

A Short Introduction to the Surface Water Resources and Hydrography of Mongolia

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Abstract

Mongolia is the meeting place of three large river catchments having separate outlets: the Arctic ocean, the Pacific Ocean, and the Central Asian territory. Western Mongolia, which covers about 35 per cent of the total area of the country, drains the central Asian territory. From a hydrographical viewpoint, the study of these river catchments is an interesting phenomenon. Because this is a self-contained hydrological system (i.e., the rivers do not flow out of their catchment area but mostly end in lakes), it is especially suited for investigations of the water cycle. In such a system a variety of ecological and hydroclimatic regions can be found close together — glaciers, tundra, forests, steppe, and desert, all situated along a river.

Introduction

Mongolia is situated on a highly elevated plateau surrounded by mountains. In general, Mongolia is a mountainous country with an average elevation of 1,580masl. The mountains are largely concentrated in the western part of the country where the highest peak has an altitude of 4,374masl. The total land area of the country is 1,566,500sq.km. Half of the land area of Mongolia is above 1,400m, 75 per cent is above 1,200masl, and 85 per cent is above 1,000masl. The lowest point is only 560masl high. The principal orographic elements of the country are the Mongolian Altai and Gobi Altai to the west and the Khangai to the north. The Great Lakes lie between the Mongolian Altai and Khangai. To the south, the Khangai formations are separated from the Gobi Altai by a valley that is dotted with lakes.

There are more than 3,800 rivers and streams with regular runoff and some 8,000 rivulets. Most are mountain rivers. Mongolia has 187 glaciers with a total volume of 63km³. There are 3,000 lakes with a total surface area of 15,600sq.km. and a total volume of 500km³. There are about 120 mineral water sources. The total amount of renewable water resources is estimated to be 34.6km³ per year, 12.6km³ of which are groundwater resources.

Climate

The climate of Mongolia is described as continental and features sharply defined seasons, high annual and diurnal temperature fluctuations, and generally low

precipitation. Because of the country's elevation, its climate is considerably colder than those of other countries at the same latitude. In southeastern Mongolia (Sainshand), the average annual temperature is 2° to 4°C; in the northwest (Uliastai), the average temperature is -7° to -5°C. Average annual temperature isopleths for the country are presented in Figure 1.

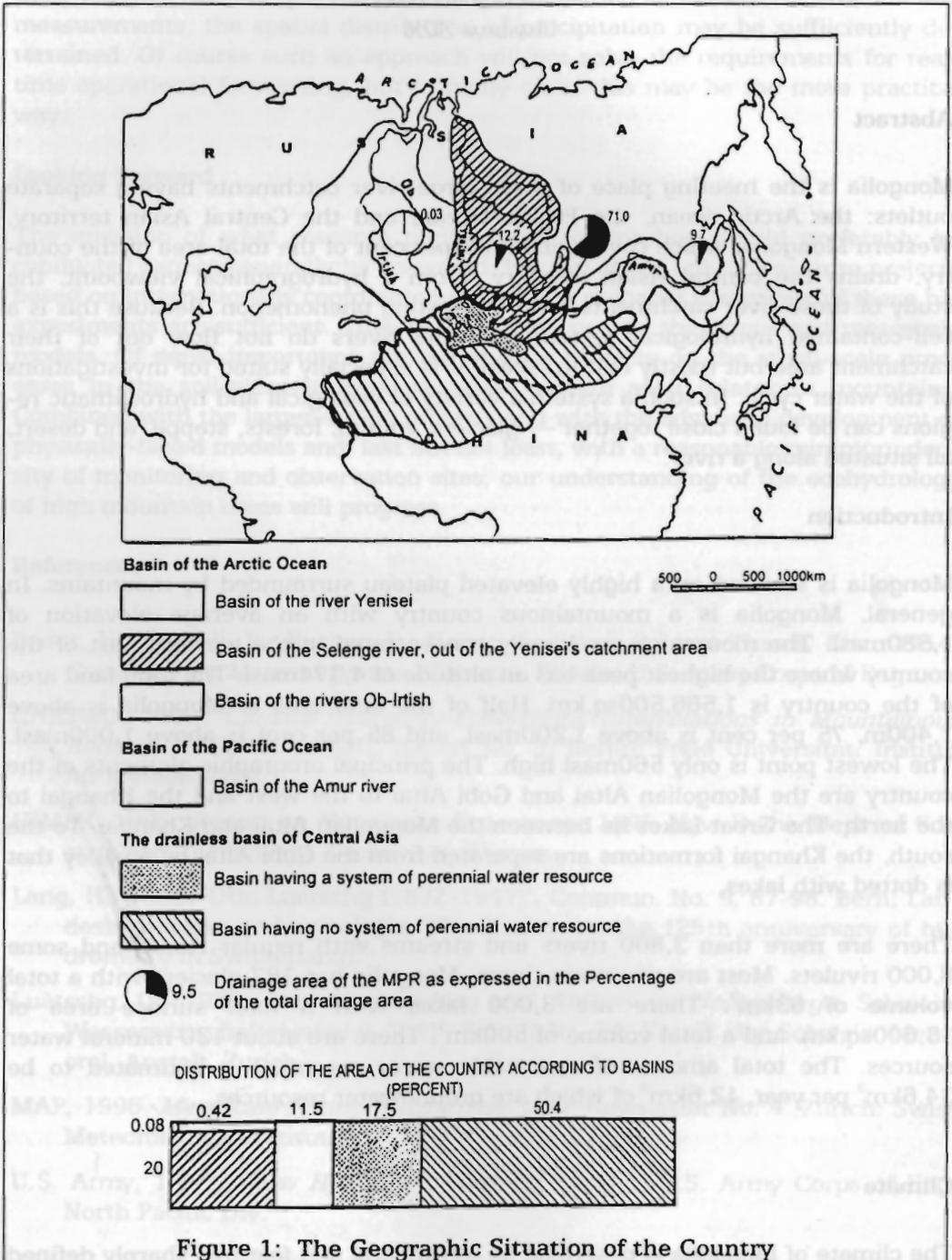


Figure 1: The Geographic Situation of the Country

Due to Mongolia's isolation from the oceans and their moderating influence on temperatures, fluctuations in temperature are extreme, both annually and diurnally. Temperatures commonly range over as much as 30°C in a single day, and the range between the average winter low temperature and the average summer high temperature exceeds 50°C. By comparison, the annual temperature range is 25°C in the countries of Eastern Europe at the same latitude. The maximum limits of yearly air temperature variation are between 81° to 98°C.

The country also has a season of intense winds, in April. These winds are often accompanied by dust storms over a large part of the country. Most of the time the wind direction in Mongolia is from west-north-west to east-south-east.

Precipitation over Mongolia is generally low, averaging from less than 50mm/year in the extreme southern Gobi desert region to somewhat over 500mm in some limited areas of the north with high mountain massifs. The average annual precipitation country-wide is 230mm. Precipitation occurs in the months of June, July, and August; the dry months are November through March.

The climatic features of Mongolia also include long winters (October to April) and a short growing season (4 months: mid-May to mid-September).

The evaporation from water surfaces is between 600 and 900mm while evapotranspiration is between 80 and 115 mm per year.

Hydrography

Mongolia has a considerable amount of surface and groundwater resources. The Selenge River, the largest river in Mongolia, and many other rivers of the country which feed the upper Enisei River empty their waters into the Arctic Ocean. The hydrographic network of the Pacific Ocean drainage basin is less developed than that of the Arctic Ocean drainage basin. The biggest river in the latter is the Khalkhin River which starts from the slopes of the Great Khyangan Mountains and drains into Buyr Nuur. There are also some major rivers, such as the Kherlen, Onon and Ulz, which arise on the eastern slopes of the Khentei Range in the same basin. Although the Kherlen River is the longest one in the basin, its yearly discharge is rather less than that of the Onon River, which comes second in terms of discharge rate after the Selenge River (Table 1).

Approximately two thirds of the territory of Mongolia belong to the Central Asian internal drainage basin. The major rivers of this basin are the Khovd River, which originates in the Mongolian Altai Mountains, and the Zavkhan and Tes rivers, starting from the western slopes of the Khangai mountains.

The hydrographic network of Mongolia is well developed in the northern and western parts of the country, in the mostly mountainous regions. There are fewer rivers in the southern, central, and eastern parts; their discharge is rather small and they end in depressions.

Table 1: Data on Selected Rivers in Mongolia

River	Observation station	Period of observation	Average discharge (m ³ /s)	Specific runoff (l/s/km ²)	Coefficient of variation and skewedness	
					Cv	Cs
Selenge	Zuunburen	1975-1994	259	1.75	0.35	0.70
Ider	Zurkh	1959-1994	36.7	1.85	0.34	0.68
Suman	Tariat	1964-1994	12.6	1.70	0.39	0.78
Delger	Muren	1947-1994	35.2	1.86	0.37	0.74
Eg	Khantai	1959-1994	98.0	2.39	0.26	0.52
Orkhon	Orkhon	1945-1994	45.4	1.25	0.40	0.80
Tuul	Ulaanbaatar	1947-1994	27.0	4.29	0.50	1.00
Kharaa	Baruun kharaa	1951-1994	10.1	0.93	0.51	1.02
Eroo	Eroo	1959-1994	55.3	5.94	0.44	0.88
Kherlen	Underkhaan	1959-1994	25.4	0.64	0.40	0.80
Kherlen	Choibalsan	1947-1994	20.1	0.28	0.48	0.96
Bogd	Uliastai	1966-1994	7.61	4.73	0.48	1.00
Khovd	Myangad	1965-1994	94.2	1.57	0.23	0.46

Mongolia has more than 3,800 permanent rivers with a total length of 67,000km. There are also many dry river courses in every part of the territory, but most of them are located in the mountains surrounding the Gobi desert valleys. Their lengths are often several tens of kilometres. The west of the country, in the valley of the Great Lakes, is where most of the big lakes of Mongolia are found. The major lakes are Uvs Nuur, Khyargas, Khar-Uus, Khar Nuur, Boon Tsagaan, Orog, and Ulaan Nuur, among others.

The average length of permanent rivers per square kilometre is as follows: for the whole country 0.005km, for the Mongolian Altai more than 0.25km, for the Khangai-Khentei mountain region 0.18-0.35km, for the Pacific ocean drainage basin 0.10-0.15km, and on the southern slopes of the Khangai it is less than 0.05 km (Surface Water of Mongolia 1996).

The meltwater from glaciers, together with snow, rain, and groundwater, are usually involved in the formation of river flows, but their roles in the recharge of rivers are different. In the Altai mountain region, the meltwater from snowcaps and glaciers plays a significant role, while in the Khangai and Khentei mountain region rainwater is the main source in the formation of river flows. There is an increasing prominence of rainwater in formational river flow processes from the south towards the north, while the role of snowmelt water compared to rainwater decreases anywhere from 55 to 75 per cent for the rivers (Khovd, Sagsai, and Byant) in the Mongolian Altai where rainwater contributes only five to 10 per cent to total river flows. For the rivers starting from the Khentei mountains (Kherlen, Tuul, Kharaa, and Eroo), the contribution of rainwater is five to six times higher than snowmeltwater. Groundwater usually provides about 20-40 per cent of the river water flow, but its importance decreases with the increase of the average elevation of the catchment area. The contribution of snowmelt and rainwater increases with the increase of the average elevation of river basins, but the rate of increase for rainwater is many times less than that of snowmeltwater. All the rivers of Mongolia have full flows in summertime, but seasonal and monthly flows vary regionally, depending mainly on recharge conditions. For instance, in the Mongolian Altai, most river flow formation occurs in July-August. In the rivers in the west near Khovsgol Lake and the northwestern

slopes of the Khangai mountains, the major flow occurs in May and June. As for rivers in the Khentei mountain region, full flow usually occurs in May and maximum flow in June and August. The rivers are under ice cover about 140-180 days per year.

The turbidity of rivers is very low (25-50g/m³) in their upper parts, but in their lower parts it increases to 200g/m³. The maximum turbidity of rivers occurs during the period of full flow and during floods. At such times, the rivers transport about 90 per cent of their annual sediments.

The full flow of rivers decreases from the north toward the south. The maximum flow of rivers (more than 200mm) is observed at the high altitudes of the Khangai, Khentei, and Mongolian Altai. The surface flow for the whole territory of the country varies between 50 and 100mm.

There are about 3,000 lakes in Mongolia. The total surface area of the lakes is equal to one per cent of the total area of the country. About 85 per cent of all lakes have less than one sq.km. of surface area. The lakes with more than 1,000km² in surface area cover only 0.2 per cent of the country's total area, but their surface area is equal to 58.6 per cent of the total surface area of lakes. Lakes are spread unevenly all over the territory of Mongolia. Most of them are located in the valleys in the northern and western parts of the country in the valley of the Great Lakes. Khovsgol Lake, the deepest one (262m) and the one with the most resources of fresh water, is located in the Selenge River basin (Table 2). According to their origin, the lakes can be divided into tectonic, volcanic, glacier, eolic, karstic, thermokarstic, blocked up, and modern accumulative lakes. About 13.3 per cent of all the lakes are located in the Altai mountain region, 20.8 per cent in the Khangai-Khentei mountain regions, 29.4 per cent in the eastern part of Mongolia, and 36.5 per cent in the Gobi Desert.

Table 2: Major Lakes in Mongolia

Lake	Surface area (sq.km.)	Average depth (m)	Maximum depth (m)	Volume (km ³)
Uvs Nuur	3,518.3	10.1	20.7	35.7
Khovsgol	2760	138	262	380.7
Khar-Us	1,495.5	2.1	5.27	3.1
Khyargas	1,478.6	50.7	84	74.9
Buyr Nuur	615.0	6.1	10	3.75
Khar Nuur	565.2	4.14	7.0	2.34

Mongolia has 187 glaciers on 38 mountain massifs located between 2,900 and 4,374masl. Their glacierised surface area is 530sq.km. Around 80 per cent of the glaciers are situated in the western part of Mongolia between longitudes 87° and 71°N. Approximately 62 per cent of the glaciers are small ones, their total surface area being 42sq.km., that is, only eight per cent of the total glacierised area; 11 glaciers have a surface area exceeding 10sq.km. and a total surface area of 311sq.km. which represents 57.4 per cent of the total glacierised area of the country. The largest one, Potanin Glacier, located in the western part of the country, has a surface area of 53.5sq.km. (Tsvetkov et al. 1996).

Water Balance

The estimated total amount of precipitation in Mongolia is 361 cubic kilometres each year, or 230mm on the average. The distribution of this precipitation is uneven, with the vast majority falling in the northern mountainous regions. Roughly 90 per cent of the total water received by the country in the form of precipitation is lost by evapotranspiration. This is an extremely high loss compared to other regions at similar latitudes. Out of the remaining 10 per cent of precipitation: i) 63 per cent becomes surface runoff. Most of this surface component 95 per cent flows out of the country, while a small portion (5%) ends up in lakes and basins within Mongolia) and ii) 36 per cent infiltrates the soil and contributes to subsurface reserves and flow.

Thus, of total annual precipitation, only roughly six per cent is transformed into available water resources in surface water bodies (and most of this flows out of the country without being utilised), while only about three per cent becomes potentially available as water resources in the form of soil moisture or groundwater balances — this is in contrast to other regions at similar latitudes, in which 30-40 per cent of precipitation remains available.

References

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