

셀렝게강 유역 통합물관리 모델 개발

Integrated Water Management Model for the Selenga River Basin, Mongolia

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요 지

셀렝게(Selenga)강은 몽골에서 발원하여 세계최대의 담수호로 알려진 러시아 바이칼호로 유입되는 국제하천으로서 소비에트 연방해체 이후 계획경제가 무너지면서 다양한 물환경문제에 노출되어 있다. 몽골의 경우 도시개발이 급격히 진행되고 있으나 처리시설의 미비로 인한 오폐수 배출 및 무분별한 광산개발에 따른 수질오염문제가 현안이 되고 있으며, 러시아(브리아트공화국)는 계획경제의 붕괴에 따른 산업구조의 변화, 처리시설의 부족 및 운영의 비효율성, 산림자원의 개발에 따른 비점오염부하의 증가 등의 수질문제 해결이 요구된다. 몽골은 자연적인 특성상 광물질을 많이 포함하는 지표수 성상 및 매우 적은 강우량으로 인한 수자원의 부족, 지역별로 극심한 물공급량의 불균형, 산업개발에 따른 지하수 오염 등의 문제를 포함한 수자원 부족이 해결해야 할 현안과제이고, 러시아는 수자원은 매우 풍부하나 공급시설의 낙후 및 비효율적인 운영으로 인한 물 공급 시스템의 개선이 절실히 요구되는 상황이다. 물 환경관리 체계를 보면 양국 공히 대내적으로는 이용 및 공급 주체별로 분화된 물 관리체제로 인해 부문간 통합성이 결여되어 있으며, 대외적으로는 셀렝게강 상하류 물이용·개발, 수질보전 및 수생태계보호와 연관된 문제해결을 위한 몽골과 러시아간의 국제적인 협력시스템이 없는 실정이다. 경제개발에 따라 최근 수질오염 및 물이용·개발과 관련된 이해당사자 간의 갈등이 심화되고 있어 이를 지역, 국가, 국제적인 차원에서 조정할 수 있는 통합관리시스템의 구축과 이해당사자의 인식제고 및 자체적인 관리능력 배양을 위한 역량강화프로그램의 개발·운영이 요구되고 있다. 따라서 본 연구에서는 동지역에서 기초현황조사, 물 환경현안 파악, 물 관리정책 및 체계와 문제점을 파악하고 향후 DPISR(Drivers-Pressures-Impact-State-Response) 분석이 가능하도록 물환경관리와 연관된 물환경상태, 현안, 원인, 영향 및 대책을 종합적인 관점에서 분석하며, 해외의 주요 국제하천의 물 환경관리모델에 대한 사례분석 및 비교연구를 통해 물이용 및 개발과 관련된 이해상충 조정체계를 개발하고자 하였다.

핵심용어: 물환경관리모델, 통합물관리, 국제하천, Selenga

1. Introduction

The river Selenge is the biggest water artery in Mongolia and Russia's Buryatia forms one half of the water flow into Lake Baikal which is a world heritage site and the biggest natural reservoir of pure water, containing 20% of the world's fresh surface water (see Figure 1). Lake Baikal and Hubsugul have strategic reserves of drinking water comparable to the

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world's reserves of oil and gas, and water ecosystems are characterized by unique biodiversity.

In addition, the Selenge River Basin is the most advanced economic zone within Mongolia and Russia's Buryatia. The Russian part, occupying 31.5% of the territory of the Republic of Buryatia, accounts for 90% of industrial and 83% of production. A similar situation is observed in the Mongolian part of the basin.

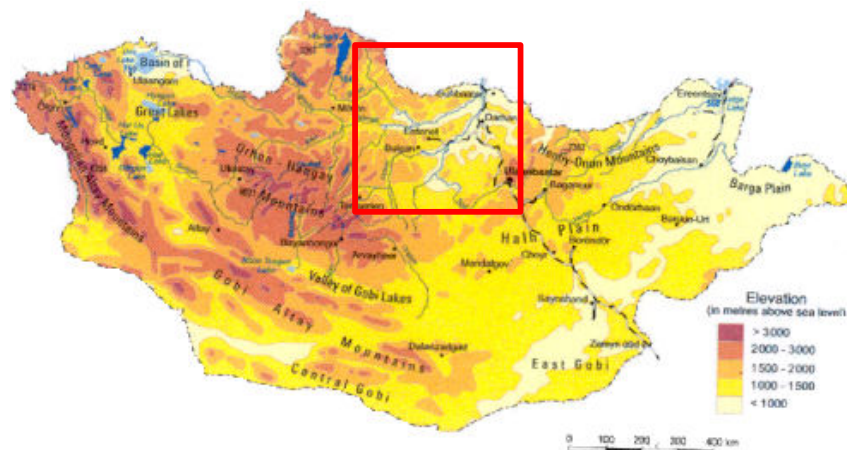


Figure 1. Geographical Location of Selenge River Basin

The river also plays an environmentally important role. It contains plentiful fish stocks, one of which is the Baikal Sturgeon, listed in the Mongolian Red Book. The associated wetlands are valuable wildlife habitats and the river valley is an important flyway and corridor for the migration of birds between the Pacific, Arctic, and Indian Oceans (Dallas, 1999). Freshwater systems in the Selenge River Basin are subject to increasing and multiplying threats, including overgrazing, dams and irrigation systems, mining and gravel extraction, climate change impacts and lack of water management policies, institutional frameworks, and international cooperation network systems.

2. Transboundary issues

Geographic and hydrological conditions

The international basin of the Selenge River is situated in the center of Eurasia, close to the watershed basins of the North Arctic and Pacific Oceans and the closed basin of Central Asia. In terms of its landscape, the Selenge River Basin is located in the area of contact with the taiga and steppe zones, which conditions the development of the natural environment, characterized by a high level of biodiversity and high sensitivity to external impact.

The river was formed after the confluence of the rivers Delgermuren and Yider, its source is considered to be the river Yider, which is longer and fuller. Crossing the uplands of the Northern Khalka in the north-eastern direction, the Selenge River turns north at the Orkhon River and accumulating the waters of its many tributaries flows into Lake Baikal. At inflow it forms a unique freshwater delta with the total area of 546 km² (before the

construction of Irkutsk hydroelectric station its area was 680 km²), which is considered a water-swampy area of international significance (object of the Ramsar convention from 1975).

Interstate borders divide the Selenge River Basin into two unequal parts: its prevailing upper part is within the Russian Federation while the lower part is in Mongolia. The hydrographic characteristics of the Selenge River is tabulated in Table 1.

Table 1. Hydrographic characteristic of the Selenge River

State	Length, km	Catchment area, thousand km ²	Ratio of catchment of Lake Baikal , %	Avg. annual river flow, km ³	Ratio of inflow into lake Baikal, %
Mongolia	534.0	282.0	55.4	14.1	23.3
Russian Federation	409.0	148.1	27.4	32.5	28.8
Total	943.0	430.1	82.8	46.8	52.1

The lower part of the Selenge River Basin is exposed to transboundary impact. This part belongs to Baikal natural territory, within which the special regime of economic activity was established by the Russian legislation. It is vitally important to note that Mongolia did not identify any environmental requirements for the use of natural resources in the upper part of the basin. Moreover, the present-day period is characterized by large-scale violations of existing standard regarding national nature-protection legislation.

A hydrological regime for the Selenge River from the Mongolian border to the inflow into Lake Baikal is characterized with fluctuations of discharge from 30 m³/sec during the winter low-water period to 7,620 m³/sec during the summer flooding period. The average annual flow of the river Selenge according to Buryat Center for Hydrometeorology in 2000–2005 was 32.5 km³. No remarkable tendency for the reduction or rise of the average water level was noted.

Social-economic and geopolitical conditions

The upper flow the Selenge River crosses the central region of Mongolia which is comprised of powerful sources of industrial pollution, connected with enterprises for the production of non-ferrous, rare, and precious metals, brown coal, and other minerals in the cities of Bulgan, Darkhan, Muren, Ulaanbaatar, Sharingol and Erdenet. The Mongolian part of the basin occupies 20% of the territory, includes 65% of the population, and accounts for 80% of industrial and 60% of agricultural production. Today the population and industries are concentrated in the Central region, placing a considerable load on the environment. Moreover, the expected social-economic breakthrough in Mongolia is entirely connected with the development of the resources of the Central region. Nowadays there are a number of big foreign companies, including Russian ones, getting ready to start work on the unique deposits (explored by Russian specialists). The total amount of Russian investment until 2020 may reach 5.5–6 billion US\$. Investments in production capacities through joint enterprises

("Erdenet", "Mongol Rostsvetmet") produce about 30% of GDP and total roughly 50% of Mongolia's exports. The development of natural resources is closely connected with the joint projects of the development of energy, machine-building, transport infrastructure aimed at strengthening the economic and political influence of Russia in Mongolia.

As a result, quite a contradictory situation has unfolded. A possible scenario of its development is that in the near future (till 2020) the industrial centers of Mongolia will have an impact on the condition of the environment in Russia. Since the Russian basin already faces the negative situation with water quality of the Selenge River, the powerful inflow containing industrial pollutants will cause a multifold growth of pollution of the main tributary of Lake Baikal and consequently Lake Baikal itself.

Present-day use of water resources in the Selenge River Basin

Today, the main uses for water resources in the Selenge River Basin are: (1) water supply for the population, industry, and (2) agriculture drainage water discharge, (3) production of mineral resources, fishing, navigation, and recreation

The total amount of water withdrawal in 2004 was 919.3 million m³, from which 70 % of water withdrawn from surface water objects. The amount of water, dumped into the river network, was 660.9 million m³ which enabled to regenerate the resources of surface water in separate sections of the Russian part. The total amount of the used water flow in 2004 was equal to 2% of the average long-term period, including irrevocably less than 1%, which testifies to the huge unrealized opportunities of using water resources.

None the less, the present problems of water use in the Selenge River Basin are rather acute, especially in Mongolia. This is connected with the disproportion of territorial distribution of the river flow and water consumers, rapid growth of demand for water, limitedness of the underground water reserves, and specific local problems (abrupt seasonal variations of the river flow, weak ability for self-purification of the flow, high natural concentration of some micro-elements). The intense situation is observed on the rivers Orkhon, Tuul, Kharaa where the biggest water consumers – the cities of Darkhan, Ulaanbaatar and Erdenet are situated and the water resources, especially in the winter period, are limited and do not allow for the further allocation of water-consuming industries and growth of the urban population.

3. River networks in Mongolian part

The Selenge River was formed by the confluence of the Ider and Delgermurun rivers. The Ider River originates southeast of the Otgontenger, the highest peak of the Khangai Mountain range. Within the Selenge River's watershed area 425,245 km², from this 282,050 km², or 66% of the catchment area are located in Mongolia. It's run 534 km before crossing the Mongolian border. The main tributaries are the Orkhon, Khanui, and Eg (refer Figure 2).

The largest tributary is the Orkhon River, which is Mongolia's longest river. Its total length is 1,124 km and its catchment area is 133,000 km², which represents about 47% of the Selenge's catchment area. The width of the river is from between 50 and 150m. Its depth is

from between 4 and 50m, with part of the chute between 1 and 1.5m. The velocity is 2.0–2.5 m/s and parts with a shallow depth are 0.5m and 1m/s.

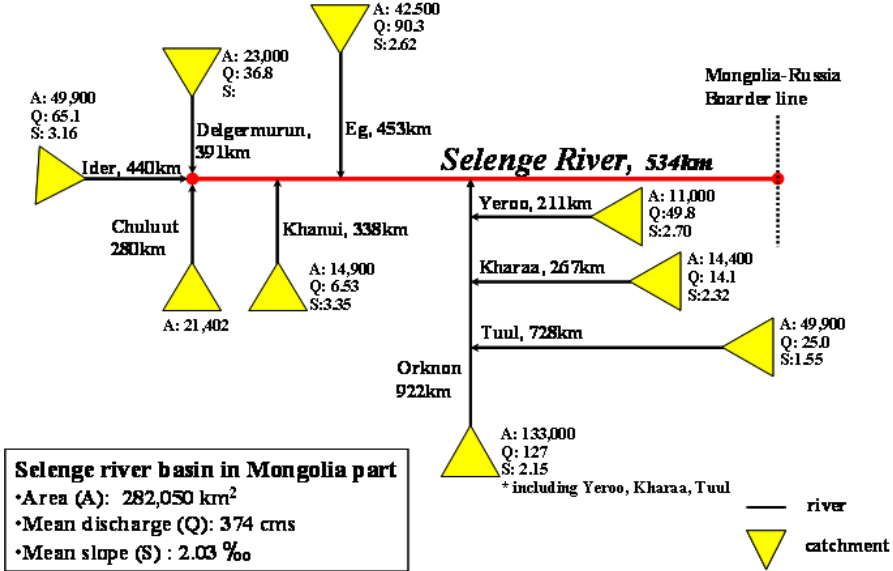


Figure 2. Schematic of Selenge River Basins in Mongolian park

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