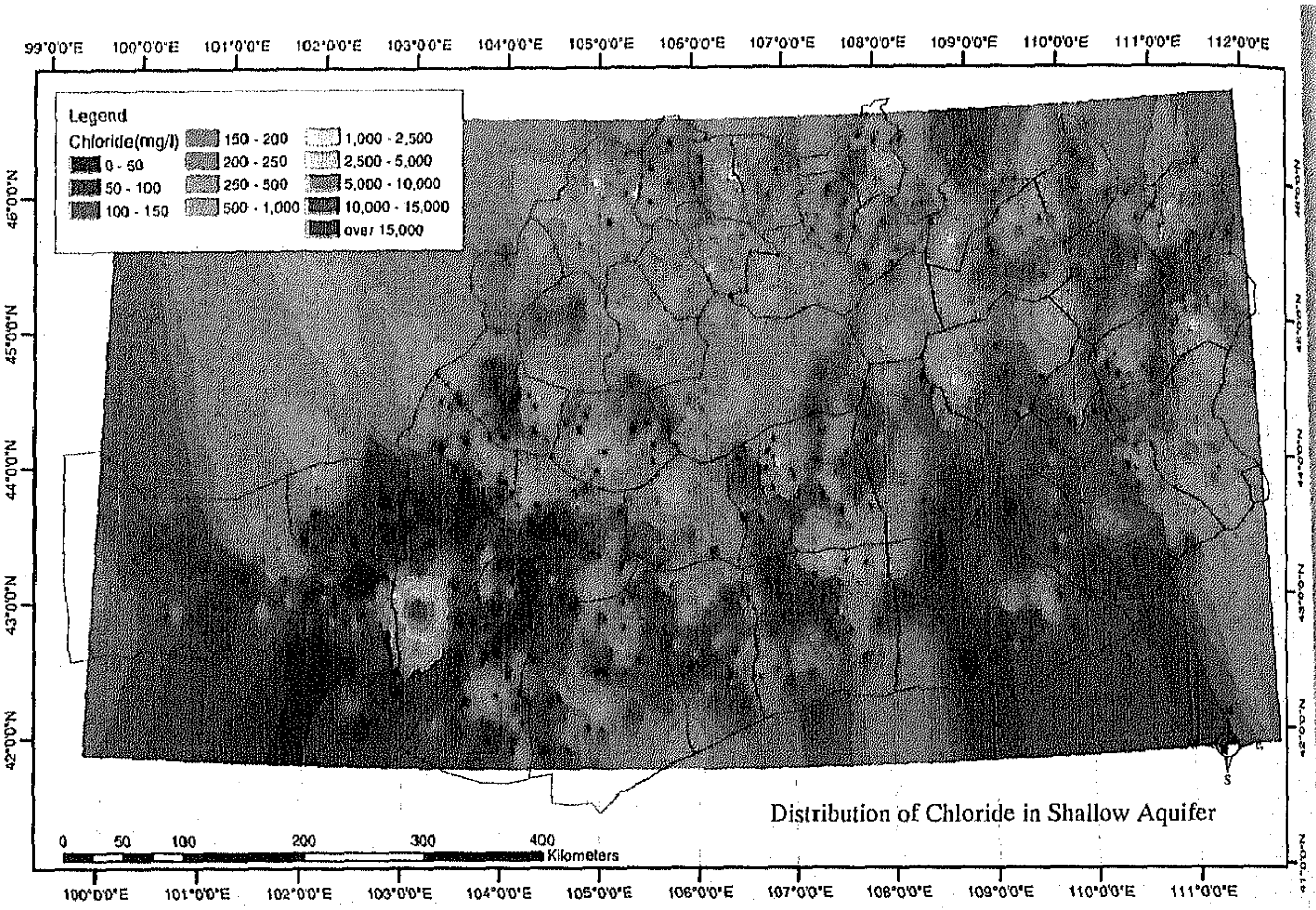
Since there is more chloride data than TDS data stored in the existing database, chloride was used for analysis of each aquifer. The standard of chloride for drinking water is less than 250mg/*l* in WHO's standards. According to the standards of groundwater quality for livestock in Wyoming (US), chloride should be less than 2,000 mg/*l* and TDS should be less than 5,000mg/*l*.

1) Shallow Aquifer

The areas where water quality is above 250 mg/*l* of the standard are spread over the central region of *Dundgobi Aimag*, and also found at the southeastern part of *Dornogobi Aimag* and the northern part of *Umnugobi Aimag*. On the other hand, better areas less than 50 mg/*l* are spread over the southwestern part of *Dornogobi Aimag* and the western part of *Umnugobi Aimag*.

2) Deep Aquifer

In general, water quality of the deep aquifer is worse than the shallow aquifer. Comparatively better quality areas are spread over the northeastern part of *Dundgobi Aimag*, the central lower part of *Dornogobi Aimag*, and around the *Gurvan Sayhan* mountains and *Huren Hanang* mountains, located in the central part of *Dornogobi Aimag* and the central part of *Umnugobi Aimag*; on the other hand, worse areas extend from the northeastern part *Dundgobi Aimag* to the southern part of *Dornogobi Aimag*.



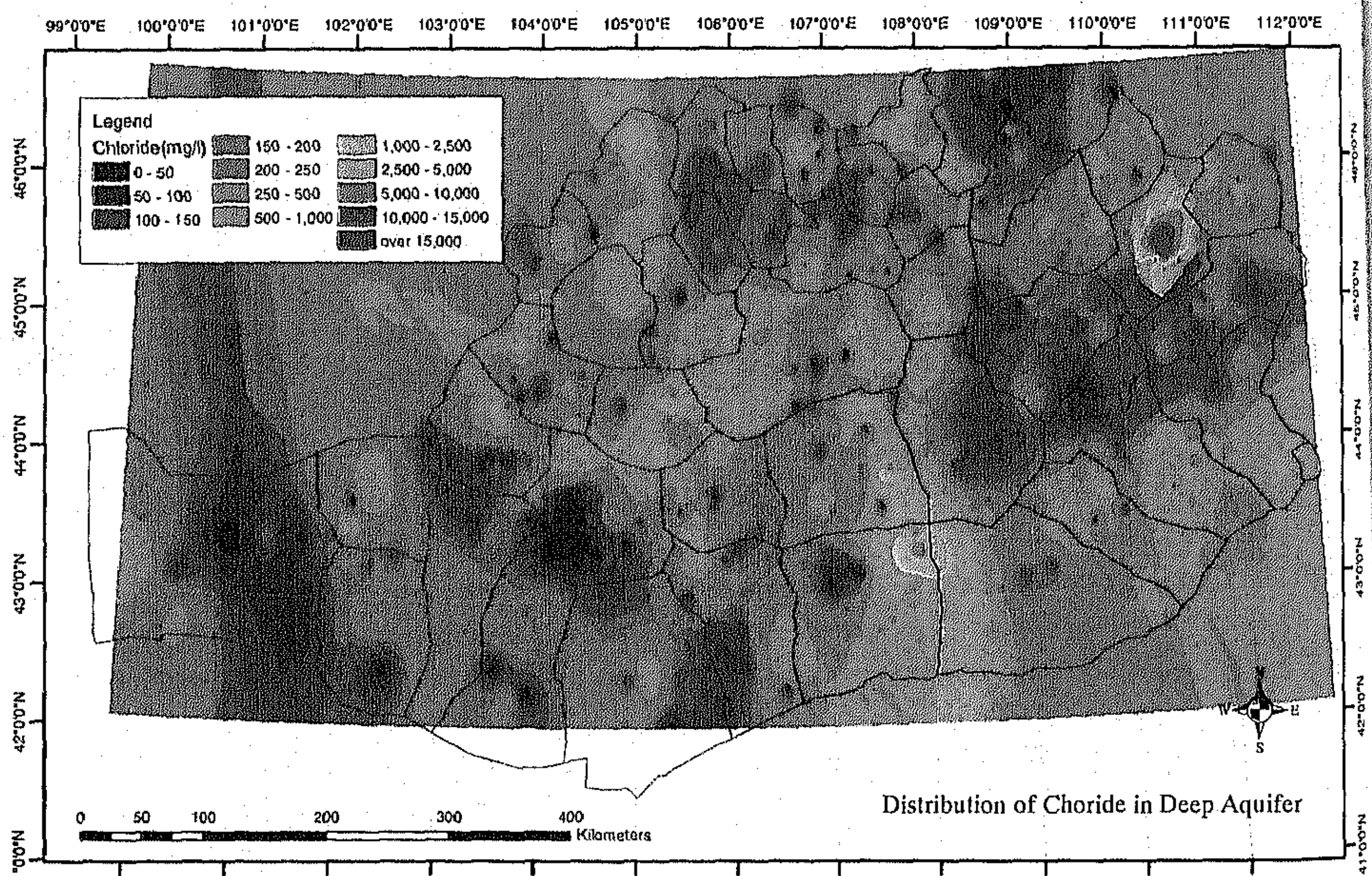


Fig. 2.2.7 Result of Water Quality Analysis

(2) Results of Groundwater Quality Analysis

Total of 127 groundwater samples, of which are 92 samples for the shallow aquifer and 35 samples for the deep aquifer were collected from the whole *Dornogobi Aimag*, including the wells constructed/rehabilitated in the Pilot Study. 29 items were selected to evaluate groundwater quality. At first water quality analysis was carried out at Chemistry & Chemical Technology Institute, Science Academy of Mongolia; however, abnormal values were recognized there. Although it was again analyzed at the other institute in Mongolia, the degree of accuracy was still low, so finally analysis of all samples was carried out again in Japan. The detailed results of water quality analysis are shown in Annex E.

The number and percentage of the samples which don't meet the water quality standard are listed in the below table. To evaluate groundwater quality of each aquifer, data of Shallow Well, Shaft Well and Traditional Well for shallow aquifer and the data of Production Well for deep aquifer were used.

Shallow Aquifer

The ratio of Fluorine and Evaporated Residue are notably bad being 78.8% and 30.3% respectively, and Arsenic was detected at three points. However, this aquifer is somewhat better than the following deep aquifer except for the three heavy minerals.

Deep Aquifer

The ratio of Hardness, Evaporated Residue, Chloride, Magnesium and Fluoride are also notably bad being 28.6%, 53.6%, 50.0%, 46.4%, and 64.3% respectively in the deep aquifer. As for other items, this aquifer is somewhat worse than the shallow aquifer.

As above mentioned, there are some problems of groundwater quality for drinking water use in *Dornogobi Aimag*. Therefore, some kind of water purification is necessary to supply safe water to the rural people.

Especially concentration of Fluorine is high throughout the whole area, so some measures are necessary. There are many practical methods of water purification now. In general, "Reverse Osmosis Membrane" is the best way to totally resolve problems so far because the groundwater quality of this *Aimag* tends to be below drinking water Quality standards in terms of not only heavy minerals but some general items, for example Hardness, Chloride, and so on. In the Pilot Study, small water purification of Reverse Osmosis Membrane was introduced, and its ability was proven. However, it had insufficient capability to purify water because the iron- rich water oxidized and heightened its turbidity and consequently the pre-filter clogged frequently. Further study is necessary to find a suitable water purification method for the local conditions.

Table 2.2.8 Results of Groundwater Quality Analysis in *Dornogobi Aimag*

Aquifer	Item	pH	Hardness	Evaporated Residue	Nitrate	Ammonium	Chloride	Sulfate	Calcium	Magnesium	Copper	Iron
		-	mgCaCO3	g/l	mg NO_3/l	mg NH_4/l	mg Cl/l	mg SO4/l	mg Ca/l	mg Mg/l	mg Cu/l	mg Fe/l
Water Quality Standard		6.5-8.5	=350	=1000	=44.3	*=1.5	=350	=500	=100	=30	=1	=1
Shallow Aquifer	No. of samples unsatisfied standard	1.0	19	30	25	1	13	15	12	33	0	7
	Percentage of samples unsatisfied standard (%)	1.0	19.2	30.3	25.3	1.0	13.1	15.2	12.1	33.3	0.0	7.07
Deep Aquifer	No. of samples unsatisfied standard	0.0	8	15	4	0	14	5	4	13	0	2
	Percentage of samples unsatisfied standard (%)	-	28.6	53.6	14.3	-	50.0	17.9	14.3	46.4	0.0	7.14
Total Aquifer	No. of samples unsatisfied standard	1.0	27	45	29	1	27	20	16	46	0	9
	Percentage of samples unsatisfied standard (%)	0.8	21.3	35.4	22.8	0.8	21.3	15.7	12.6	36.2	0.0	7.09

Aquifer	Item	Manganese	Zinc	Lead	Chromium	Mercury	Cadmium	Fluoride	Molybdenum	Beryllium	Aluminum	Arsenic
		mg Mn/l	mg Zn/l	mg Pb/l	mg Cr/l	mg Hg/l	mg Cd/l	mg F/l	mg Mo/l	mg Be/l	mg AL/l	mg As/l
Water Quality Standard		=0.1	=5	<0.03	<0.05	*=0.001	<0.01	<1.5	=0.25	<0.0002	=0.5	=0.01
Shallow Aquifer	No. of samples unsatisfied standard	19	1	0	0	2	0	78	15	10	11	3
	Percentage of samples unsatisfied standard (%)	19.2	1.0	0.0	0.0	2.0	0.0	78.8	15.2	10.1	11.1	3.0
Deep Aquifer	No. of samples unsatisfied standard	5	0	0	0	0	0	18	0	7	1	0
	Percentage of samples unsatisfied standard (%)	17.9	0.0	0.0	0.0	0.0	0.0	64.3	-	25.0	3.6	-
Total Aquifer	No. of samples unsatisfied standard	24	1	0	0	2	0	96	15	17	12	3
	Percentage of samples unsatisfied standard (%)	18.9	0.8	0.0	0.0	1.6	0.0	75.6	11.8	13.4	9.4	2.4

* WHO Standard

Shallow Aquifer = Shallow Well, Shaft Well & Traditional Well (Dug Well) : Deep Aquifer = Production Well

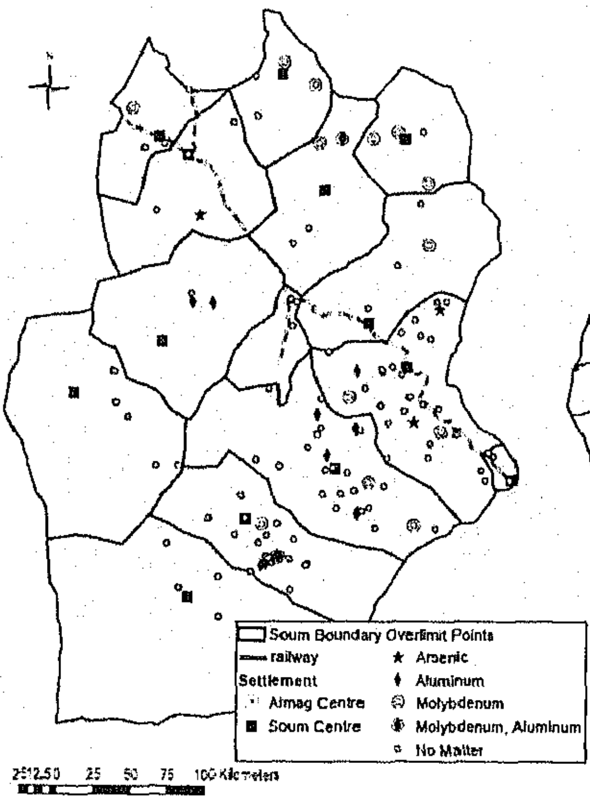


Fig. 2.2.8 Location of Over limit (Heavy Metal) Point

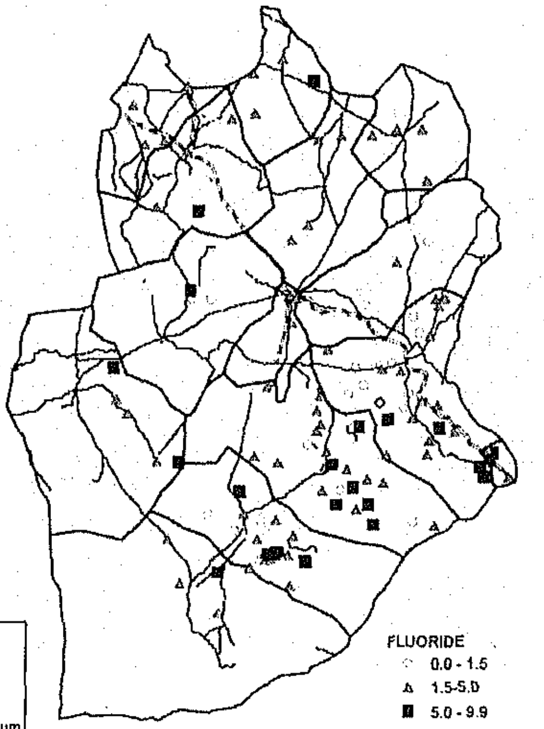


Fig. 2.2.9 Result of Analysis (Fluoride: mgF/l)

2.2.6 GROUNDWATER POTENTIAL EVALUATION - AVAILABLE GROUNDWATER VOLUME

According to the macro water balance in Mongolia, 90% of total precipitation is lost by evapo-transpiration and the balance 10% is divided into surface water (6.3%) and groundwater (3.7%). 95% of the surface water flow out of the country and only 0.3% of total precipitation is retained in Mongolia. Meanwhile, groundwater's share in it is only 3.7%.

Total available groundwater volumes in three *Aimags* were estimated by Ministry of Food and Agriculture as shown in Table 2.2.9. Since the values are equivalent to the following ratios of total precipitation (2.3% for *Umnugobi*, 1.0% for *Dundgobi* and 1.3% for *Dornogobi*), it is a reasonable estimation of the recharge volume or development volume in these areas considering that the precipitation is less than the average of Mongolia and temperature should be higher than that for active evapo-transpiration. Seasonal division is set up so that winter volume is half of summer.

Table 2.2.9 Groundwater Volume of Each *Aimag*

Aimag	Area ($10^3 km^2$)	Groundwater			
		Total Resources (million m^3/year)	Not Available (million m^3/year)	Available in Summer (million m^3/year)	Available in Winter (million m^3/year)
Dornogobi	109.5	167.2	50.2	78.0	39.0
Dundgobi	74.7	284.0	0	189.3	94.7
Umnugobi	165.4	211.2	0	140.8	70.4

Source: Ministry of Food and Agriculture

Daily average of available groundwater development per unit area is estimated from above mentioned groundwater volume as shown below.

(a) *Dornogobi* 4,200 liter/day/km^2
(b) *Dundgobi* 10,400 liter/day/km^2
(c) *Umnugobi* 3,500 liter/day/km^2

Assuming that the average pasture capacity in Gobi Area is 3 ha/sheep/year and unit water demand is 5.0 liter/sheep/day, daily water demand for livestock per unit area is as follows:

Unit Daily Water Demand =100 ha/3 ha x 5.0 = <u>167 liter/day/km^2</u>

In consideration of water demand for herder family (25～50 liter/day/family), the groundwater volume seems to be sufficient; however, it is noteworthy that groundwater is not stored everywhere evenly and its potential is not so high in terms of quality and cost of exploitation.

2.3 SOCIAL AND ECONOMIC CONDITIONS

2.3.1 POPULATION AND EMPLOYMENT

Because of the traditional dominance of pastoral livestock herding, the majority of people live in rural areas. The portion of rural population in *Soums* ranges between 40.4% and 85.2% in *Dundgobi Aimag*, 29.1% and 81.0% in *Dornogobi Aimag*, and 65.1% and 85.7% in *Umnugobi Aimag*. (Note: residents in *Soum* centers are included in the urban population in the *Soums*.) On the other hand, the share of urban population is 35.9% in *Dundgobi Aimag*, 70.1% in *Dornogobi Aimag* and 45.1% in *Umnugobi Aimag*.

The relatively high portion of urban population in *Dornogobi Aimag* is related to comparatively high development of infrastructure and service sectors associated with the Trans-Siberian railway that cuts longitudinally the *Aimag*. *Soums* that are located along the railway have relatively high portion of non-herding population who provide services to the railway.

According to the employment by main activities, agriculture, primarily livestock farming are the dominant economic activity. The only exceptions are transport, storage and communication activities in *Dornogobi Aimag*, which accounts for 12.8% of the total employment. Again this can be reasonably explained by the presence of main railway in the *Aimag* that brought development of associated infrastructure and services along the railway. In addition, the share of mining and manufacturing activities is also high in this *Aimag* (3.5% and 2.8% respectively) against 0.3% and 1% respectively in the both *Dundgobi* and *Umnugobi Aimags*. Relatively high percentage of 'Public administration, defense and compulsory social security' in *Dornogobi* and *Umnugobi Aimags* is largely due to the military and border guards presence in these *Aimags* because of the long border with China.

Table 2.3.1 Employment by Main Activities, 2002

	Dundgobi		*Dornogobi*		*Umnugobi*		Country
	Number	%	Number	%	Number	%	%
Agriculture, hunting and forestry	17,746	79.9	8,877	44.7	14,492	69.9	48.3
Mining and quarrying	61	0.3	689	3.5	63	0.3	2.4
Manufacturing	231	1.0	549	2.8	213	1.0	6.7
Electricity, gas and water supply	202	0.9	412	2.1	311	1.5	2.1
Construction	29	0.1	147	0.7	197	0.9	2.5
Trade, repair household goods	811	3.7	1,234	6.2	901	4.3	10.8
Hotels and restaurants	63	0.3	197	1.0	75	0.4	2.0
Transport, storage and communication	393	1.8	2,537	12.8	454	2.2	4.2
Financial intermediation	82	0.4	96	0.5	84	0.4	0.9
Real state, renting and business activities	75	0.3	122	0.6	96	0.5	0.8
Public administration, defense and compulsory social security	769	3.5	3,161	15.9	2,129	10.3	4.9
Education	886	4.0	914	4.6	914	4.4	6.6
Health and social work	637	2.9	599	3.0	533	2.6	4.0
Others	231	1.0	343	1.7	277	1.3	3.7
Total	22,216	100	19,877	100	20,739	100	100

Source: *Aimag* of *Dundgobi, Dornogobi, Umnugobi* : 2001

2.3.2 ECONOMIC ACTIVITY

Comparing the general structure of the economy in the three *Aimags* with the national average, *Dundgobi* and *Umnugobi Aimags* are dominated by the agricultural or livestock sector with share of 45.3% to 53.4% in GDP respectively. The economy in *Dornogobi Aimag* is dominated by the industry sector with share of 43.4% in GDP. The share of the agricultural sector is around twice as much as the national average in *Dundgobi* and *Umnugobi Aimags*, and the same for the industry sector in *Dornogobi Aimag*.

The bulk of the industry sector in *Dornogobi Aimag* belongs to manufacturing which accounts for 33.8% of GDP. The share of the construction of 15% is also much higher than the national average in this *Aimag*. The share of the manufacturing is also marginally higher than the national average in *Dundgobi Aimag*. The share of the energy sector is higher than the national average in *Dornogobi* and *Umnugobi Aimags*. Because of the presence of a comparatively big power station, *Umnugobi Aimag* shows the highest portion of the energy sector in GDP.

As for the service sector, all three *Aimags* are much lower than the national average. In contrast, the share of budget-supported activities is higher than the national average in all three *Aimags*.

Table 2.3.2 GDP by *Aimags* 2001 (Tg million)

	Dundgobi		*Dornogobi*		*Umnugobi*		Country
	Soum	%	*Soum*	%	*Soum*	%	%
A. Agriculture	8,409.7	53.4	4,614.2	26.5	9,549.0	45.3	26.0
Livestock sector	8,243.1	52.3	4,538.2	26.1	9,029.8	42.8	
Crop sector	166.6	1.1	76.0	0.4	519.2	2.5	
B. Industry	1,572.9	10.0	7,548.9	43.4	2,350.5	11.1	23.0
Manufacturing	1,337.3	8.5	5,877.0	33.8	181.8	0.9	7.2
Mining*	80.8	0.5	0*	0	310.4	1.5	11.7
Energy	31.8	0.2	604.4	3.5	1,595.4	7.6	2.1
Construction	123.1	0.8	1,067.5	6.1	262.8	1.2	2.0
C. Service sector	2,514.6	16.0	2,614.0	15.0	4,076.5	19.3	42.2
Banking, finances, real estate, leasing	136.3	0.9	91.8	0.5	149.0	0.7	4.5
Transport & Communication	467.1	3.0	448.2	2.6	730.1	3.5	11.7
Trade, Hotels, Public Utility	1,911.2	12.1	2,614.0	15.0	3,197.5	15.2	26.0
D. Budgetary bodies and NGOs	3,263.4	20.7	2,633.4	15.1	3,362.6	15.9	11.2
E. Others					1,751.2	8.3	-2.4
Total	15,760.6	100	17,410.5	100	21,089.8	100	100

* Mining included in the manufacturing sector.

Source: Country Figures of 2001

As for Per Capita GDP in three *Aimags*, *Umnugobi* is the most labor productive *Aimag*; it varied between Tg 413,000 and Tg 484,000 in 1999-2001 against the national average of Tg 392,000 and Tg 478,000 for the same period. *Dundgobi Aimag's* labor productivity was hit hardest by the *Dzud* declining from Tg 511,000 in 1999 to Tg 162,000 in 2000. A similar situation is shown in case of *Dornogobi Aimag* from 2000 to 2001.

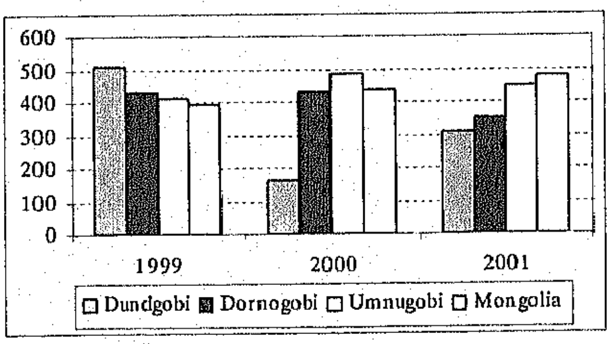


Fig. 2.3.1 GDP per Capita (1999-2001,Tg 1000)

Source: *Aimag of Dundgobi, Dornogobi and Umnugobi*

The national Per Capita GDP would have increased much more if not depressed by declines in the livestock sector caused by serious *Dzud* in 1999-2001.

2.3.3 LIVESTOCK FARMING

The livestock sector is the primary economic activity in all three *Aimags* in terms of employment share and in *Dundgobi* and *Umnugobi Aimags* in terms of both employment and GDP share.

The livestock sector in three *Aimags* faces the same common problems with the other *Aimags* in Mongolia. The most prominent challenges include: low productivity of the animals, dependency on and low protection against natural calamities, existing fragmentation of the industry by too small household economies scattered over enormous territory with poor infrastructure, and certain difficulties with introducing some elements of modern society because of the mobile/nomadic nature of herder lifestyle.

Because of ecological constraints, the extensive livestock industry in Mongolia is characterized by low and basically constant yields of meat, milk and wool per animal over time. The productivity of major livestock products per animal is shown in Table 2.3.3.

Table 2.3.3 Per Head Production of Meat, Wool and Milk in Mongolia

	1960	1980	1991
Average live weight sold to the state (kg)			
-Cattle	248	217	245
-Sheep	36	33	39
-Goat	28	26	33
Wool yield (g)			
-Sheep	1,186	1,390	1,243
-Camel	4,104	5,034	4,365
-Cow milk (*l*)	344	292	323

Source: Central Statistical Board of the Mongolian People's Republic (1970, 1981 and 1992 editions)

For 30 years up to 1990, the centrally planned system of agriculture moved towards intensification of production by providing shelter structures and veterinary services for livestock, making supplementary fodder and concentrates and supplying water to natural pasture. The intensification process was claimed to be one of the successes of the communist system in the agricultural area, in the sense that it could decrease the mortality rate and increase the birth rate of pastoral animals, although it could not much change the biological productivity per animal.

Due to consecutive years of *Dzud* from 1999, in 2001, 87.5% of all households with livestock have less than 200 animals and 67.5% have less than 100 animals nationwide.

A similar situation exists in *Dornogobi*, *Dundgobi* and *Umnugobi Aimags*, although the herd size is a little higher in all three *Aimags* compared with national average. The share of households with less than 200 livestock in *Dornogobi*, *Dundgobi* and *Umnugobi Aimags* is 76.17%, 74.47% and 76.72% respectively, compared with 83.6% of the nationwide average (2001).

Table 2.3.4 Wealth Groups of Households with Livestock (2002)

Aimags	Up to 50	51 to 100	101 to 200	201 to 500	More than 501	Total No. of house-holds	% households up to 50	% households up to 100	% households up to 200
Dornogobi	1,732	1,176	1,339	1,143	186	5,576	31.06	52.15	76.17
Dundgobi	2,227	2,246	2,510	2,042	352	9,377	23.75	47.70	74.47
Umnugobi	1,855	1,855	2,614	1,765	154	8,243	22.50	45.01	76.72

(Source: *Dornogobi, Dundgobi, Umnugobi*)

Although the total number of livestock is crucial in herder livelihood, it is not the only indicator; the composition of animal species such as portion cashmere goat and draft animals, and marketing conditions are also important.

As logically acknowledged by *Aimag* governments, a lack of fodder is one of the main reasons for mass losses of animals during the *Dzud*. Because of ecological constraints, the *Aimags* have very limited potentials for preparing fodder locally. The volume of locally prepared fodder is shown in Table 2.3.5.

The total volume of fodder prepared per sheep unit in kg of feed units is only 0.81, 1.27 and 1.41 respectively in *Dornogobi*, *Dundgobi* and *Umnugobi Aimags*. The relatively high production of fodder in *Umnugobi Aimag* can be explained, at least partly, better self-initiatives of herders in the *Aimag* to prepare fodder using local potentials.

Table 2.3.5 Fodder Supply in kg per Sheep Unit (2002)

Aimags	Hay	Hand fodder	Concentrate	Total in feed unit	Average for 1999-2001
Dornogobi	1.37	0.07	0.18	0.89	0.81
Dundgobi	0.00	1.42	0.00	1.42	1.27
Umnugobi	2.69	0.47	0.27	1.98	1.41

(Source: *Dornogobi, Dundgobi, Umnugobi*)

Although all three *Aimags* largely belong to the Gobi region, the ecological conditions, consequently possibilities for producing fodder are likely to differ across *Soums* in each *Aimag*. These differences together with *Soum*-specific traditions and weather conditions in 1999-2001 have shaped the differences in the level of fodder production in the three *Aimags*.

Lots of herders lost livestock due to *Dzud* that continued for three years from 1999 to 2001 in three *Aimags*, and which has increased poverty in the rural and substantially worsened the livelihood of herders. Thus, there was the strong inverse correlation between the number of owned livestock and the number of poor families. As shown in Table 2.3.6, the number of poor families was reduced until 1999 in *Dornogobi*, 1998 in *Dundgobi* and 1997 in *Umnugobi* respectively, due to increase of the number of livestock. However, the number of poor families has rapidly increased due to loss of livestock since then.

Table 2.3.6 Number of Livestock and Poor Families

Aimags		No. of Livestock and Poor Families							Annual Growth Rate (%)					
		1996	1997	1998	1999	2000	2001	2002	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002
Dornogobi	A	922.6	963.2	1,017.9	1,110.2	1,036.6	838.3	825.8	4.4	*5.7*	*9.1*	(6.6)	**(19.1)**	**(1.5)**
	B	1,334	2,641	2,169	1,488	1,647	2,318	2,343	98.0	*(17.9)*	*(31.4)*	-	**40.7**	**1.1**
Dundgobi	A	1,844.8	2,025.7	2,212.8	2,105.2	1,282.8	1,397	1,475	9.8	*9.2*	**(4.9)**	**(39.1)**	8.9	5.6
	B	914	2,451	2,215	2,909	4,403	5675		168.2	*(9.6)*	**31.3**	**51.4**	28.9	
Umnugobi	A	1,212.1	1,509.4	1,603.8	1,608.9	1,337.7	1,209.6	909.1	*24.5*	6.3	0.3	(16.9)	**(9.6)**	**(24.8)**
	B	1,877	1,740	2,326	2,640	2,034	3,275	3,672	*(7.3)*	33.7	13.5	(23.0)	**61.0**	**12.1**

A: Number of Livestock (1,000 heads)

B: Number of Poor Family

No. : shows Increase of Number of Livestock and Decrease of Poor Family

No. : shows Decrease of Number of Livestock and Increase of Poor Family

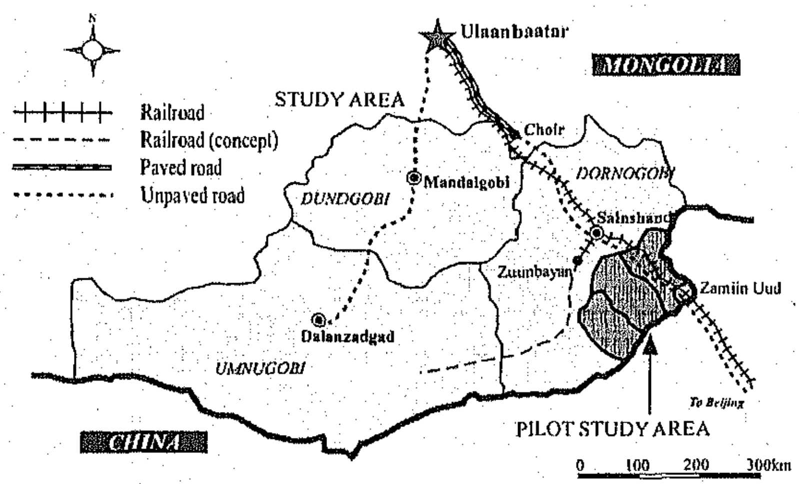
Source: *Dornogobi, Dundgobi, Umnugobi*

2.3.4 SOCIAL INFRASTRUCTURE

(1) Railway and Road Network

The railway is the artery of the Mongolian economy and it passes through *Dornogobi*. It connects *Ulaanbaatar*, the Capital of Mongolia, to *Saninshand*, capital of *Dornogobi*, and then passes *Zamiin Uud*, the land-port to China. Moreover, a branch line expands from *Sainshand* to *Zuunbayan*, and it is planned to extend to *Umnugobi*.

There is pavement road from *Ulaanbaatar* to *Choir*. The road between *Choir* and *Zamiin Uud* is 442 km and unpaved in present, but pavement road construction is scheduled after 2006. In the plan, the construction of "Car park (a rest area)" in *Erdene Soum* is also included. The Railway and road network in the Study are summarized below in Fig. 2.3.2.



Source: JICA Study Team Fig.2.3.2 Railway and Road Network in the Study Area

(2) Power Supply

3 *Soums* are not connected to the central power grid in *Dornogobi* and 2 *Soums* in *Dundgobi*. In these unconnected *Soums*, there is no full-time power supply; it is limited only 3 to 6

hours per day. The whole *Umnugobi Aimag* is not connected to central power grid, and *Dalanzadgad, Aimag* center of *Umnugobi*, is generating electricity and supplying it to surrounding *Soums*; the other *Soums* have generators by themselves.

Table 2.3.7 Power Supply in the Study Area

(1: Connecting to Central Power Grid/ fulltime supply, 2: Power supply from 3 / fulltime supply, 3: Generating in the territory/Limited supply expecting Dalanzadgad)

Dornogobi	
Soum	Status
Sainshand	1
Airag	1
Altanshiree	1
Dalanjargalan	1
Delgerekh	1
Ikh khet	1
Mandakh	3
Urgun	1
Saikhandulaan	1
Ulaanbadrakh	1
Khatanbulag	3
Khubsgul	3
Erdene	1
Zamin uud	1

Dundgobi	
Soum	Status
Mandalgobi	1
Adaatsag	1
Bayanjargalan	1
Gobi -Ugtaal	1
Gurvansaikhan	1
Delgerkhangai	1
Delgertsogt	1
Deren	1
Luus	1
Ulziit	3
Undurshil	3
Saintsagaan	1
Saikhan ovoo	1
Khuld	1
Tsagaan delger	1
Erdenedalai	1

Umnugobi	
Soum	Status
Dalanzadgad	3
Bayandalai	2
Bayan - Ovoo	3
Bulgan	3
Gurvantes	3
Mandal - Ovoo	3
Manlai	3
Noyon	3
Nomgon	3
Sevrei	3
Khanbogd	3
Khankhongor	2
Hyrmen	2
Tsogt - Ovoo	3
Tsogttsetsii	3

Source: Statistical Year Book 2004

2.4 RURAL SOCIETY

2.4.1 LOCAL GOVERNMENT CAPACITIES

Rural Mongolia is divided administratively into *Aimags*, *Soums* and *Bags*. One *Aimag* consists of 12 to 25 *Soums* and one *Soum* consists of 3 to 7 *Bags*. The average size of *Soum* is around 300,000 ha and 500 to 1,300 families. The average size of *Bag* is 60,000 ha and more than 100 families.

Because enormous territory and low population density, the delivery of state services to herders is primarily focused on *Soum* and *Bag* levels. Because of low capacities of the *Soum* economy to generate revenues for local budget, the *Soums* are dependent on subsidies from *Aimags*.

Table 2.4.1 shows the revenues and expenditures by *Soums* in three *Aimags* and the dependency ratio (revenues divided by expenditures). The rural *Soums* in *Umnugobi Aimag* are dependent on subsidies from the *Aimag* for 73% to 86% and the *Aimag* is dependent on state subsidies for 61%. *Dornogobi Aimag* has relatively less dependence on subsidies because of comparatively developed industry and service sectors.

Table 2.4.1 Budget by *Aimag* (Tg. Million)

Aimag	Revenues (A)	Expenditures (B)	% (A/B)
Dundgobi	1,148.5	3,312.8	34.7
Dornogobi	2,607.6	4,825.50	54.0
Umnugobi	1,555.3	3,969.5	39.2

(Source: *Dundgobi, Dornogobi, Umnugobi*)

As for structure for local revenues the share of herder taxes constitutes only a small portion.

Table 2.4.2 Structure of Budget Revenues of *Aimags*, 2002 (Tg. Million, 2002)

	Dundgobi	*Dornogobi*	*Umnugobi*
Total revenue	1,148.50	2,607.62	1,555.28
Tax revenue	1,099.57	2,120.87	532.29
Out of which tax revenues from herders	83.53	77.43	93.67
% herders' taxes in total revenue	7.27	2.97	6.02
Non-tax revenue	112.82	415.68	253.75
Capital revenue	0.00	71.07	10.44
Others	0.00	0.00	758.81

(Source: *Dundgobi, Dornogobi, Umnugobi*)

Dependency of local budgets on subsidies from the above has serious implications for both efficiency and effectiveness of the delivery of social services to rural population. Lack of material and financial resources and professional staff combined with poor infrastructure seriously erode the quality and coverage of basic social services in *Soums*, especially in remote *Bags*. Since the market economic system has spread across Mongolia, the distribution and quality of social services has declined due to serious budget deficiencies. The rural population has suffered the most under this new situation.

Lack of resources especially hits the *Bags* hard. The *Bag* is lowest administrative unit, and therefore the closest to herders. In practice, the *Bag* staff consists of only a *Bag* governor, who is usually one of the better-educated herders, and in some cases an assistant doctor or nurse is added. The *Bag* budget funds only salaries with social and health insurance funds for staff, limited funds for fuel/petrol to be used for the motorbike of the Governor and small fund for stationery. In many cases *Bags* do not have offices and *Bag* governors use their *Gers* as offices. This means that *Bag* has no permanent location since the *Bag* governor also makes seasonal migrations just as any other herder.

2.4.2 ECONOMIC SITUATION OF HERDERS

To demonstrate the economic situation of a typical herder household with 5 members, the following income and expenditure tables were developed using the data collected during the fieldwork as well as the relevant averages for some indicators. (See Table 2.4.3). The averages used may slightly differ if compared with individual cases of families and *Soums*; however, they are a good representation of the reality. To see the variability of incomes and expenditures, a model was calculated for households with 100 and 200 animals.

As shown in Table 2.4.3, the total sales revenue is a Tg 666,400 for household with 100 animals and Tg 1,263,720 for household with 200 animals. Including the value of animals consumed for food, the figure increases to Tg 950,400 and 1,675,720 respectively. However, the number of animals decreases by one horse with the value of Tg 60,000 for the household with 100 animals and increases by 2 animals with the total value change of minus Tg 16,000 for the household with 200 animals.

Table 2.4.3 Average Income per Household

	Household with 100 Animals						Household with 200 Animals					
	Camel	Horse	Cattle	Sheep	Goat	Total	Camel	Horse	Cattle	Sheep	Goat	Total
Livestock at the beginning of year	1	10	10	40	39	100	3	17	14	88	78	200
Share of reproductive female	28.5	29.1	37.7	45.1	43.8		28.5	29.1	37.7	45.1	43.8	184
Number of reproductive female	0	3	4	18	17	42	1	5	5	40	34	85
Young per 100 female	39	64	74	82	77	336	39	64	74	82	77	336
Number of young	0	2	3	15	13	33	0	3	4	33	26	66
Mortality rate %	4	5.5	7	4.4	4.4		4	5.5	7	4.4	4.4	25
Number of deaths	0	1	1	2	2	5	0	1	1	4	3	9
Number of livestock consumed	0	1	0	8	8	17	0	1	1	11	8	21
Yield of wool per animal (kg)	5			1.6	0.26	7	5			1.6	0.26	7
Sold live animals	0	1	2	5	3	11		2	2	16	14	34
Wool and cashmere	5	0	0	64	10.14	79	15	0	0	140.8	20.28	176
Hide and skin	0	1	0	8	8	17	0	1	1	11	8	21
Milk	0	0	0	0	0	0	0	0	0	0	0	0
Unit Price, '000 Tg						0						0
Live animals	100	60	80	16	12	268	100	60	80	16	12	268
Wool and cashmere	1,5	0	0	0.15	20	21.65	1.5	0	0	0.15	20	21.65
Hide and skin	12	15	17	6	7	57	12	15	17	6	7	5.7
Milk	0,3	0,2	0.15	0,15	0.15	0.95	0.3	0.2	0.15	0.15	0.15	0.95
Sales Revenue Total, '000 Tg	7.5	75.0	177.0	133.6	273.3	666.4	22.5	135.0	177.0	321.1	608.1	1263.7
Live animals	0	60.0	160.0	80.0	36.0	336.0	0	120.0	160.0	256.0	168.0	9,112.
Wool and cashmere	7.5	0	0	9.6	202.8	220.0	22.5	0	0	21.1	405.6	449.0
Hide and skin	0	15.0	17.0	44.0	34.5	111.0	0	15.0	17.0	44.0	34.5	111.0
Milk	0	0	0	0	0	0	0	0	0	0	0	0
Value of animals consumed	0	60.0	0	128.0	96.0	284.0	0	60.0	80.0	176.0	96.0	412.0
Total Revenue, '000 Tg	7.50	135.0	177.0	261.6	369.3	950.4	22.50	195.0	257.0	497.1	704.1	1,675.7
Livestock at the end of year	1	9	10	40	39	99	3	16	14	90	79	202
Change in animal numbers	0	-1	0	0	0	0	0	-1	0	2	1	2
Value of changes in numbers	0	-60.0	0	0	0	-60.0	0	-60.0	0	32.0	12.0	-16.0

(Source: JICA Study Team)

The following averages were used to estimate annual consumption and expenditures per capita:

- Meat: 131.8 kg, Milk: 270 liter, Flour : 75 kg, Rice : 20 kg, Sugar : 10.3 kg
- Health /per family/ Tg 29,000
  - o Tg 24,000 for health insurance
  - o Tg 5,000 for medicines
- Transport /per family/ Tg 35,000
  - o Tg 20,000 within *Soum*
  - o Tg 35,000 within *Aimag*
  - o Tg 30,000 outside *Aimag*
- Meat yield of animals, kg
  - o Camel 256.5, Horse 145.3 , Cattle 139.4
  - o Sheep 19.1, Goat 12.9

Household expenditures include items for *Ger* and other household needs such as *Ger* covers, candle and matches. Clothing consumption is based on the average need for clothing for each member of family and minimum market prices. Education of schools children involves basic costs for bags, books, notebooks, clothing and sanitary items. Holiday preparation costs include largely those associated with *tsagaan sar*, lunar new year celebration in February, the most costly and widely celebrated holiday among herders.

The total expenditure is Tg 1,360,730 and Tg 1,617,950 respectively for households with 100 and 200 animals. The biggest portion of expenditures goes to food and clothing, which is characteristic of any poor family.

Table 2.4.4 Average Expenditures per Household (Tg 1,000)

Expenditures by type	Household with 100 animals	Household with 200 animals
Production	140.03	269.25
Food	210.1	210.1
Value of animals consumed	284.0	412.0
Household	63.6	63.6
Holiday preparation	135.0	135.0
Transportation	85.0	85.0
Sanitary	30.0	30.0
Health	29.0	29.0
Clothing	317.0	317.0
Education of school children	67.0	67.0
Total	1,360.73	1,617.95

Source: JICA Study Team

The revenues and expenditures are roughly equal for the family with 200 animals suggesting that at this herd size, a herder's family may sustain a very basic livelihood. However, sustaining a basic livelihood is a relative concept. If one of the children of a household goes to university this will entail costs up to Tg 1 million including around Tg 260,000 of university fee and living expenses. In other words, the household cannot afford high education for any children.

The revenues of the family with 100 animals fall Tg 410,330 (950,400-1,360,730) short of expenditures. This means that a household needs revenues from alternative sources or has to decrease expenditures.

In practice priority ranking of expenditure or consumption items varies across households. For example, if a household does not have a quality drinking water source, it may sacrifice some other consumption item in order to pay for the quality water.

Table 2.4.5 Average Production Expenditures per Household (Tg 1,000)

	Household with 100 animals	Household with 200 animals
Livestock in sheep units for inputs	207	372
Livestock in sheep units for taxation	204	390
Number of livestock taxed	104	290
Fodder for sheep unit, Tg	130	130
Tax per sheep unit, Tg	75	75
Number of migrations per year	5	7
Costs per migration, Tg	12000	12000
Veterinary costs per animal, Tg	226	226
Expenditures incurred, '000 Tg		
Taxes*	7.76	21.75
Fodder, Tg	26.39	48.75
Migration**	60.00	84.00
Veterinary services	45.88	84.75
Fuel	0.00	30.00
Total	140.03	269.25

*20 animals per a member of family or 100 animals per 5 member family are free from taxes

**One migration costs around one young sheep value. (Source: JICA Study Team)

2.4.3 HERDER COMMUNITIES

(1) Informal Communities of Herders

In Mongolia, 2 -10 households which cooperate in everyday herding activities; these are local neighborhood communities (*neg nutgiinhan*, "people of one place") formed of *Khot Ailes* which use the same pastoral resources for at least part of each year. *Khot Aile* is a group of households camping together and sharing labor. It also plays a social role as the smallest local community. It has a loose internal structure and flexible composition from year to year. In the *Khot Aile* many family functions become shared between families within the *Khot Aile* irrespective of whether they are related or not. These families cooperate in day to day herding activities, but the animal and other assets owned separately by households.

It is common that *Khot Aile* member families are related to each other on a kinship basis. However, it is also not rare that families are not related but camp together on friends or *nutgiin aile* (family from native place) basis. In the *Khot Aile* that consists of families with non-kinship relationships, it is not rare that the poorer families joined the wealthier families to get help and better accesses to key resources, and the wealthier families to help the poorer relatives in return for primarily labor inputs and thus safeguard their reputation among the society. Often, the poor families look after animals of the wealthier families together with own animals and the wealthier families assist the poor families in buying clothing and schooling equipment for their children. However, these kinds of help usually are only of a short-term survival nature, and have no long-term vision to get the poor out of poverty.

As the number of animals per camp depends on the carrying capacity of pastures, the number of families within the *Khot Aile* has clear tendency to decline in drier steppe and Gobi regions. While in productive *Khangai* regions, the *Khot Aile* consisting of 4 and more families is not rare. In the Gobi region the *Khot Aile* size tends to not exceed 2-3 families..

The second and bigger neighborhood group/community of herders is *neg nutgiinhan*, (people of one place) which is based on the neighborhood a relationship of several *Khot Ailes*. Since a key natural resource plays a crucial role in forming such groups, they are formed primarily around the water point in the Gobi region and in some places called *neg usniihan* (people of one water source). The degree and scope of relationships between families are usually weak compared with that within the *Khot Aile*.

(2) Life Situation of Herders

Mongolian herders depend on their livestock for subsistence mainly, obtaining much of their food from meat and dairy products; using wool, hair, and hides for domestic purposes; burning dung for fuel; selling or bartering livestock and livestock products for cash or goods; and using camels, horses and cattle for transportation and draft purposes.

In early 1990s, as a result of the collapse of the *Negdel* system, the livestock sector shifted to small household economic units. In the process of the privatization of the livestock, there was no appropriate supporting services; therefore, not only responsibility for production and marketing fell to herding families who had no experience of running businesses in a market economy, but also all of the risks related to weather and prices were neglected. Herders responded rationally to these risks by increasing the herd size to the detriment of free state-owned pasturelands, and by decreasing the utilization of purchased inputs. Following this strategy, the bulk of herders did not succeed much because of limits in the carrying capacity of pastures. In addition, it eroded the quality of pastures, the basis for pastoral livestock production, causing overgrazing and degradation, especially in areas near water points and urban settlements.

Poor and new herders were hit hardest by the *Dzud*. After *Dzud* these people looked for job opportunities elsewhere because they thought that livestock herding was not a reliable business. Herders who have lost animals in the *Dzud* mostly migrated to the *Soums* center in search of jobs. However, it is very difficult to find jobs there.

Because of lack of transportation means, the small herder families have poor capabilities to access better markets and organize seasonal migrations, thus are more vulnerable to natural calamities. Marketing capability and bargaining power of small herder households are weak because of lack of cooperative action. Price of livestock products decreases and consumer goods increases as the distance to central markets increase; especially herders do not have proper access to markets, so barter trade is dominant and the level of raw material processing is low. Herders often have the same source of water for drinking and livestock purposes. Most herders consume unhealthy water from springs, snow, and ice.

Because of limitations in fodder production and high transportation costs, the price of fodder was comparatively high in all three *Aimags*, thus preventing the herders from buying fodder in a sufficient quantity.

Delivery of appropriate social services is one of the still unsolved problems for herders. Particularly, there is limited access to the achievements of modern civilization. As of 2001, herder households with electricity sources accounted for 18.2% in *Dornogobi Aimag*, 15.4% in *Dundgobi* and 33.7% in *Umnugobi Aimag*; households with TV sets accounted for 17.6%, 13.3% and19.2% respectively in the *Aimags*.

Herders are scattered across vast territories, which causes significant logistical problems for the delivery of social services. In addition, because of the constraints caused by the transition to a market economy, budget resources allocated for rural education and health have been reduced, so rural people, especially people in remote regions have poor access to quality health service.

School dropout, especially among rural boys is more common among poor, small size families and women headed families. The coverage of social insurance is very low among rural population, seriously jeopardizing the social security of herders in the future.