GOVERNMENT OF MONGOLIA

MINISTRY OF ENVIRONMENT AND GREEN DEVELOPMENT

INTEGRATED WATER MANAGEMENT PLAN
MONGOLIA

Ulaanbaatar
2013

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INTEGRATED WATER MANAGEMENT PLAN OF MONGOLIA

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List of abbreviations

ADB	Asian Development Bank
CNDS	Comprehensive National Development Strategy
FA	Forest Authority (former)
GASI	General Agency for Specialized Inspection
GDP	Gross Domestic Production
GEI	Geo Ecological Institute
GIS	Geographical Information System
GNI	Gross National Income
GOM	Government of Mongolia
HDI	Human Development Index
IFAD	International Fund for Agricultural Development
IMF	International Monetary Fund
IMHE	Institute of Meteorology, Hydrology and Environment
IWRM	Integrated Water Resource Management
MARCC	Mongolia: Assessment Report on Climate Change 2009
MCUD	Ministry of Construction and Urban Development
MDG	Millennium Development Goals
MECS	Ministry of Education, Culture and Science (former)
MEGD	Ministry of Environment and Green Development
MES	Ministry of Education and Science
MF	Ministry of Finance
MFALI	Ministry of Food, Agriculture and Light Industry (former)
MIA	Ministry of Industry and Agriculture
MMRE	Ministry of Mineral Resources and Energy (former)
MNET	Ministry of Nature, Environment and Tourism (former)
MNT	Mongolian Tugrug
MoMo	Integrated Water Resources Management in Central Asia: Model Region Mongolia
MRA	Mineral Resource Agency
MRTCUD	Ministry of Roads, Transportation, Construction and Urban Development (former)
MUST	Mongolian University of Science and Technology
NAMHEM	National Agency for Meteorology, Hydrology, and Environmental Monitoring
NDIC	National Development and Innovation Committee
NETD	Nature Environment and Tourism Department

NFC	National Forest Committee
NGIC	National Geo-Information Centre for Natural Resource Management
NGO	Non-governmental Organization
NSO	National Statistical Office
NWC	National Water Committee
NWSI	National Water Security Index
RB	River Basin
RBA	River Basin Administration
RBC	River Basin Council
RBO	River Basin Organisation
SDC	Swiss Agency for Development and Cooperation
SIK	State Ikh Khural
SPC	State Property Committee
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNDP	United Nations Development Program
USUG	Ulaanbaatar Water Supply and Sewerage Company
WA	Water Authority
WB	World Bank
WBA	Water Basin Administration
WBC	Water Basin Council
WHO	World Health Organization
WWF	World Wildlife Fund
WWTP	Waste Water Treatment Plant

PART A – INTRODUCTION

1. Background

1.1. Water management in Mongolia

Box 1.

'Failing to plan is planning to fail'

(Alan Lakein)

Most of Mongolia lies in arid and semi-arid climate zones. Nevertheless the volume of renewable water available per capita exceeds 10,000 m^3/year, which is more than in most other countries in the world. This seeming contradiction can be explained by the country's population density of only 1.77/km^2, which is the lowest in the world. Obviously this is also the essence of water management in Mongolia: the country as a whole does have a tremendous potential of fresh water resources, but these are thinly distributed and dispersed across a vast area. The water management challenge is to make this thinly distributed resource available at the locations where the needs are. Mongolia intends to develop this resource to benefit its population, while minimizing the adverse impacts this may have on the natural environment and ecology.

Despite the huge amount of renewable water in the country, its availability is unevenly distributed in space and in time. Measures are needed to ensure that users receive the water they need of the right quality, at the right place and on the right moment. These measures are not limited to infrastructure only, but also include assessment, research, capacity building, rules and regulations, organizations, monitoring and enforcement. At some specific locations in the country economic activity is rapidly intensifying and urbanization is growing fast. There, water use is rising sharply, going hand in hand with increased production of waste and waste water. Water resources are being polluted in the process, harming ecosystems and the environment and rendering the source unfit for consumption and other uses. Some locations face water shortages, others suffer from occasional floods. This is addressed in this Integrated Water Management Plan.

1.2. Why a National Water Management Plan?

The Law on Water of Mongolia states that an Integrated Water Management Plan should be developed and approved by the Government. Water management however, is not an objective in itself; water management should support the development of the socio-economic sectors while protecting the environment. Therefore the National Development Goals as laid out in the MDG-Based Comprehensive National Development Strategy of Mongolia (2008) provide the direction for Mongolia's socio-economic development and this Integrated Water Management Plan (IWM Plan) should aim to provide – in a sustainable manner - the water necessary for achieving these socio-economic development goals. Hence water management supports the government policies derived from this development strategy. The objectives of the MDG-Based Comprehensive National Development Strategy of Mongolia can be summarized as: (i) Social improvement, (ii) Economic development and (iii) Environmental conservation. The IWM Plan in particular aims to support these objectives.

In follow up of the MDG-Based Comprehensive National Development Strategy of Mongolia the Government has developed the Water National Programme. The

Programme was approved in May 2010 by the Mongolian Parliament and specifies the objectives, strategic goals and required actions. The actions are planned for implementation in two phases. The first phase will be completed in June 2015 while the second phase will end in June 2021. The Water National Programme is comprised of a detailed list of actions that are deemed necessary to achieve the strategic goals. This IWM Plan has incorporated much of the Programme and links the actions to specific problems or issues and evaluates these actions in terms of effectiveness, economic efficiency, environmental sustainability and social equity.

Therefore the IWM Plan provides the underpinning of the actions proposed in the Water National Programme, providing a scientific basis, regional detail, and a methodical approach for ranking the actions including their impacts assessment and risks. The IWM Plan is supported by in-depth analyses that make use of extensive hydrological and economic calculations. The sector development goals are linked to the way water resource development and management are needed to achieve these sector goals. Also the IWM Plan includes a quantified evaluation of the actions on the basis of the criteria specified in the Water National Programme and other sectors' programs as well as a detailed implementation plan on responsibilities and financing (who will do what, when and how will it be financed). The methodological approach for the IWM Plan, which includes a conceptual framework (analysis steps) and a computational modeling framework, is described in Annex 1.

The IWM Plan is a plan at national level. It focuses on those issues that need to be addressed at the national level. Issues that can be solved at a regional or local level will be addressed at those levels. This is known as the '*principle of subsidiarity*'. Subsidiarity is the principle of devolving decisions to the lowest practical level or in other words: delegate the handling of all matters to the smallest, lowest or least centralized competent authority. This means that the IWM Plan focuses on national issues such as major investments (e.g. reservoirs), inter-basin transfers (e.g. to the Gobi, upstream-downstream) and nation-wide actions (e.g. legislation, monitoring). Local and regional issues will be addressed in the water basin[1] plans that are being developed in the context of this national plan.

1.3. Strategic goals and objectives for water management in Mongolia

Good planning practices start with today's vision on how we see the future. Our vision for water management is:

"We envision a Mongolia in which all people have access to affordable, safe and sufficient water resources to meet all their needs and development ambitions, in sustainable ways that maintain the integrity of the country's environment and ecosystems. A national awareness of the vulnerability of the country's water resources and environment brings about the development of new institutional frameworks for managing the country's water resources in an integrated manner at all levels, from the individual to the national, to serve the interests of all Mongolians and their country – effectively, efficiently, and equitability"

The mission for the IWM Plan is to make a major contribution towards realizing this vision. Based upon this mission four strategic goals are formulated and five objectives. These strategic goals and objectives of the IWM Plan are derived directly from the sector policies of the MDG-based Comprehensive National development Strategy and the

1 The term 'water basin' is the general term for the basins in Mongolia. The term 'river basin' is used for water basins with perennial rivers. Both terms are used in this plan consistent with the terminology of the Law on Water.

Water Management mission and are presented in Figure 1. The relations between these strategic goals and objectives and the over-arching MDGs-Based National Strategic Goals are described in more detail in Chapters 6 and 7.

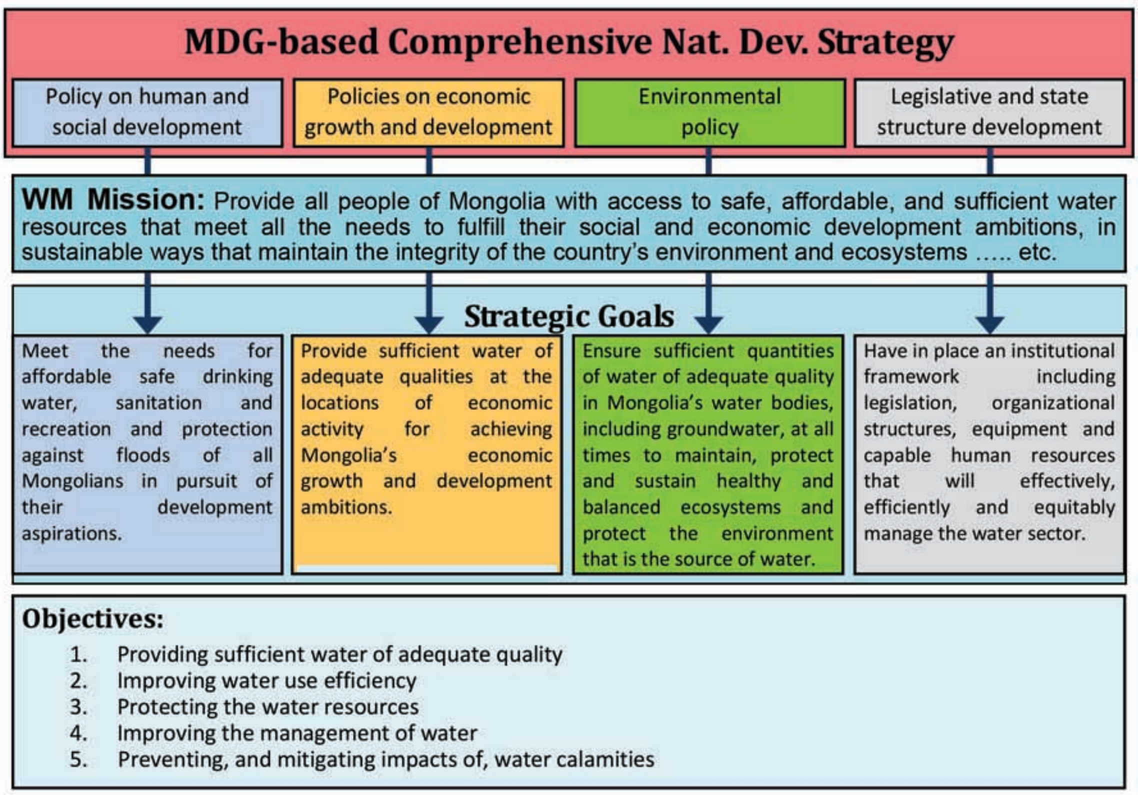


Figure 1. Mission, Strategic Goals and Objectives of the IWM Plan

1.4. Integrated Water Resources Management (IWRM) approach

The strategic goals can be summarized as '*Aiming for a water-secure Mongolia*'. Lately the concept of water security is intensively discussed in international forums and is gradually maturing as a framework for formulating development goals. At the same time the concept of 'Green Growth' or 'Green Development' is gaining ground. Green Growth supports economic growth as a driver for development, including water security, while ensuring environmental sustainability.This introduces a whole set of boundary conditions on the ways to achieve the goals and IWRM provides the approach to achieve the goals within the constraints of these boundary conditions. This IWM Plan aims at improving Mongolia's water security in an environmentally sustainable manner and applies the IWRM principles to achieve that. Internationally IWRM has been accepted as the preferred approach for water management. IWRM made water managers to change from a mainly supply-oriented, engineering biased approach towards a demand-oriented, multi-sectoral approach.

> **Box 2. Definition of IWRM**
>
> IWRM is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.
>
> GWP, 2000

Important principles of IWRM are the participatory approach, the recognition of the economic value of water and the emphasis on sustainability.

The IWM Plan applies the general principles of IWRM requiring that the approach should be employed in all planning activities related to water. Exactly how these IWRM principles have to be applied depends on the local situation. IWRM is in particular valuable in situations with conflicts between stakeholders and where decisions need to be made on allocation of scarce resources such as land, water or finances.

Not in all cases such competition for resources is immediately obvious as some stakeholders do not have a voice e.g. the environment and the poor. The IWRM approach ensures that all affected people and environmental issues are always addressed. Some regions in Mongolia are very thinly populated and have sufficient water. Withdrawals from the water system in these regions are very unlikely to lead to conflicts with other users. However polluted return flows (sewage, drainage, mining, etc.) could have adverse impacts that need to be addressed. In such situations water management following an IWRM approach can be limited to just those issues. IWRM is particularly useful in situations with high population pressure, with concentrated economic activities, or where interventions are planned with a major impact on the available resource. Examples are the Tuul and the Orkhon river basins, the mining developments and hydro-power dams.

The national principles and guidelines for water development and management in this IWM Plan are based on the IWRM approach. Rather than using the term 'IWRM Plan' the term 'IWM Plan' is preferred because besides the management of water resources the plan also deals with water uses and water demands. The national IWM Plan guides the development of IWM plans for the 29 water basins in Mongolia. The IWM Plan also addresses the issues that play at national level (e.g. on energy and monitoring) and projects that involve inter-basin transfer.

1.5. Main IWRM challenges in Mongolia

Mongolia does have sufficient water, by volume, to support its population and economic activities, also in the future. The main issue is that this water is not available at the right place, on the right moment and of the right quality. The infrastructure needed for a sufficient and safe provision of water to the users is far from adequate. The institutional structure to develop and manage the water resources still has not fully adapted to the new market economy since its change from a socialist system in 1990. The government is presently rebuilding that system. The IWM Plan is an instrument to identify the most important issues and the actions needed to solve these. These issues and actions are described in the following chapters. The main challenges appear to be the following:

Improving water conditions in and around urban centres

The rapid urbanization in Mongolia and the inadequate water management organizations has resulted in very poor water conditions in most of the urban centers. In many places the supply of drinking water is below standard. The same, but usually worse applies to sanitation, sewage and waste water treatment. This requires major investments in infrastructure but also the development of better organizations that take care of the domestic, municipal and industrial supply, sewage system and treatment and a corresponding financing structure to cover the capital costs and the operation and maintenance (O&M) of the system. A particular hotspot in this respect is the capital Ulaanbaatar but the water supply and water quality issues of the other urban centers will also be addressed.

Mining, water supply and safeguarding environmental impacts

The mining industry is the motor behind the present economic growth. The water resource system has to support this economic activity by providing, where possible, the water they need. The mining industry needs water for their operations and but also the new cities that grow around the industry need to be provided with water. This may require transportation of water over long distances, e.g. to the Gobi. Mining, due to the size and nature of its operations, has the potential to severely impact its surroundings in more than one way. Procedures should be in place to ensure that the environmental impacts of the mining operations do comply with water quality and ecological standards for surface water and groundwater. This applies for the larger mining industries but also for the Artisanal and Small-scale Mining (ASMs, also known as “ninja’s”).

Supply of water for herders

The water supply for pasture lands is in serious disrepair and urgently needs to be improved, not only as drinking water for the livestock but also to prevent pasture degradations. Traditionally individual water points were constructed for livestock watering including both deep, high yielding tube wells and shallow herder-made wells. Due to a lack of maintenance and unresolved ownership issues the engineering type wells in particular have degraded during and after the transition period and the number of operational wells has sharply declined. This forced herders to move their stock to areas around the decreasing number of operational wells and close to rivers. The carrying capacity of the pastures in these areas is far exceeded; causing serious land degradation leading to unsustainable situations.

Developing the national hydropower potential

Mongolia’s energy demand is expected to grow fast due to urbanization, increased welfare and a steep economic growth. At present most of the electricity is generated by coal-fired power plants, 5% of the electricity needs is imported from abroad and a minor part (< 4%) is from hydropower. The potential for hydropower however is significant. Coal-fired plants are a major source of air pollution and their intake of cooling water and their heated discharge potentially have considerable environmental impacts. Hydropower provides a clean source of energy. The downside of hydropower is that suitable locations for hydropower dams are often far from the industrial and population centres requiring long transmission lines that are costly and are a source of energy losses. The impounding of the reservoirs and the controlled release from the reservoirs do have considerable ecological impacts in the basin. The pro and cons of hydropower development depend on the location and are evaluated on a case by case basis.

Institutional framework for water management

The water sector in Mongolia is institutionally complex and dispersed, especially at national level. Mandates and responsibilities are not always clear, subject to interpretation, and overlapping on several issues, while at the same time some necessary water management functions have not been assigned at all. A recent UNDP project document (2009) characterized the institutional organization of the water sector as “The water sector in Mongolia is one of the most disorganized to be found...” At least six ministries have responsibilities in water management. A Government restructuring in 2012 completely changed the water management organizational structure. The National Water Committee was elevated to resort under the Prime Minster and was strengthened with a technical support unit, while the Water Authority was dissolved to be replaced by Water Basin Authorities in the 29 water basins. In the recent past about 15 (sub-) Water Basin Councils have been established. These WBCs are still young, institutionally immature and need to further develop their capabilities especially in the field of IWRM.

Policy development for water management

The MDGs-Based Comprehensive National Development Strategy also provides the framework for water management in Mongolia. There are many sector policies in Mongolia with a bearing on water resources and/or water management. Most of the water related issues in these policies have been incorporated in the Water National Programme (WNP) with the notable exception of institutional and capacity building issues. Commonly sector policy and program implementation is poorly monitored and inconsistently reported on. Often it is not clear whether, and to what extent, a new policy is an addition to, or a replacement of a previous policy. Policy documents are found to typically focus on measures (solutions) and provide hardly any problem analysis. The WNP provides a solid starting point for this Integrated Water Management Plan.

1.6. Main outcomes of the IWM Plan

Through analysis of the challenges a total of 88 measures were formulated to address the 96 issues that have been identified. The costs for implementing these measures have been estimated to amount to just over 7.8 trillion MNT. Out of this about 3.0 trillion MNT (39%) is expected to be financed by the private sector, 24% (about 1.9 trillion MNT) from the state budget, 5% (about 0.4 trillion MNT) from local budgets and 32% (about 2.5 trillion) through foreign loans and grants. Over and above that an amount of about 0.96 trillion MNT will be needed to cover the recurrent costs for the new investments during the implementation period till 2021 and after that to continue at an estimated 294 billion MNT annually (at current prices).

As a result of the implementation of this IWM Plan Mongolia's water security will improve. According to the Asian Water Development Outlook 2012 Mongolia's National Water Security Index was 2 on a scale of 1 to 5 in 2010, with an indicator value of 2.00. After having implemented the IWM Plan completely by 2021 the indicator value is estimated to rise to 2.60, which is an increase of 30%. The NWS Index would still be at 2, but by then Mongolia would approach the 2010 water security level of the Republic of Korea.

1.7. Planning a continuous exercise

Any plan, also this IWM Plan, is based on existing data and on information and present thinking about issues and priorities. New data and information will continue to become available and conditions with respect to socio-economic developments will change. Therefore planning needs to be seen as a continuous process in which this IWM Plan will be updated regularly, e.g. each 5 years. The data, available for developing the present IWM Plan, was limited and one of the actions recommended in the Plan is to extend and improve the monitoring of the water system, as well as the data storage and accessibility. At the same time the IWM Plan recommends strengthening of the planning capacity in the water sector, in particular for the National Water Committee (NWC) and its technical support unit, but also at the other stakeholder ministries, the Water Basin Authorities (WBAs) and at Water Basin Councils (WBCs). Together that should result in a strong information base for the next IWM Plan. The lack of certain information and data used in the present IWM Plan should therefore not be seen as an omission but as a challenge to make that information and data available for use in the next version of the IWM Plan.

1.8. Outline of this IWM Plan

This document describes the Integrated Water Management Plan of Mongolia. The content of the Plan is structured as follows:

▪ Introduction	Chapter 1
▪ The natural resources system	Chapter 2 and 3
▪ The users and their water demands	Chapter 4 and 5
▪ The policy and development context	Chapter 6
▪ The issues and how to address them	Chapter 7
▪ IWRM strategy, addressing the issues	Chapter 8
▪ Implementation of the plan	Chapter 9

The plan as presented in this document is based on an extensive analysis carried out by the Project team supported by several partner organizations such as the Institute of Geo-ecology, the Institute of Meteorology, Hydrology and Environment and the now defunct Water Authority.. This document provides the final results of the analysis and a summary of the information that is generated by the Project. This Plan is supported by 12 technical reports that are published separately as Integrated Water Management National Assessment Reports Volume I and II as follows:

Volume I:

1. Surface water resources assessment
2. HBV Hydrological modeling
3. Climate change
4. Groundwater resources assessment

Volume II:

1. Socio-economic development of Mongolia
2. Land use
3. Water quality and ecological assessment
4. Water supply, hydro constructions, water use and water demand
5. Wastewater treatment and sanitation
6. Mongolian legal arrangements for integrated water resources management
7. Institutional analysis of the water sector in Mongolia
8. Strengthening Human resources in the water sector

PART B – THE NATURAL RESOURCES SYSTEM – THE SUPPLY

2. Natural condition of Mongolia

2.1. General geographical conditions

Mongolia is a landlocked country located in Northeast Central Asia, between China and Russia. It is situated at a high elevation, on average 1580 m above sea level and forms the transition zone between the great Siberian taiga and the Central Asian desert. The geological history of Mongolia is characterized by periods of mountain folding and volcanism and subsequent periods of uplifting and subsidence. In the beginning the region was mountainous and rugged, with rivers flowing in all directions to the surrounding seas. After a very long period of erosion, the ancient continent was worn down almost to base-level, and since that time mountain-folding has not occurred. As a consequence a number of internally draining inland basins developed in the Gobi area. Ever since the Lower Cretaceous, when these changes took place, the region has been continental in nature.

Flat undulating steppe land with extensive grasslands forms the eastern part of the country. The central and western parts are characterized by the mountain ranges of Khentii, Khangai and Altai. The highest point in Mongolia is Khuiten Mountain at 4374 m above sea level in the Altai Mountains; the lowest point is Khokh Nuur valley at an elevation of 532 m in the north-east.

Figure 2. Topography of Mongolia

The total territory of Mongolia is 1,564,116 km^2. The distance from west to east is 2392 km and from north to south 1259 km. The country is listed as the eighteenth largest and least densely populated (1.77 persons per km^2) country in the world. The capital

Ulaanbaatar is located at an elevation of 1350 m above sea level. The other two main cities, Darkhan and Erdenet, are located 230 km north and 370 km northwest from the capital city, respectively.

2.2. Climate

Due to its inland location and mountainous topography the climate of Mongolia is continental, harsh and arid. The climate is characterized by long winters and short summers, large fluctuations in both daily and seasonal temperatures, a relatively high number of cloudless days and low precipitation falling predominantly (85%) in summer (*Figure* 4). The average annual precipitation is about 250-350 mm in the Khangai, Khentii, and Khuvsgul mountain regions; 150-300 mm in the Mongol Altai area; and 50-150 mm in the Gobi Desert (Figure 3). Most of the country is hot in the summer and extremely cold in the winter, with January averages dropping as low as -30˚C. The average annual temperature is between -7.8˚C and -8.5˚C.

Source: Gomboluudev, 2009

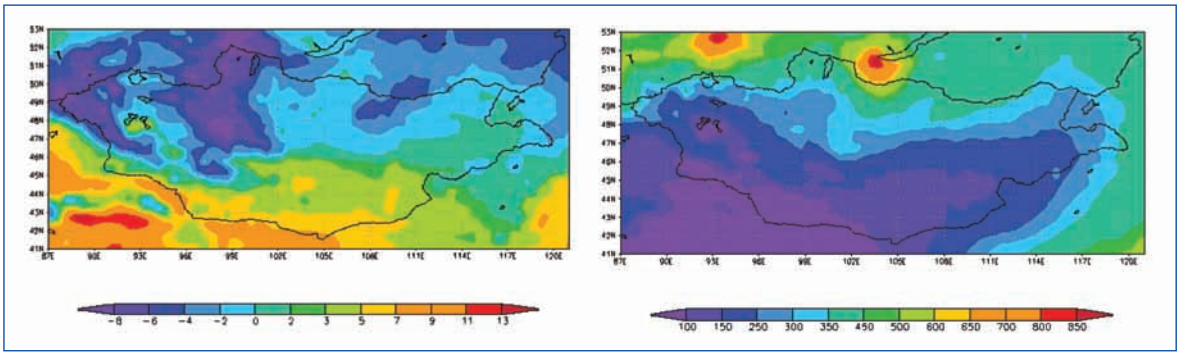


Figure 3. Geographical distribution of annual temperature in ˚C and annual precipitation in mm (1961-1990)

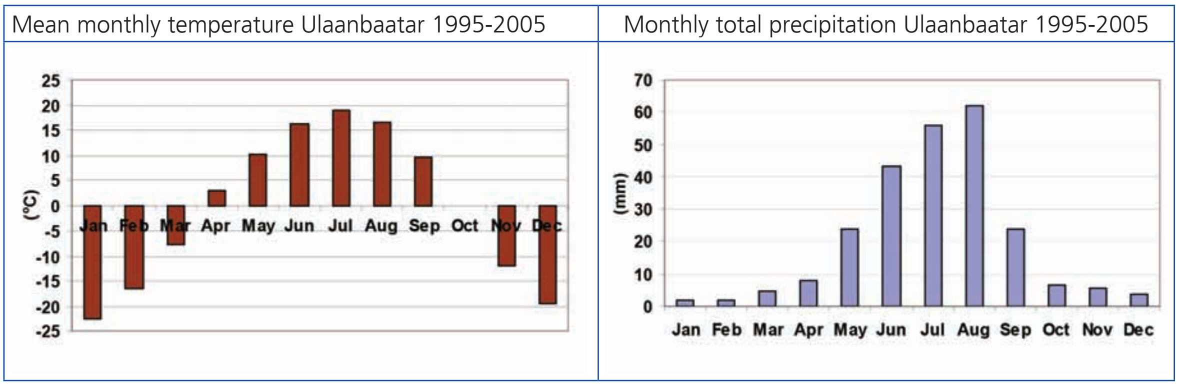


Figure 4. Monthly temperature and precipitation at Ulaanbaatar

Most precipitation falls in the Khangai, Khentii and Khuvsgul mountain regions. In these areas 60 percent of the precipitation is lost to the atmosphere again through evapotranspiration. The Altai mountain area is drier, but more water adds to the water resources as the evapotranspiration losses are smaller. In the Gobi region nearly all precipitation is lost through evapotranspiration.

Open water evaporation is around 300-400 mm in the mountain areas, 600-1000 mm in the steppe region and 1000-1300 mm in the Gobi area (Figure 5). Actual evapotranspiration losses are low in the mountain regions due to low temperatures. Actual evapotranspiration losses are low in the Gobi area due to a lack of water in the soil.

Source: National Atlas of Mongolia, 2009

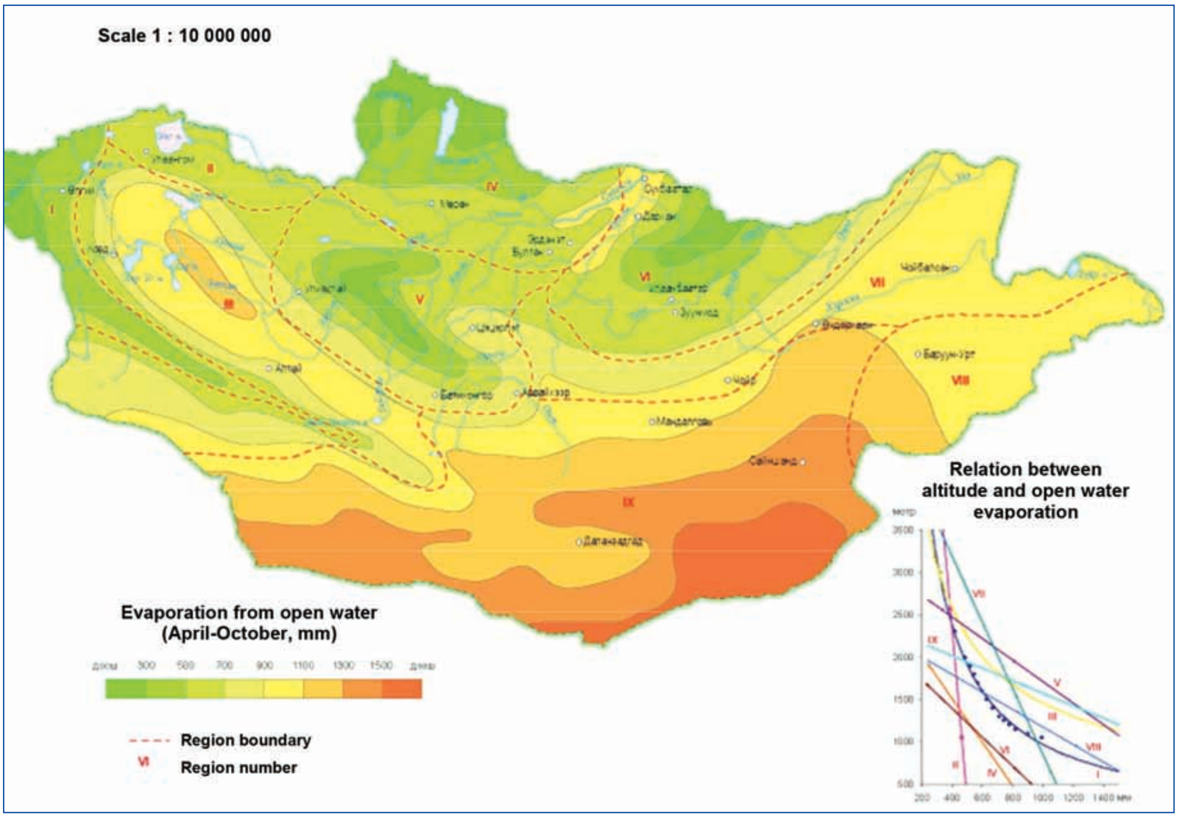


Figure 5. Evaporation from open water surface, mm/year

2.2.1. Climate trends

The average annual temperature has risen by more than 2°C over Mongolia during the past 70 years (Figure 6). This rise is higher than the globally observed average temperature rise. Both average winter and summer temperatures went up, but the winter trend is more pronounced (+3.3°C) than the summer trend. The average annual number of hot days is also increasing in Mongolia and maximum temperature records were broken in recent years.

Precipitation is much more variable than temperature, both geographically and over time. Mongolian precipitation records show long persistent periods that are drier and wetter than average. Over entire Mongolia precipitation is decreasing, with a notable reduction in the last 20 years. However, when considering the 40 years observation period, the trend is very weak and its reliability is considered low. Decline in precipitation is highest in those areas where most precipitation falls (Figure 6). The decreasing trend is showing in all seasons, apart from the winter.

2.2.2. Expected climate change

Climate change will lead to a rise in temperatures worldwide. This will provoke changes in other climate parameters as well. The hydrological cycle will speed up, resulting in more rainfall and more evaporation, since warmer air can contain more water than cold air. Global rainfall patterns will change, as will the distribution between snow- and rainfall, the intensity of rainfall events, and the water losses due to evaporation. Besides, the duration of prolonged wet and dry periods will alter. These changes will affect the water balance of whole regions and river basins. River discharges will change and there may be shifts in timing of low and high flows. The recharge to the groundwater will alter and vegetation will demand more water, because evapotranspiration increases.

Source: Gomboluudev, 2009

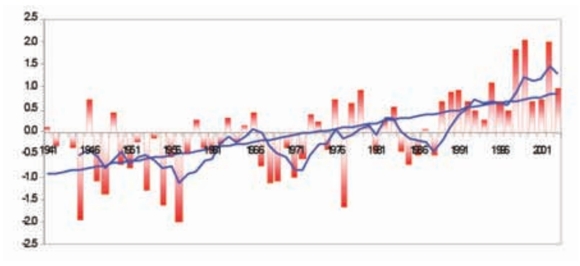
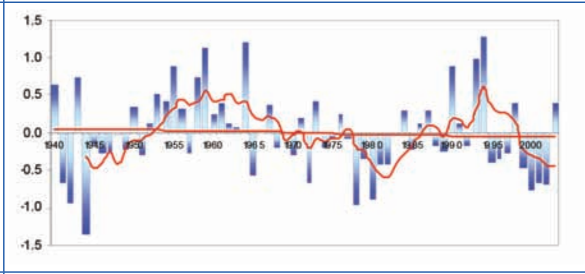
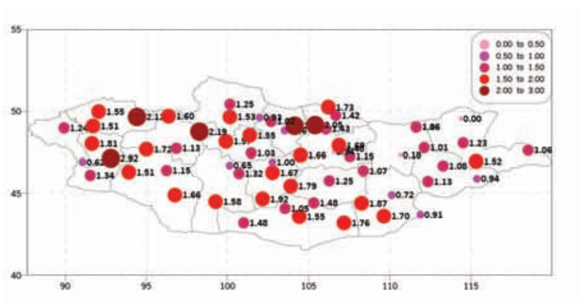
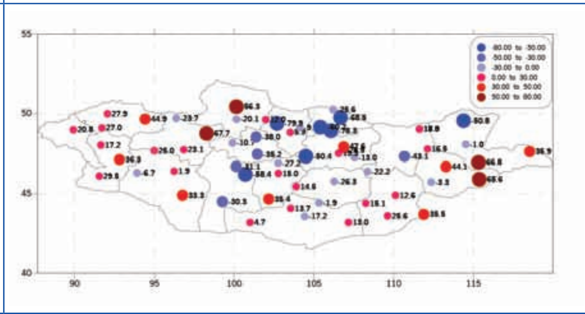
Temperature	Precipitation
	
	
Upper panel: Annual and 5-year running mean country averaged temperature deviation from the 1941-2003 mean temperature over Mongolia; Lower panel: Geographical spreading of warming over Mongolia Units are fractions of the long term average	Upper panel: Annual and 5-year running mean country averaged precipitation deviation from the 1941-2003 mean temperature over Mongolia; Lower panel: Geographical spreading of the precipitation trend over Mongolia; Units are fractions of the long term average

Figure 6. Temperature and precipitation anomalies from the long term average 1941-2003

The consequences of climate change for Mongolia can be both positive and negative. Many research reports describe the negative impacts such as desertification, droughts, dzuds, sandstorms, melting glaciers, etc., and conclude that these will prevail. Less attention is given to the potential positive consequences.

It is known that in regions where the losses of water due to evapotranspiration are high compared to the rivers discharges, as is the case in Mongolia, relatively small changes in precipitation lead to rather large changes in runoff. The various impacts of the dry period since 1995 confirm this.

The climate scenarios used in this plan are based on predictions of temperature, precipitation and evaporation made with an ensemble of 10 different climate models. These models simulate global climate changes, but are not very well suited to predict changes in local rainfall accurately. As a consequence, changes in rainfall simulated by the models differ considerably. Overall the models indicate an increase of 20 to 25% in winter precipitation, but a clear trend in summer precipitation is not detectable. The predicted year to year variability in precipitation is (very) large in both seasons. This variability seems to increase with time. As far as temperature is concerned, the simulations foresee a higher average temperature, 4.5° C (in winter) and 4°C (in summer), by the end of this century. All models strongly suggest that the potential evapotranspiration during the summer period becomes larger.

Changes in river runoff (Chapter 3.3.1) were derived using estimations of the changes in the various components of the water balance. These estimations are based on trends derived from observed records and on predictions made with the climate model ensemble.

2.3. Land use and land cover

Agricultural land occupies 115.5 million ha or 73.9% of the country's land area. Pasture land accounts for more than 98% of the agricultural area. Traditionally the pastures are used for (semi-) nomadic livestock husbandry and hay making. Crop land occupies only 0.93 million ha (0.8%) of the agricultural land (Figure 7). About one third (some 14.3 million ha) of the remaining land is forested. These forests are mainly found in the mountainous area in the north.

Source: National Atlas of Mongolia, 2009

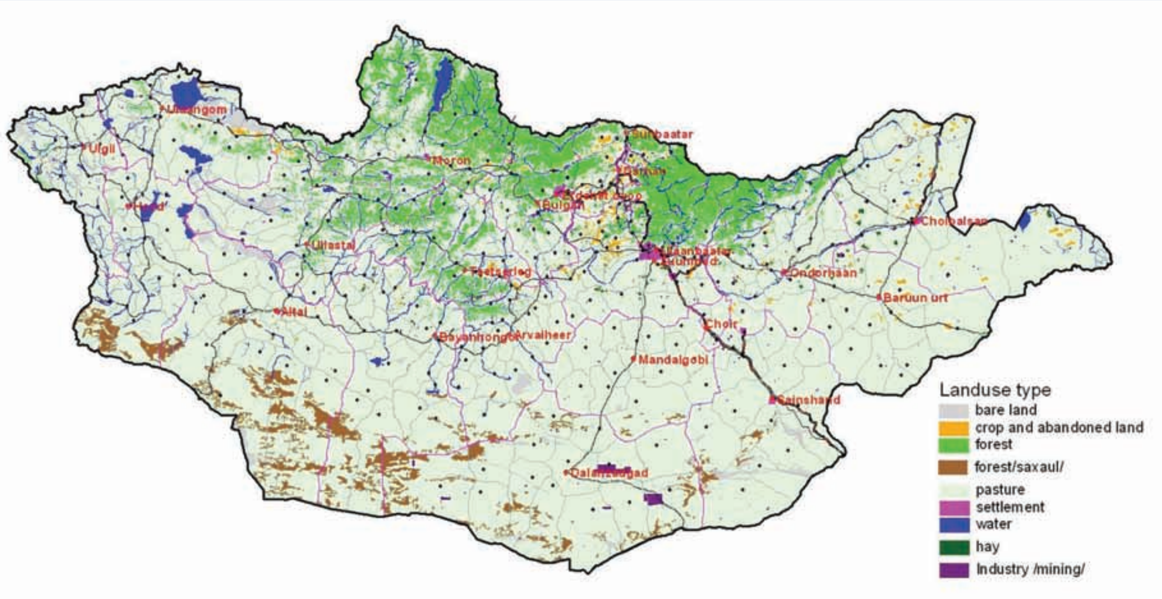


Figure 7. Land use map of Mongolia

2.3.1. Trends in land use

Over a century (1918-2010) the area of pasture land decreased with about 15 million ha, while the livestock population increased with about 25 million head. This gradually increased the pressure on the grazing lands, because of the reduced area per head of livestock. In 1990, crop irrigation in Mongolia was well developed; the total area of irrigation schemes was 91.8 thousand ha, of which 90% was irrigated with surface water, the remainder with groundwater. In 1998 the area had decreased to about 5,000 ha. Since 2003 the irrigated area gradually increased to 37.5 thousand ha in 2010 (about 10% of the actually cropped area).

Table 1 shows the land use changes in the past 20 years. Urban area/settlement areas and areas occupied by roads and other infrastructure increased, while the agricultural area and the area occupied by water bodies decreased in size.[1]

1 The classification of land use changed after changes in the Law on Land in 1998. The protected areas were deleted from the list (but were subsequently reintroduced), while the roads and infrastructure land use type was newly introduced

Table 1. Land use development 1986 - 2010

Land use type	1986		1998		2005		2008		2010	
	Thous. ha	%	Thous. ha	%	Thous. ha	%	Thous. ha	%	Thous. ha	%
Agricultural land	128,398	82.1	129,132	82.6	115,274	73.7	115,824	74.1	115,526	73.9
Urban areas, settlements, mining areas	474	0.3	376	0.2	469	0.3	530	0.3	620	0.4
Protected areas	8,317	5.3	-	-	24,713	15.8	24,793	15.9	24,877	15.9
Forest land	14,595	9.3	17,852	11.4	14,703	9.4	14,227	9.1	14,298	9.1
Water bodies	1,635	1.1	1,665	1.1	939	0.6	666	0.4	683	0.4
Reserve land	2,992	1.9	7,056	4.5	-	-	-	-	-	-
Roads and infrastructure	-	-	330	0.2	313	0.2	371	0.2	407	0.3
Total area	156,411	100	156,411	100	156,411	100	156,411	100	156,411	100

2.3.2. Natural vegetation

The natural vegetation, going from north to south, gradually changes from cedar and larch forests to a steppe vegetation characterized by various kinds of feather grass and finally to a very sparse desert vegetation (Figure 8). The vegetation zones have an east-west orientation, but are interrupted by mountain chains. The mountainous regions in the north, Altai, Khangai, and Khentii Mountains, are covered with cedar and larch forests, while the Mongolian Altai and Gobi Altai Mountains in the south have a more bushy vegetation. High plateaus of the Gobi desert and steppes occupy the eastern and southern part of the country.

Source: National Atlas of Mongolia, 2009

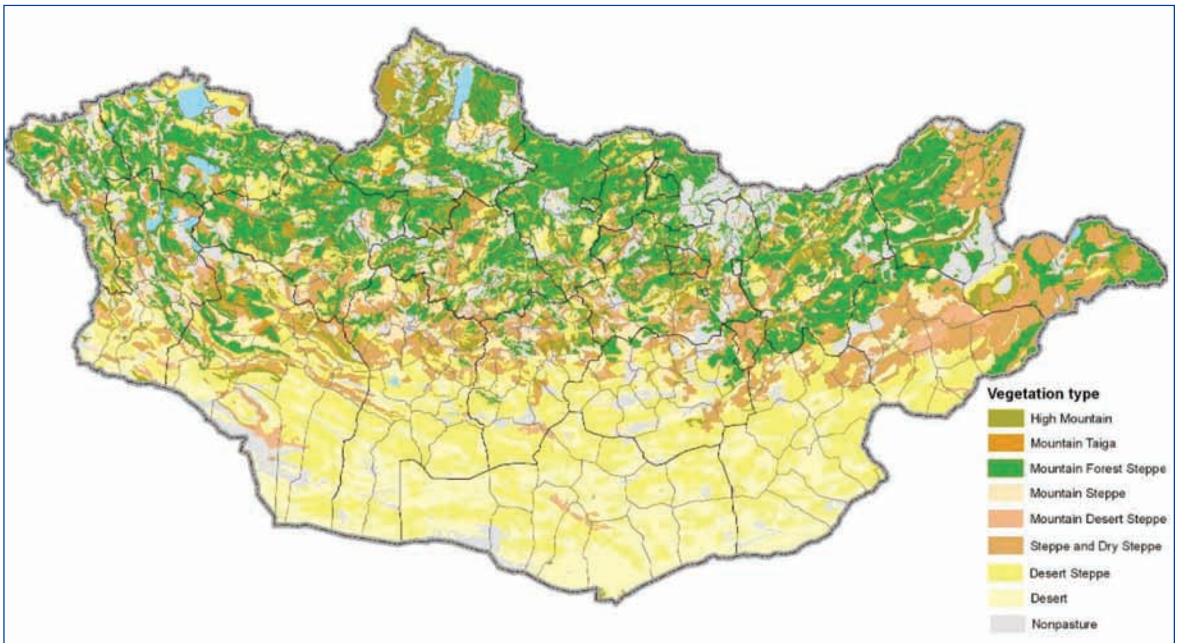
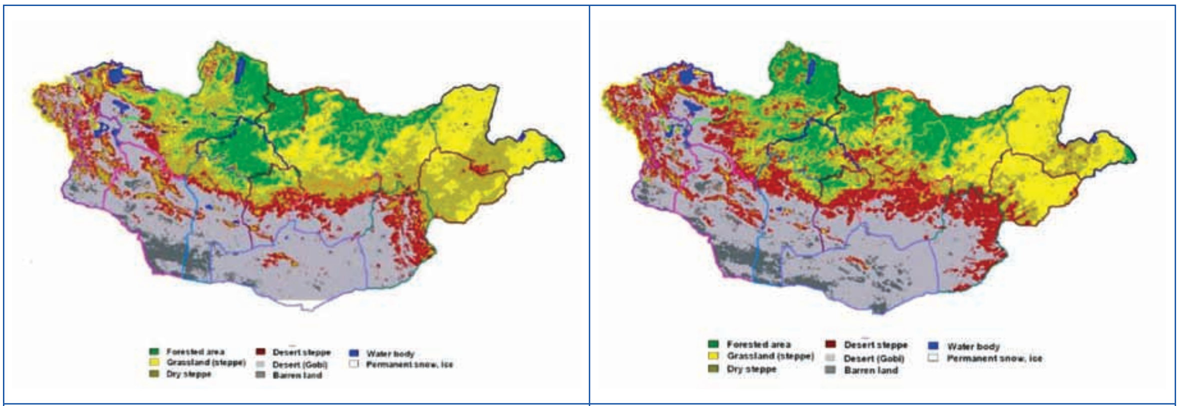


Figure 8. Natural vegetation zones in Mongolia

2.3.3. Changes in vegetation, land degradation and desertification

As noted on satellite images of 1992 and 2002 the dry zone in the southern part of the county is shifting northward in recent years. Other observations also indicate an ongoing desertification.

Source: Environmental Information Center



Vegetation cover 1992	Vegetation cover 2002

Figure 9. Vegetation cover in 1992 and 2002 based on analysis of satellite images

Precipitation records show a prolonged dry period since 1995. These dry conditions are also reflected in the discharge records of the Tuul, Orkhon and other rivers. Moreover dust storms and droughts are reported more frequently than before 1995.

Source: National Atlas of Mongolia, 2009

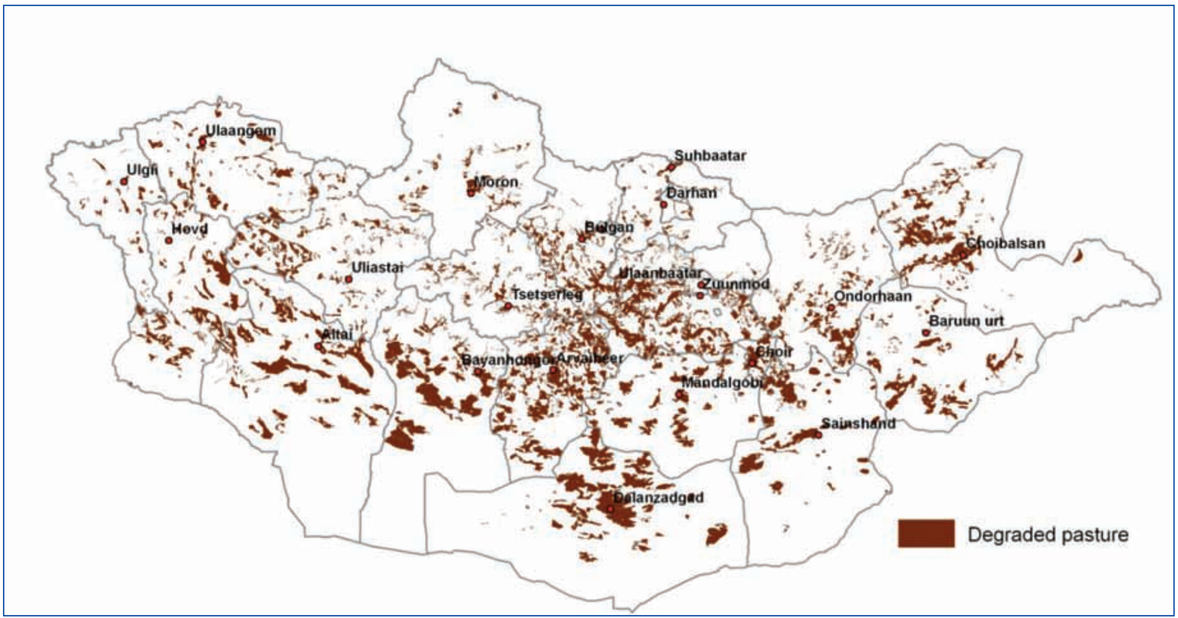


Figure 10. Degraded pastures in Mongolia

The dry conditions are, at least partly, the cause of the ongoing degradation of the pasture land (Figure 10). Whether or not the dry conditions are the result of long term climatic change is hard to prove, natural climate variability may also be the cause. However, it clearly shows how sensitive the steppe environment is for variations in precipitation.

Next to climatic conditions, pressure on the land by the increasing livestock numbers also contributes to the degradation of the pastureland. This pressure is particularly high around wells where the herds gather and around urban centres and water points, where the land is intensively used.

2.3.4. Nature reserves and protected areas

Mongolia is located between the Great Siberian taiga, the Central Asian steppe and the Central Asian deserts, as a consequence it has a rich diversity in transitional ecosystems that occur nowhere else in the world and hence are of global biological significance. The uniqueness of the biological system is also very much related to the traditional nomadic way of life of the herders.

As a result of the very low population density, ecosystems are still relatively intact. However, the number of species in Mongolia is fairly low compared with tropical or sub-tropical countries of comparable size, and there are relatively few endemic species.

Protected areas, nature reserves, national parks and natural historical monuments were established by the government to protect valuable environmental and ecological zones. About 16 % of the total land area has a protected status and it is intended to enlarge this to 30% in future. About 40% of all endangered animals and plants are found in the protected areas. Buffer zones around the protected areas provide a transition zone in which the local population is allowed to undertake economic activities.

The protected areas include both water bodies and forested land. Eleven lakes and there surrounding wetlands are registered as RAMSAR sites of international importance. Forests, occupying 9.1% of the country, form an important habitat and provide important natural resources. Forested cover is decreasing due to forest fires, infection by insects and illegal logging. Regeneration of forests is attempted by the government with little success.

Source: NGIC database

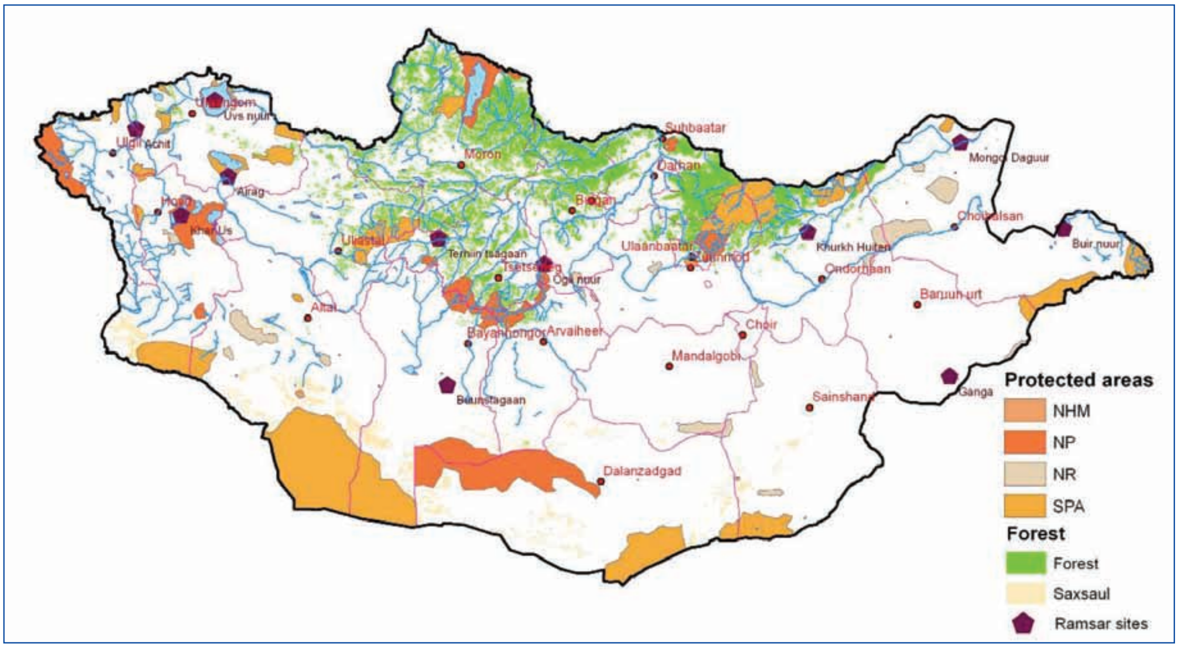


Figure 11. Location of ecologically important areas (forests, lakes and protected areas)

3. Water resources of Mongolia

The surface water resources of Mongolia are monitored by IMHE with a hydrological gauging network of 126 permanent gauging stations at 110 rivers and 16 lakes. The longest records go back to 1942. Groundwater monitoring is conducted by various organizations at an increasing number of sites. Only a few of these sites have records longer than ten years. Surface water quality samples are taken at 140 sites by IMHE. Benthos and plankton are sampled by IMHE at 64 sites.

Mongolia is a large country with a huge variation in climatic and geographic conditions. As a consequence, an accurate assessment of the water resources on the national scale is difficult.

3.1. Continental basins

Mongolia is located on the divide of three continental basins, the Arctic Ocean, the Pacific Ocean and the Central Asian Internal Drainage basin.

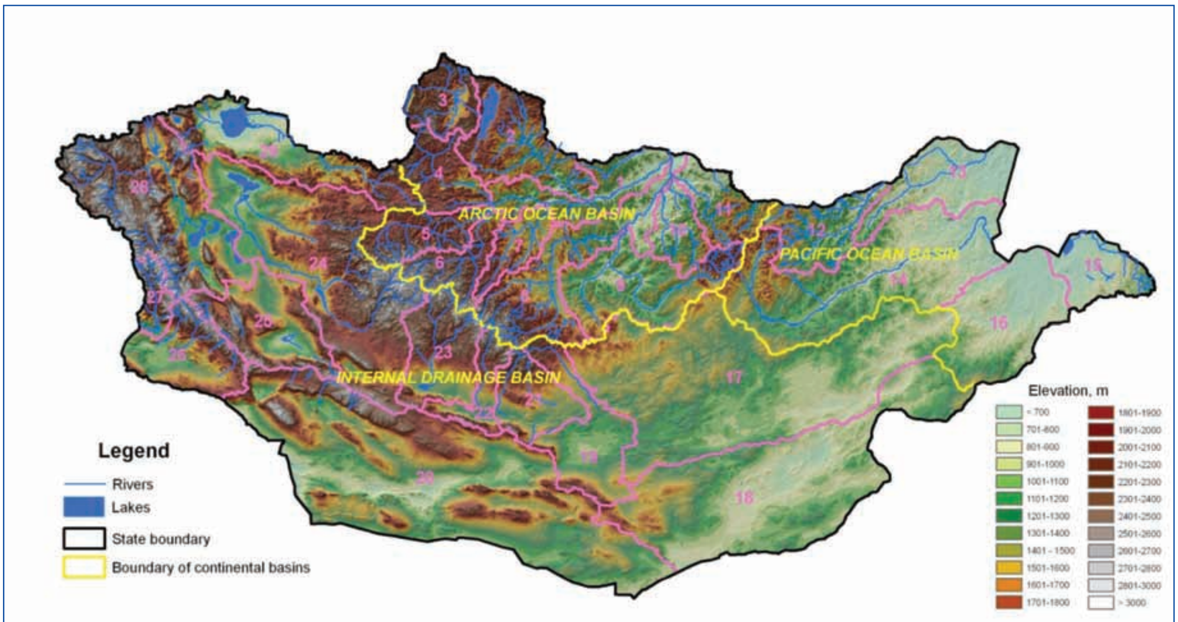


Figure 12. Continental basins of Mongolia

The Arctic Ocean basin drains to the north, feeding the Russian rivers that debouch into the Arctic Ocean. Approximately half of the total river runoff of Mongolia is generated in this basin. The main river is the Selenge River, which contributes to the large lake Baikal in Russia. Because of the large runoff volume generated in the central and northern mountains, this basin has a high potential for reservoir development. The rivers Tuul and Orkhon are part of the Arctic Ocean basin. About 65% of the Mongolian population lives in this basin and by far most of the socio-economical activities in Mongolia take place here.

The Pacific Ocean basin drains to the east and forms the head waters of the Amur River. This river flows along the border between Russia and Chinese Manchuria before debouching into the Pacific Ocean. About one tenth of the river runoff of Mongolia is generated in this basin. The main river is the Onon River that rises in the mountains east of Ulaanbaatar.

The rivers in the Central Asian Internal Drainage basin drain approximately forty percent of the total river runoff. They are important for the water supply of the aimags in the semi-desert area, where water availability is limited. The rivers in the western aimags flow into the lakes in the internally drained Great Lake Valley. The largest lakes are Uvs Lake, fed by the Tes and other smaller rivers, Khar Us, fed by the Khovd River and Khyargas Lake, fed by the Zavkhan River. Other rivers e.g. the Baidrag River, the Tui River, the Taats River and the Ongi River are feeding small lakes in the Bayankhongor-Ovorkhangai aimags. The runoff is crucial for the sustenance of these lakes of which several are ecologically important.

3.2. Water management basins

The management of the water resources is organized by dividing the territory of Mongolia in 29 water basins (Figure 13 and Table 2).

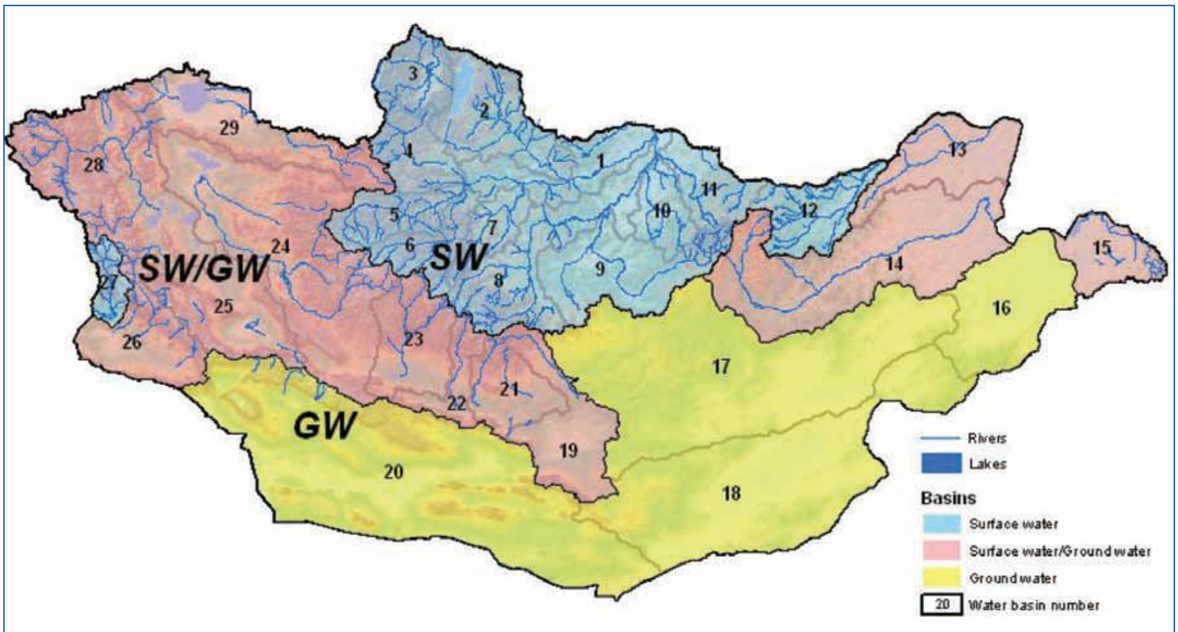


Figure 13. Classification of water basins

From an IWRM perspective the water basins can be classified in three types:

- Basins with abundant surface water, flowing through a relatively dense network of rivers. Groundwater resources are annually renewed, mainly through infiltration of surface water. Important issues in these basins are the spread of pollutants through the surface water, and the potential for development of water harvesting reservoirs;
- Basins without permanent surface water where water is mainly available as groundwater. Shallow groundwater resources are annually renewed but deep groundwater resources are not renewed and considered fossil. Important issues in these basins are the depletion of groundwater resources as a result of groundwater mining and the chemical composition of the groundwater, which makes the water unsuitable for drinking, for livestock watering and for irrigation of crops;
- Basins with areas with and without permanent surface water. Important issues in these basins are drying of downstream river sections, poor groundwater quality and changing environmental conditions.

Table 2. Water basins in Mongolia and their water resources

Nr	Name	Area (km²)	Basin	Type	Surface water resources (million m³/year)			Groundwater resources (million m³/year)	
					Total resources	Environ-mental	Possible use	Potential exploitable	Exploitable resources
1	Selenge	31,395	A	SW	2,133	1,856	277.3	697	90.3
2	Khuvsgul Lake - Eg	41,871	A	SW	2,971	2,570	401.1	432	0.2
3	Shishkhid	20,362	A	SW	519	481	39.0	206	0.2
4	Delgermurun	23,324	A	SW	1,080	999	81.0	229	2.7
5	Ider	23,061	A	SW	710	657	53.3	129	0.5
6	Chuluut	20,078	A	SW	185	171	13.9	86	0.1
7	Khanui	15,755	A	SW	231	217	13.9	96	0.2
8	Orkhon	53,455	A	SW	2,345	2,123	221.6	838.3	26.7
9	Tuul	50,074	A	SW	1,073	1,010	63.1	637.7	142.8
10	Kharaa	17,697	A	SW	432	406	25.9	182	52.6
11	Eroo	22,280	A	SW	1,121	925	196.2	239	0.6
12	Onon	28,241	P	SW	1,480	1,221	259.0	344	0.6
13	Ulz	37,961	P	SW	130	107	22.7	320	26.4
14	Kherlen	107,906	P	SW	567	507	59.5	721	43.9
15	Buir Lake - Khalkh	23,756	P	SW	1,023	920	102.3	198	1.1
16	Menengiin Tal	54,082	P	GW	0	0	0.0	168	0.1
17	Umard Goviin Guveet - Khalkhiin Dundad Tal	180,555	CA	GW	0	0	0.0	433	46.7
18	Galba – Uush - Doloodiin Govi	142,287	CA	GW	0	0	0.0	352	59.0
19	Ongi	39,724	CA	SW/GW	26	25	1.0	294	5.8
20	Altain Uvur Govi	221,156	CA	GW	0	0	0.0	337	65.5
21	Taats	25,425	CA	SW/GW	22	21	0.9	61	0.5
22	Orog Lake - Tui	15,735	CA	SW/GW	66	63	2.6	33	5.9
23	Buuntsagaan Lake – Baidrag	35,622	CA	SW/GW	303	280	22.7	174	2.9
24	Khyargas Lake – Zavkhan	122,315	CA	SW/GW	599	554	44.9	892	10.0
25	Khuisiin Govi - Tsetseg Lake	43,024	CA	SW/GW	0	0	0.0	493	8.1
26	Uench - Bodonch	34,491	CA	SW/GW	66	64	2.7	237	11.3
27	Bulgan	10,155	CA	SW	207	199	8.3	86	0.0
28	Khar Lake - Khovd	88,936	CA	SW/GW	2,317	2,201	115.8	684	12.7
29	Uvs Lake - Tes	54,223	CA	SW/GW	1,578	1,514	63.1	405	6.1
	Mongolia	1,584,946			21,184	19,092	2,092	10,004	623.4

Explanation:

Basin: A = Arctic Basin, P = Pacific Basin, CA = Central Asian Internal Drainage Basin

Type: SW = Surface water, GW = Groundwater

Surface water: Total resources based on surface water which is generated in an average year within the river basin only; inflow from other upstream river basins is not included.

Environmental flow: Davaa and Myagmarjav (1999) estimated the minimum flow requirement in Mongolian rivers. The environmental resources are based on their estimate. Possible use: total resources – environmental resources

Groundwater: Potential resources based on aquifer properties and renewable resources. Exploitable resources based on approved groundwater deposits.

3.3. Surface water

The surface water resources of Mongolia comprise rivers, lakes, springs and glaciers. The total volume of fresh surface water is estimated at about 535 km^3. Additional 90 km^3 surface water is stored in saline and brackish lakes.

The surface water resources are unevenly distributed over the country. In the northern and central part of the country the river network is much more dense than in the rest of the country. About seventy percent of all the surface water resources is formed in the mountain ranges, which occupy only thirty percent of the country. Figure 14 shows the network of all permanent rivers in Mongolia. Figure 15 shows the runoff forming areas.

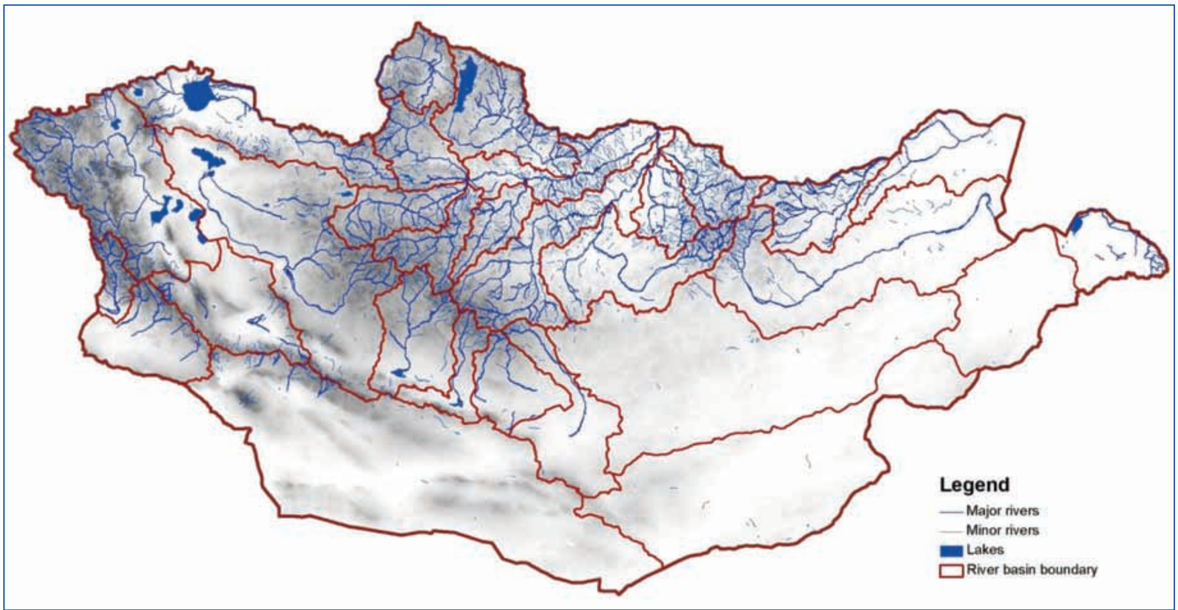


Figure 14. Surface water network of Mongolia

Source: Davaa, IMHE, 2002

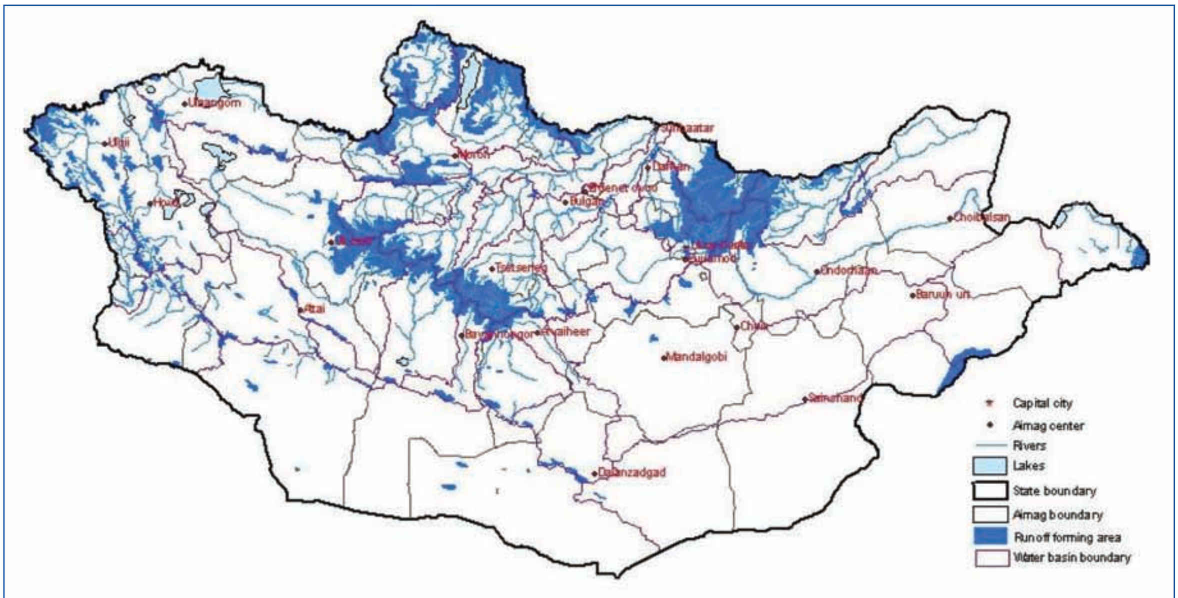


Figure 15. Surface water runoff forming areas in Mongolia

3.3.1. Rivers

The average runoff volume of the Mongolian rivers is estimated at 34.6 km^3 of which 4.0 km^3 is formed outside the country. This estimate is based on the long term observed runoff. The usable volume from this runoff for water supply and other means is estimated at 15 percent. The runoff of the Mongolian rivers varies significantly from year to year and also varies over the year. During the year a distinction is made between a spring, a summer and a winter flow regime (Figure 16).

The spring flow originates from snow and ice melt. Depending on the altitude it starts from the end of March to the end of April. The spring flow is succeeded by a low flow period in June. River regimes also differ geographically according to the timing of snow and glacier melt and their relative contribution to the formation of the runoff. For example in the Altai Mountains the spring flows continues into June as the snow cover remains until this month.

The summer flow, the largest flow, is generated by the rainfall in July and August and may continue until the end of September. After this month rainfall quantities decrease substantially and river flows recede until November when the water starts to freeze and the winter low flow period commences. In shallow rivers the water may freeze to the river bottom and river flow comes to a halt, until the spring melt.

Source: National Atlas of Mongolia, 2009

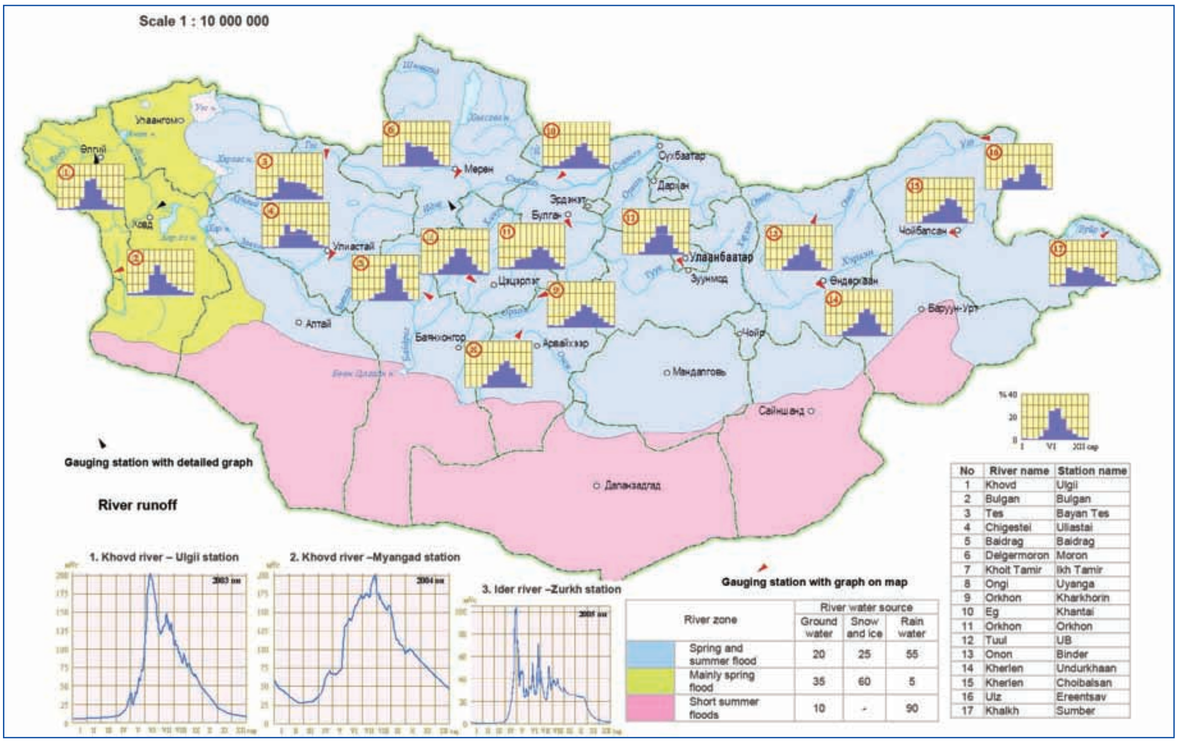


Figure 16. Geographical distribution of flow regimes

The average annual surface water flow in a river basin may be estimated using the specific runoff. The specific runoff is the mean runoff per unit area and it is determined from the relation between the observed river runoff and the surface elevation to enable an estimate of the available surface water resources at any location within the basin. The specific runoff was used in the water balance as presented in Chapter 7.2.2.

The specific runoff map of Mongolia updated in 2012 is presented in Figure 17. The relation between elevation and mean annual river runoff is determined in 31 runoff regions (indicated as river basins on the map). The relation is subsequently used to calculate the mean annual runoff in the whole area of the river basins. The specific runoff is highest in the Khentii, Khuvsgul and Altai mountain regions and lowest in the dry southern area of the country.

Source: Davaa, IMHE, 2012

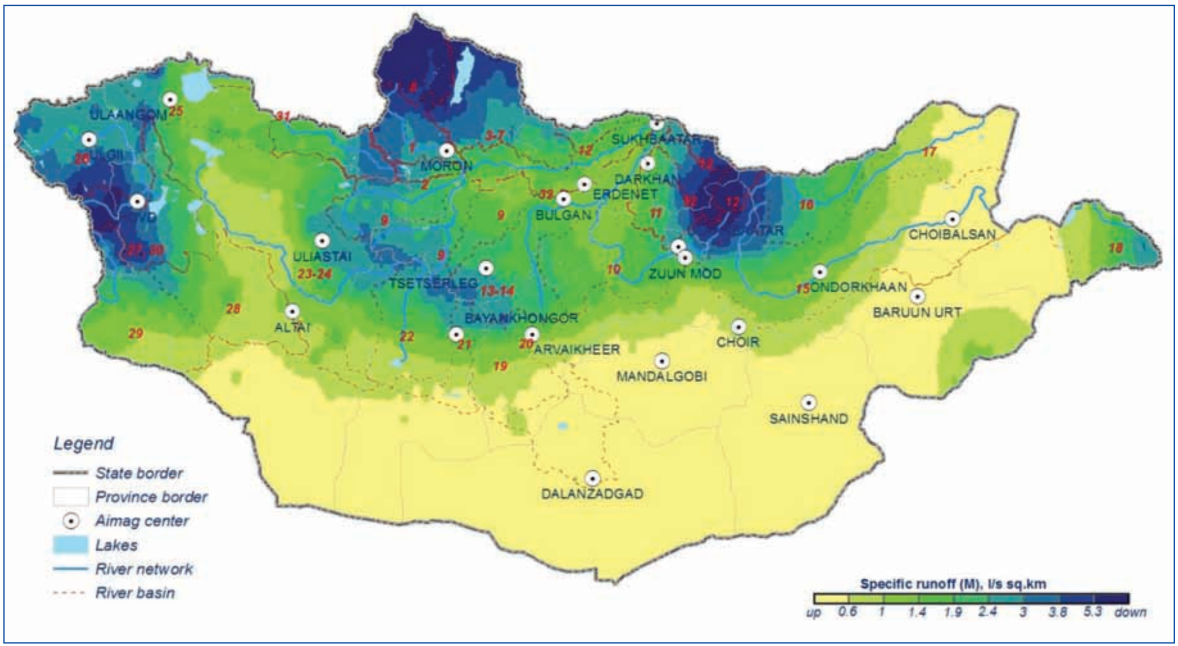


Figure 17. Specific runoff map

Floods and Droughts

Extreme events such as floods and droughts occur with different frequency and intensity. Floods in rivers occur during the summer flow period; however big floods have not occurred in central Mongolia since 1994 (Figure 18). Flash floods occur annually in smaller rivers. They are caused by intense rainfall and may cause local damage to people, animals or buildings. Droughts or dry conditions occur on average every 3 years when summer rainfall is less than normal. The effects of such dry conditions are felt in winter as less forage is available for livestock and can be dramatic in winters with extreme low temperatures and/or much snowfall, the so-called dzud conditions.

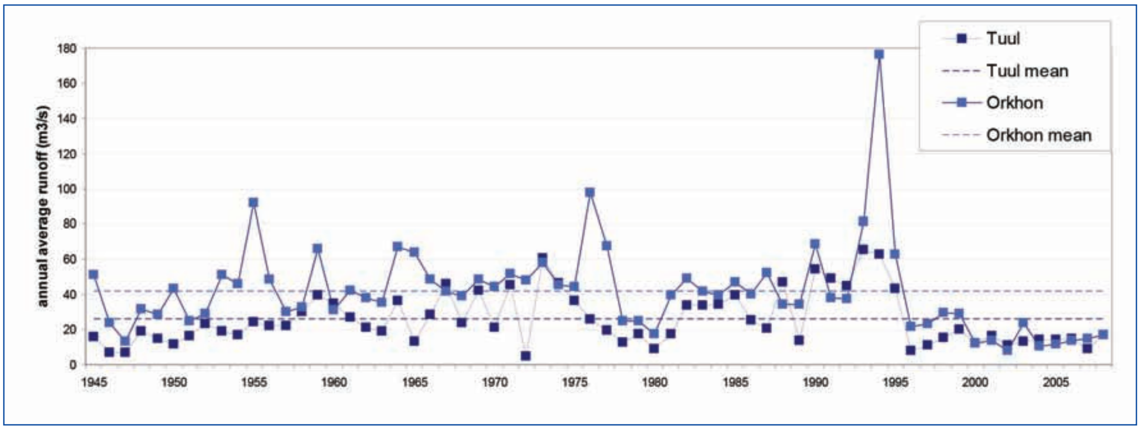


Figure 18. Annual runoff of the Tuul River at Ulaanbaatar and the Orkhon River at Orkhon (1945-2008)

Variation in river runoff

The year to year variability of the river runoff in Mongolia is large, which means that trends are difficult to detect. In many rivers prolonged periods with high runoff are followed by extended periods with low runoff (Figure 18). For example the annual runoff in the river Tuul at Ulaanbaatar shows above average flows in 1990-1995 and below average flows in 1996-2008. The Orkhon River at Orkhon shows the same above and below average periods although less pronounced. The low flow of the Tuul River since 1995 is correlated with a decrease in precipitation in the same period.

The available river runoff data show an increase in winter runoff, but a decrease in other seasons in the rivers originating from the slopes of the Khangai and Khentii mountains. Runoff increases in all seasons in the rivers that originate from the glaciers in the Altai, Khangai and Otgontenger mountains. In the downstream parts of the larger rivers, only an increase in winter runoff is observed, while in the Gobi and steppe areas river runoff tends to decrease in all seasons.

As already stated for precipitation (Chapter 2.2.2), no firm conclusions can be drawn about more permanent trends in the runoff in Mongolia during the past 40-60 years. However, due to the dry conditions since 1995 the overall surface runoff in Mongolia is below the long term average for already a rather long period, implying that large variations in climate conditions need to be considered in the water resources management in Mongolia.

Surface water inventories

Surface water inventories, executed by the Water Authority every 4 years indicate changes in the numbers of dried up rivers, lakes and springs. Results have to be treated cautiously, since the methodology of the inventory changed over the years. The year 2011 was wetter than 2003 and 2007, which is indicated by the lower percentage of dry rivers and lakes. The percentage of dry springs did not change significantly which may be explained by the fact that springs are fed by slow groundwater systems.

Table 3. Surface water inventory of Mongolia

Year	Number of rivers		Number of lakes		Number of springs		Number of mineral springs
	Total	Dry	Total	Dry	Total	Dry	Total
2003	5,565	683 (12.3%)	4,193	760 (18.1%)	9,600	1,484 (15.4%)	-
2007	5,128	852 (16.6%)	3,747	1,181 (31.5%)	429	60 (14.0%)	-
2011	6,646	551 (8.3%)	3.613	483 (13.4%)	10,557	1587 (15.0%)	265

Remark: no inventory of mineral springs in 2003 and 2007; 2011 inventory numbers are preliminary

Future trends in surface runoff

Climate change will influence the hydrological conditions in Mongolia. For water resources planning purposes it is imperative to determine whether this change is significant compared to the observed hydrological variability.

To assess the impact of climate change on the hydrological conditions, results of an ensemble of 10 climate models, simulating both present (2010) and future (2080-2100) climatic conditions (precipitation, temperature and a number of parameters needed to estimate evaporation) were used as input into a hydrological model. The hydrological model simulated the complete water balance: surface- and groundwater, snow cover and soil moisture. The change in river runoff was calculated for each water basin in Mongolia. The results were statistically summarized in three scenarios (Figure 19):

1. Dry scenario (25% of the climate models predict drier conditions and 75% of the climate models predict wetter conditions),
2. Medium scenario (50% of the climate models predict drier conditions and 50% of the climate models predict wetter conditions) and
3. Wet scenario (75% of the climate models predict drier conditions and 25% of the climate models predict wetter conditions).

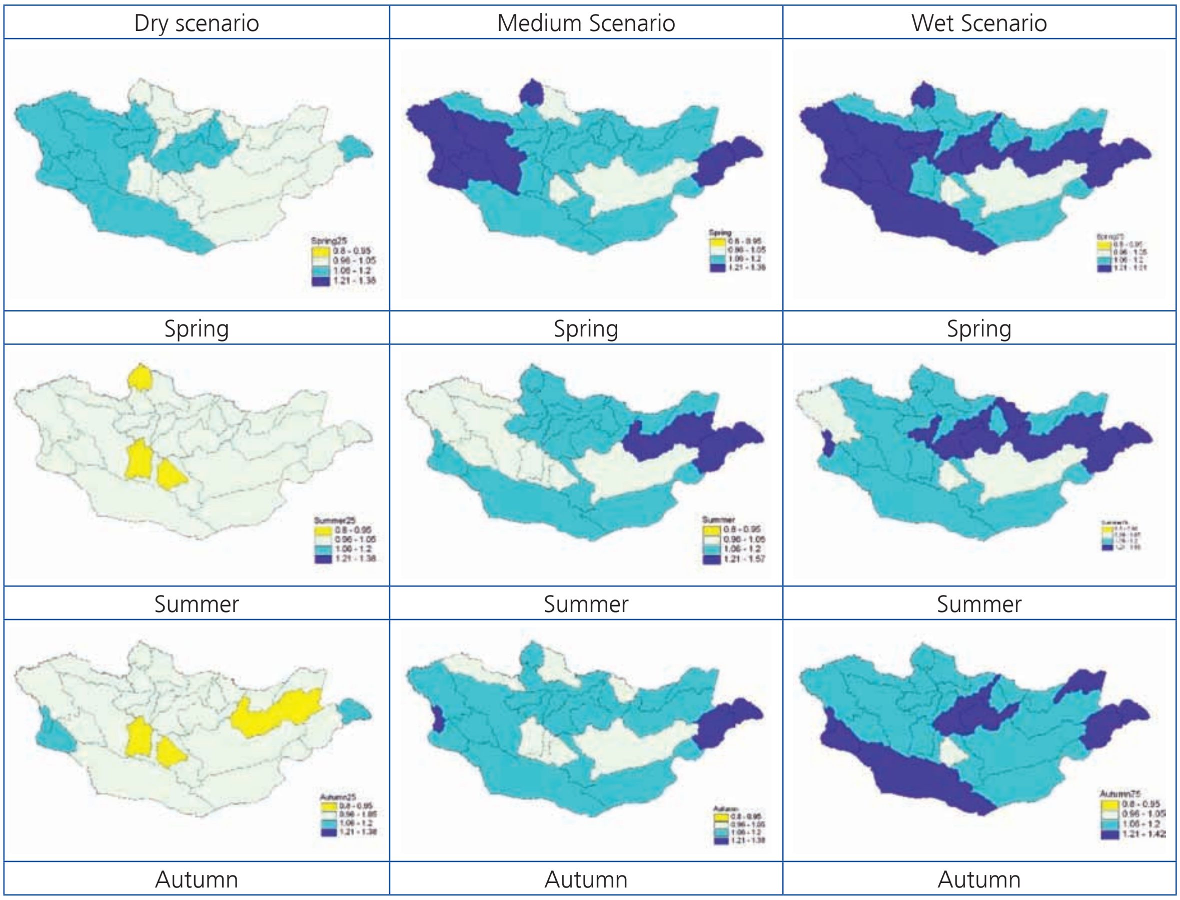


Figure 19. Climate change (2080-2100) induced decreases (yellow) and increases (blue) in river runoff for dry, medium and wet scenario

Analysis of the results presented in Figure 19 indicates that a trend towards conditions with larger runoff volumes seems more likely than a trend towards less runoff, particularly in spring. More specifically the following trends show:

- In spring the trend to wetter conditions is most pronounced in the mountainous basins;
- In summer the increase is most pronounced in the northern basins;
- In autumn the Dry Scenario suggests slightly drier conditions in some of the northern basins, other basins show an increase in runoff; and
- In winter (not shown) more snowfall can be expected as nearly all climate models suggest an increase in winter precipitation.

Even though the time horizon of the scenarios is 2080-2100, the magnitude of the predicted changes is rather small. This implies that for the time horizon of the national plan 2015 and 2021, the changes in runoff due to climate change will be very limited.

3.3.2. Lakes

The lakes in Mongolia cover only 0.4% of the territory but store a significant volume of water. The lakes can be distinguished in fresh water lakes and brackish water lakes. The fresh water lakes have an outlet and the water is refreshed by inflow. The total volume of the fresh water lakes is 500 km^3. Approximately 75% of all the fresh water resources is stored in the lakes. By far the largest is Lake Khuvsgul that stores three-quarter of this water volume (380 km^3). Other large fresh water lakes are Buir Lake, Khar Lake and Khar-Us Lake. The brackish lakes have no outlet and concentrations of dissolved solids increase over time due to evaporation of the water. The total volume of the Mongolian brackish water lakes is 90 km^3. The largest brackish water lakes are Uvs Lake and Khyargas Lake. Both fresh and brackish water lakes provide unique habitats for flora and fauna and are therefore protected.

Variation in lake levels

Trends in lake levels (Figure 20) are identified from the records of the 16 operational lake level recording stations. The records go back to 1962. Most lakes in Mongolia have falling water levels since approximately 2000. This is particularly the case for the lakes in the Great Lake Valley and in the Gobi. Since 1995 the conditions are relatively dry and drying-up of lakes in the Gobi is reported. Two big lakes show rising water levels. The Uvs Lake, the biggest lake by surface, rose by 2 meters between 1964-1995, but shows a falling trend ever since.

Source: Davaa, IMHE, 2011

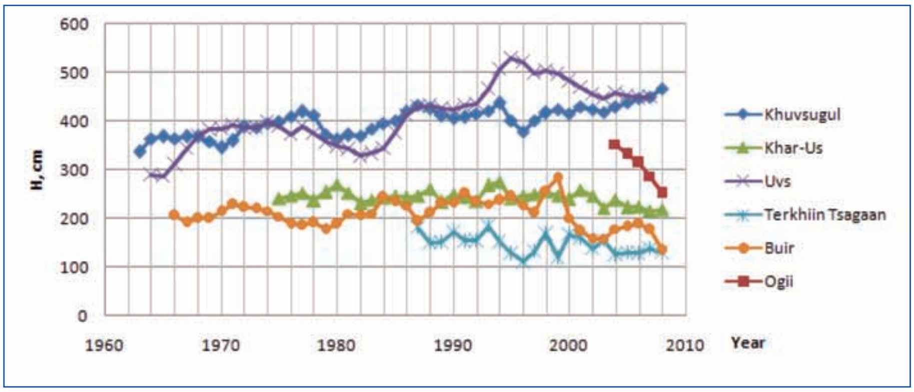


Figure 20. Water level fluctuations in selected lakes

A reconstruction of lake levels since 1570, based on dendrochronology, suggests that the present day water levels are unusually high. The water level of the Khuvsgul Lake, the largest and deepest lake in Mongolia, has steadily increased by 1 meter since 1963. The cause of this rise is not clear. It has been attributed to the melting of the permafrost, to an increase in rainfall, to obstruction of the outflow due to sand banks in the Eg River and to a reduction of evaporation from the water surface due to lower water temperatures. Drops in lake level were noticed in 1979 and one 1995-1996. These can be explained by the low rainfall amounts in these years.

Future trends in lake levels

The response of a lake to changes in climate depends on the geographical location and the bathymetry of the lake. Levels of the lakes in the Great Lake Valley and the Gobi may decrease in future, as evaporation from the lake surface increases more than the river inflow. This effect will be amplified by an increase in upstream water use. On the other hand, lakes with a large drainage basin and substantial inflow, located in the mountains, including Lake Khuvsgul, will be more sensitive to changes in river inflow than to changes in evaporation.

3.3.3. Glaciers, snow cover and permafrost

Estimates made in the past showed that Mongolia had 262 glaciers, with a total surface area of 659 km^2. The glaciers are a reliable source of water for the rivers running from the Altai, Khangai and Otgontenger Mountains. The melting ice provides a permanent minimum flow.

Snow volumes in winter are relatively small. Nevertheless, melting snow forms the main contribution to the runoff in spring when rainfall is still scarce. Snow is also important as a source of drinking water for livestock and wild animals in winter. Abundant snowfall can, however, lead to very harsh conditions in winters (white Dzuds).

Permafrost is found in the northern part of Mongolia (Figure 21). Permafrost is affecting water retention and infiltration conditions. Water can only infiltrate the soil after thawing of the upper layer. With increasing temperatures in future, the layer that seasonally thaws becomes thicker. This increases the storage capacity of the soil and releases water from the soil to the rivers. Consequently, changes in the active layer thickness and permafrost continuity affect groundwater availability and river runoff.

Source: (MARCC, 2009)

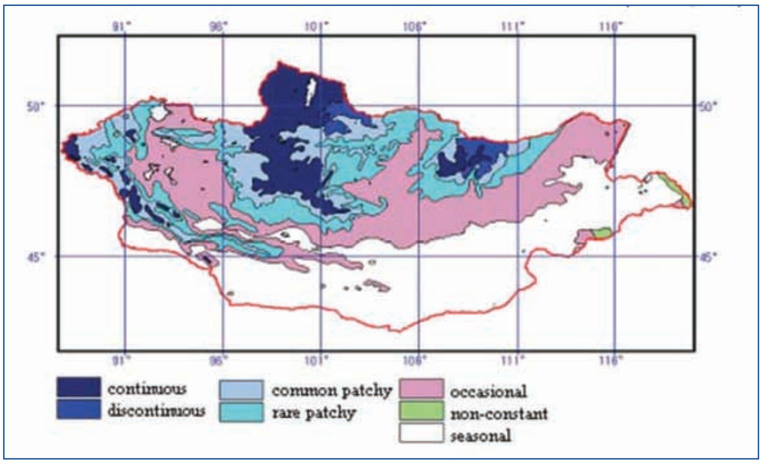


Figure 21. Permafrost in Mongolia in 1974

Trends in glacier areas, snow cover and permafrost

Glacier areas are steadily decreasing in Mongolia, e.g. by approximately 30% in the Altai Mountains since 1940. Snow cover depth is decreasing in northern Mongolian mountains, and increases in the Gobi mountains and the eastern and western steppe regions. The thickness of the seasonally frozen soil decreased by 10-20 cm in the last 30 years and phenomena suggesting melting of the permafrost, such as melting mounds (pingo's), thermokarst, and solifluction, are observed more frequently. The rise in air temperature causes a change in permafrost from continuous to discontinuous or seasonal.

Future trends in glacier areas and permafrost

The volume of the glaciers in Mongolia is estimated at 63 km^3. Extrapolating the current loss rates, the glaciers will virtually have disappeared at the end of this century. The water from the melting glaciers adds to the runoff of the rivers, leading to a temporary increase in baseflow. This effect of glacial melt may progress far down stream to the lakes of the western region.

Climate models predict that the continuous permafrost will disappear during this century (Figure 22). The thawing of the permafrost causes a temporary increase in river runoff. However the volume of water involved is relatively small as it is estimated that permafrost soil in Mongolia only contains 10% of water.

3.3.4. Surface water temperature, ice and sediments

Although trends in river runoff are difficult to identify, there are clear trends in other water related parameters, e.g. the water temperature. During the last 30-60 years the water temperature of the rivers in Mongolia increased by 1-4 °C. The higher temperatures reduced by 15-44 days the average length of period over which rivers or lakes are frozen in winter. However, this does not include the Selenge and Onon river basins and the rivers originating from the lee slope of the Altai Mountains. Here water temperatures have decreased and the period over which the rivers and lakes freeze in winter increased by 10-20 days.

Source of data: MARCC, 2009

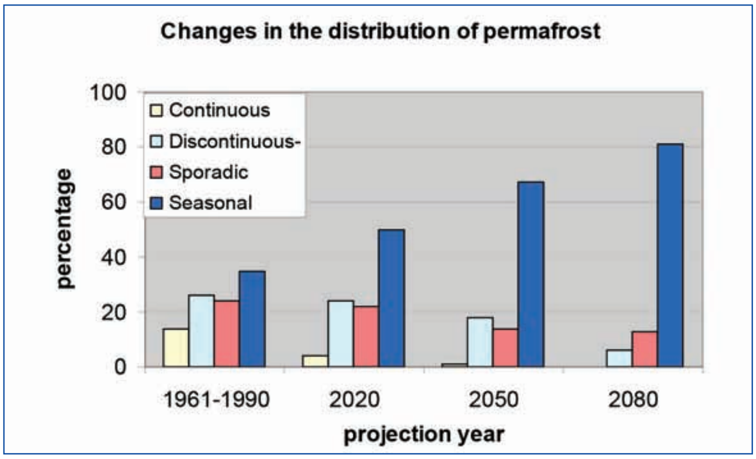


Figure 22. Historic and predicted future distribution of permafrost

3.3.5. Surface water quality

The water quality of the surface water in 72 rivers and 9 lakes is monitored at approximately 140 monitoring sites by IMHE. The parameters observed are major cations and anions, total dissolved solids (TDS), pH, O_2, BOD and some trace metals.

Natural chemical composition

The TDS of the river water ranges between 300-500 mg/l, while the concentrations of the various anions and cations are highly variable and depend on local geological, climatic, and geographical conditions. Ca^{2+} and HCO_3^- are the dominant ions. Ammonium concentrations range from a minimum of 0.1 to more than 1 mg/l but concentrations higher than 0.5 mg/l are very rare. The average concentration of phosphorus (PO_4-P) is 0.025 mg/l, which reflects the condition of unpolluted rivers.

The TDS in the fresh water lakes ranges from 50-300 mg/l, but is much higher in the brackish water lakes (2,000-15,000 mg/l).

Water pollution

Most of the river water is suitable for any use. However, locally, the river water becomes more and more affected by mining and other human influences. Mining activities cause increased turbidity due to activities in the river beds (e.g. in the Tuul River at Zaamar), or discharge heavy metals through leakage from tailings (e.g. in the Kharaa Basin). Rivers in the Selenge basin are polluted by gold mining industries.

The sediment and nutrient (nitrates, phosphates) load of rivers also increases due to ongoing deforestation and trampling of river banks by livestock. This diffuse pollution occurs especially in areas with high concentration of people and animals.

The effluent of waste water treatment plants of many aimag and soum centers is polluting the surface water due to poor operation of the facilities. At Ulaanbaatar the Central Waste Water Treatment Plant pollutes the Tuul River. The treated sewage water from the treatment plant is still ranked as "very polluted" according to the water quality standards. The efficiency of the plant is low and discharges of waste water from industries and enterprises disturb the treatment processes of the plant that is designed for the treatment of domestic waste water only. The discharge of chromium from tanneries is of much concern especially in case special treatment facilities are not working.

Eutrophication

Although in general eutrophication is not a major issue yet, in some parts of Mongolia like Buir Lake it has become a major problem. Lake water gets green in mid July every year and domestic animals are reported to have died after drinking water from the lake. Preliminary data from a biodiversity survey of Western Mongolian lakes indicate that eutrophication is becoming more common.

Ecology

The surface waters of Mongolia form an important water habitat in an often dry environment. Apart from the livestock herders also typical flora and fauna species depend on the favorable wet conditions. The lakes and wetlands in Mongolia are an important breeding ground for seasonal birds. Some of these birds, like the Dalmatian Pelican, are rare and endangered.

The rivers and lakes of Mongolia are abundant with fish but contain a limited number of fish species of which many are endemic to the country. They therefore have a high ecological value, such as the Taimen. In recent years the number of fishes is declining rapidly due to overfishing (both commercial and touristic) and locally due to pollution.

3.4. Groundwater

3.4.1. Geology and hydrogeology

The hydrogeological map of Mongolia differentiates between (1) Basement complexes consisting of metamorphic and crystalline rocks of the Precambrian, and oceanic and volcanic rocks of the Paleozoic and (2) Platform cover with "enclosing or covering layers" of Permian, Mesozoic or Cenozoic age. Hydrogeological investigations have concentrated on areas with an extra demand for groundwater near urban areas, mines or industrial activity. This has yielded descriptions of so-called "groundwater deposits".

Groundwater is abstracted from two types of aquifers: fissured and granular. The highest yielding aquifers are the granular aquifers of the Quaternary alluvial sediments situated along river valleys. Where these sediments do not exist or where recharge is insufficient groundwater is abstracted from fissured aquifers, the Cretaceous sediments being the most important.

3.4.2. Groundwater resources

Groundwater is the main water source in Mongolia for drinking water and industrial water. It may be estimated that 99% of the population uses groundwater for drinking water. Livestock watering uses groundwater from wells in areas away from rivers. Irrigation schemes in majority use surface water but the use of groundwater is increasing. Also the majority of the mines and industries extract groundwater. Mines also pump groundwater to dewater the mine pit. Industries in urban areas either use water from the central system or from own wells.

Currently groundwater monitoring is conducted by MEGD, IMHE, GEI, MUST, water supply and private mining companies at an increasing number of sites. The length of the available observation records is generally too short to allow using this data at this moment for groundwater resources estimation.

In 1958, groundwater resources were estimated for the first time in Mongolia. Since then several attempts were made to derive a more accurate estimate. In 1971-1975, the "General scheme of integrated use and protection of water resources of the People's Republic of Mongolia" estimated the total groundwater resources at 12.1 km^3/year and the available groundwater resources at 6.1 km^3/year. Estimates of the exploitable groundwater resources were mainly based on the indirect evidence of the recharge to the groundwater and from the knowledge on the extent of the aquifers. Investigations with sufficient detail to improve these figures were not carried out so far.

A new estimate of the potential exploitable groundwater resources was made for each water basin based on the 1,000,000 scale hydrogeological map published in 1996 (Explanatory Notes were published in 2003), the potential groundwater recharge (the renewable groundwater resources) and the potential yield of groundwater wells. This estimate gives a higher total than the previous estimates of available groundwater resources: 10.0 km^3/year (Table 2 and Figure 23). A note should be made that such an estimate can be indicative only. Local groundwater investigations at groundwater deposits are required to identify the actual available groundwater resources. These are indicated as the exploitable groundwater resources in Table 2 and amount to a total of 0.6 km^3/year. This available volume corresponds with the explored and approved groundwater resources and the volume will certainly become larger in the future once more groundwater deposits are surveyed and assessed.

Studies of the groundwater deposits have been done since the 1960s and they provide the information on the locally available groundwater resources. Due to their local character they form a category that is typically described in the water management plans of the water basins.

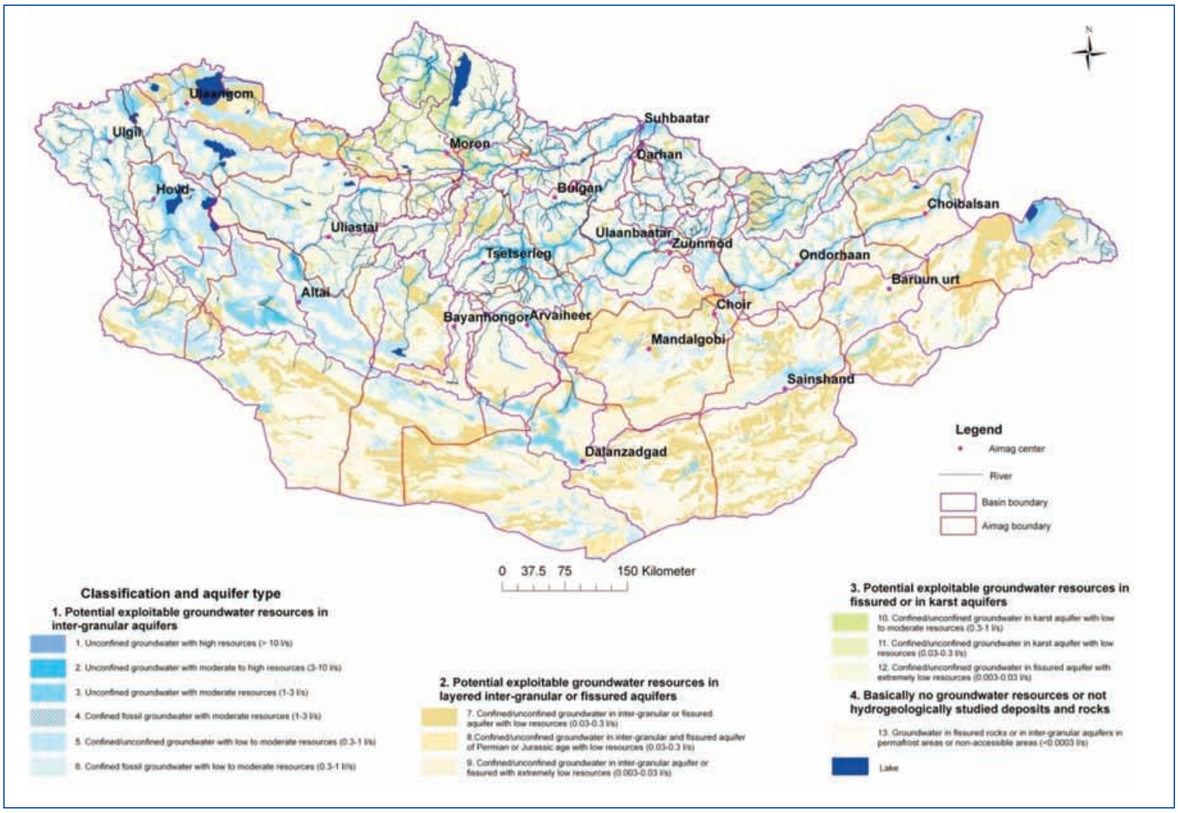


Figure 23. Potential exploitable groundwater resources map of Mongolia

Trends in groundwater levels

There is a lack of good data to assess the long-term trends in groundwater levels, but a decline in groundwater levels in wells observed by IMHE between 1995 and 2005 is reported. It is not clear whether this is caused by increased groundwater use in the vicinity of the monitoring wells or by a reduction in groundwater recharge. Groundwater levels in shallow aquifers posses a strong seasonal variability and trends are difficult to identify. Groundwater levels in deep aquifers with little or no recharge will show a decline as soon exploitation of the groundwater starts. Here monitoring is important to manage the availability of the groundwater resources.

Source of data: IMHE, 1995-2005

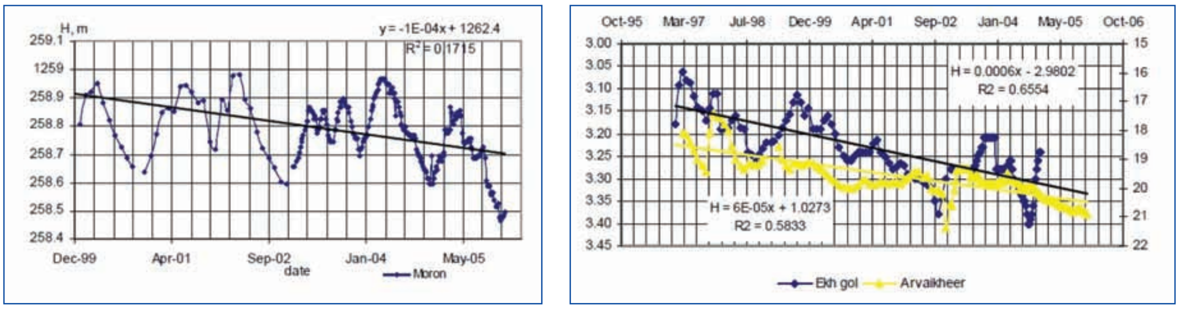


Figure 24. Observed groundwater levels at Moron, Ekh Gol and Arvakheer

A decline of groundwater levels is reported at Ulaanbaatar. Here the problem appears to be caused by increased groundwater abstractions which are larger than the rate of recharge.

Springs and mineral springs

Springs form an important water source in the rural areas of the country, because the water is safe for drinking. Their essential role in the water supply requires a proper protection to prevent pollution. There are an estimated 9,600 springs in the country. The surface water inventories of 2003 and 2007 indicated that 15% of the springs have dried up in recent times. The chemical composition of the springs varies. So-called mineral springs are often connected to spas and health resorts.

Future trends in groundwater resources

The potential of the groundwater resources depends on the possible recharge. Groundwater resources recharged by infiltration of rainfall or river water will not change significantly. The effect of climate change on river runoff duration will increase the infiltration period but the increased variability of precipitation and river runoff may cause longer dry periods.

The groundwater resources in deep aquifers will not be affected much by climate change because recharge is usually negligible. The management of these groundwater resources must take into account that these resources are not renewable. Therefore future availability of these resources will depend on the planned groundwater abstractions in each groundwater deposit.

3.4.3. Groundwater quality

The total dissolved solids content of groundwater increases with decreasing precipitation and flow. This means that the concentration of solubles in the groundwater increases in southern direction and away from rivers. Groundwater with high total dissolved solids contents is found in areas with high evaporation and low groundwater flow velocities, in confined aquifers, which receive little recharge and in areas with easily soluble mineral deposits, such as rock salt, gypsum or soda.

The groundwater quality can be defined by 4 physical-geographical zones:

1. The *Khangai-Khentii mountainous region,* the forest steppe area (30% of Mongolia) that covers the northern and central part of the country. Groundwater in this region generally has a TDS between 100-800 mg/l, with rare exceptions of >1000 mg/l. The hardness of water in the region is about 4.5 mg-eqv/l.
2. The *Altai mountainous region,* the mountains of western Mongolia. Average TDS of the groundwater ranges between 510-810 mg/l and hardness is 4.5-5.2 mg-eqv/l, with the highest concentrations found in Gobi-Altai.
3. The *Mongolian Dornod steppe region* in the east of the country. Groundwater in this zone has an average TDS of 950 mg/l, the average hardness is 5.6 mg-eqv/l and it is characterized by a high concentration of iron.
4. The *Gobi region*. Groundwater typically has a TDS of 500-1350 mg/l and the hardness is 3.4-7.0 mg-eqv/l.

Water quality in more than 100 soums does not meet the drinking water quality standard since 60% of the soums have water with a too high TDS and 40% have high hardness. The natural groundwater quality in the Gobi and Dornod region is generally less good than in the other regions. The groundwater quality locally may be substantially influenced by infiltration of water from mine waste dumps or waste water discharges from urban areas.

Apart from TDS and hardness, too high and too low fluoride and too high arsenic concentrations are sometimes making groundwater unsuitable for consumption.

Groundwater with too high fluoride concentrations is found in 25-35% of the soums in the Dornod and Gobi regions. Too low fluoride concentrations are found in the majority of the other regions. Besides this fluoride deficiency, iodide deficiency is found in the mountainous regions of Mongolia. In the Gobi some soums have too high arsenic concentrations in the groundwater.

3.5. Reservoirs and ponds

Reservoirs and ponds are constructed in Mongolia for water supply and energy production. The size of the reservoirs and ponds varies. Large reservoirs have been constructed for hydropower production. Small reservoirs and ponds are generally used for water supply of livestock or sometimes irrigation. Many reservoirs and ponds constructed before 1990 suffer from a lack of maintenance and are presently not used to their full capacity.

Two new dams for power generation were completed in 2008 in the Zavkhan River (Taishir Dam) and Chono Kharaikh River (Durgun Dam). The construction of these dams was not without controversy. The Durgun Dam raised the water level of the Khar Us Lake. The Taishir Dam reduced the runoff in the downstream part of the Zavkhan River which negatively affected the vegetation in the pasture and hay fields in the floodplain of the river. But in the meantime the Taishir Dam also protected the pasture and hay fields against floods.

New hydropower dams are planned in the Tuul, Orkhon, Eg and Selenge rivers. Diversion dams are considered in the Orkhon and Kherlen rivers to supply south Gobi areas through pipelines.

3.6. Water resource pollution, scarcity and their evaluation

3.6.1. Main pollution sources

Although the volume of the annual water use in Mongolia is small, the regime and quality of water resources become more and more affected by human influences, climate change and changing soil and vegetation cover. A state inventory for surface water conducted in 2003 showed that although most of the rivers still contain mountain fresh water, for at least 23 rivers in 8 aimags riverbeds have changed and/or are polluted due to mining activities. For example rivers in the Selenge river basin have been polluted from the impacts of gold mining industries. These industries discharge heavy metals through leakage from tailings or cause turbidity due to activities in the river beds.

Especially placer mining activities that occur in river beds are a source of pollution as they release fine particles of soil in streams, increasing turbidity. In some cases sulfate-based compounds are used in copper mines, and can be transferred to surface water. Some heavy metals such as arsenic or mercury are used to recover gold, and can be found downstream of illegal mining sites in surface water.

Livestock directly affects surface water quality via their dejections which transfer nutrients such as nitrate, ammonia, nitrite, and phosphate in the streams when manure is washed away after precipitation or floods. The magnitude of the pollution is closely related to the distance of the livestock from the stream. Manure can be the source of bacteriological contamination as well, especially in lakes where conditions for bacterial development are better, due to higher temperatures and nutrient availability. Probably the biggest impact of livestock on surface water quality is indirect through destruction of the vegetation cover by grazing, which favors erosion and releases fine particles of soil and nutrients in rivers and lakes after precipitation and floods.

The effluent of waste water treatment plants of many aimag and soum centers is polluting the surface water due to poor operation of the facilities. Domestic wastewater contains nutrients, which favor eutrophication and toxic substances such as ammonia and nitrite that can be a threat for human health and livestock. Industrial wastewater can contain a wider range of pollutants, some of them being toxic at very low concentrations. Pollutants from industrial effluents cannot be properly treated in treatment plants designed for domestic wastewater. At Ulaanbaatar the Central Waste Water Treatment Plant pollutes the Tuul River. The treated sewage water from the treatment plant is ranked as "much polluted" according to the fresh surface water standard, because the efficiency is less than 100%. An added problem is the waste water from industries and enterprises to the plant, while it is designed for the treatment of domestic waste water only.

The use of fertilizers and pesticides is not widespread in Mongolia but could increase in the future with the development of crop production. Fertilizers contain nutrients such as nitrate and phosphate to enrich soils. These elements can be transferred to streams via surface runoff after rainfall or groundwater transfer. Risks of nutrient transfer decrease with the distance to the stream. Pesticides are substances or mixture of substances intended for preventing and destroying any pest. They can cause various effects on human health and biodiversity, even at very low concentrations.

3.6.2. Reuse of waste water to increase water resources

The reuse of waste water is desired increasingly to augment water resources in urban areas. It is applied internationally but not yet at a large scale in Mongolia. To ensure an efficient operation it is necessary to have sufficient water available and also to allow use of the water possible. Reuse of waste water from industrial treatment plants is relatively easy to implement because water reuse will be possible at the industries themselves. Reuse of waste water from municipal waste water treatment plants operated by municipalities is more difficult to implement because potential water users should be available nearby. Such reuse could be organized in cooperation with thermal power plants or industries located near the waste water treatment plant. The waste water from municipal waste water treatment plants is usually discharged to rivers or infiltration ponds and use of this water further downstream could also be considered as reuse.

3.7. Transboundary water issues

Mongolia borders with the People's Republic of China and Russia and there are many rivers and lakes that cross the national boundary. The Mongolian government made a first agreement on protection and utilization of the transboundary waters with the People's Republic of China on April 29, 1994 and with Russia on February 15, 1995. On April 15, 1995, the Mongolian and Russian government entered into an agreement upon scientific and technological co-operation on hydrology, meteorology and research monitoring.

According to the agreement between Mongolia and the People's Republic of China, parties agreed to establish a transboundary water council and to appoint representatives. The council members meet every two years. During the meetings, members discuss all the transboundary issues and the implementation of the agreement. The duration of the agreement was set at ten years and one year before the expiration of the agreement, the agreement is extended for 5 years, unless one of the parties officially informs the other party that he wishes cancellation of the agreement. The main transboundary waters between Mongolia and the People's Republican of China are the Khalkh, Kherlen and Bulgan Rivers and the Buir Lake.

The agreement between Mongolia and Russia regulates issues on lakes, rivers, and other surface waters as well as groundwater aquifers which are crossing the boundary or form the boundary. According to the agreement, both parties agree to appoint representatives and 2 deputies to a working group. The working group meets annually in order to discuss all transboundary issues and implementation of the agreement. The agreement was made for ten years and automatically will be extended with 5 years, unless one of the countries objects.

Within the framework of the agreements with Russia and the People's Republic of China, the following activities are implemented:

- Mongolia and Russia agreed to jointly elaborate the Selenge River basin scheme for integrated use and protection of water resources, Russia will fund the project. Within the scope of this project, a study is planned of the impacts of mining activities on water resources. The study has not yet started. Both parties monitor pollution levels and exchange information. The joint study revealed that the boundary waters are not polluted.
- In the agreement with China, activities were planned for monitoring the impacts of the exploitation of gold mining in the upstream part of the Kherlen River, for studying the water use along the river, and for setting up hydrological gauging stations in the downstream part of the Kherlen River. None of these activities has started yet. Planned joint activities, such as hydrological and water quality studies on the Khalkh, Nomrog and Sharilj Rivers, a study of these rivers upstream protection areas, and an assessment of Buir Lake fish resources, did not start either.

PART C – THE USERS OF THE WATER – THE DEMAND

4. Socio-economic development

4.1. Government and administration

Mongolia is a parliamentary republic. The parliament is elected by the people and in turn elects the government. The president is elected directly. Mongolia's constitution guarantees full freedom of expression, religion, and gives other freedoms. Mongolia has a number of political parties, the biggest ones being the Democratic Party (DP), the Mongolian People's Party (MPP) and the Mongolian People's Revolutionary Party (MPRP).

In 1990 Mongolia changed from a centrally planned economy towards a democratic free market economy. This brought about important changes, but the transition period was difficult and most social economic development indicators decreased. From 1993 this trend has reversed.

Administratively Mongolia is divided into 21 aimags and the Capital city. The aimags are subdivided into 329 soums, the soums into 1568 bags. The capital city is subdivided into 9 districts, and the districts into 132 khoroos.

For development planning the country is divided into 5 economical regions: the Khangai, Western, Central, Eastern and Ulaanbaatar region.

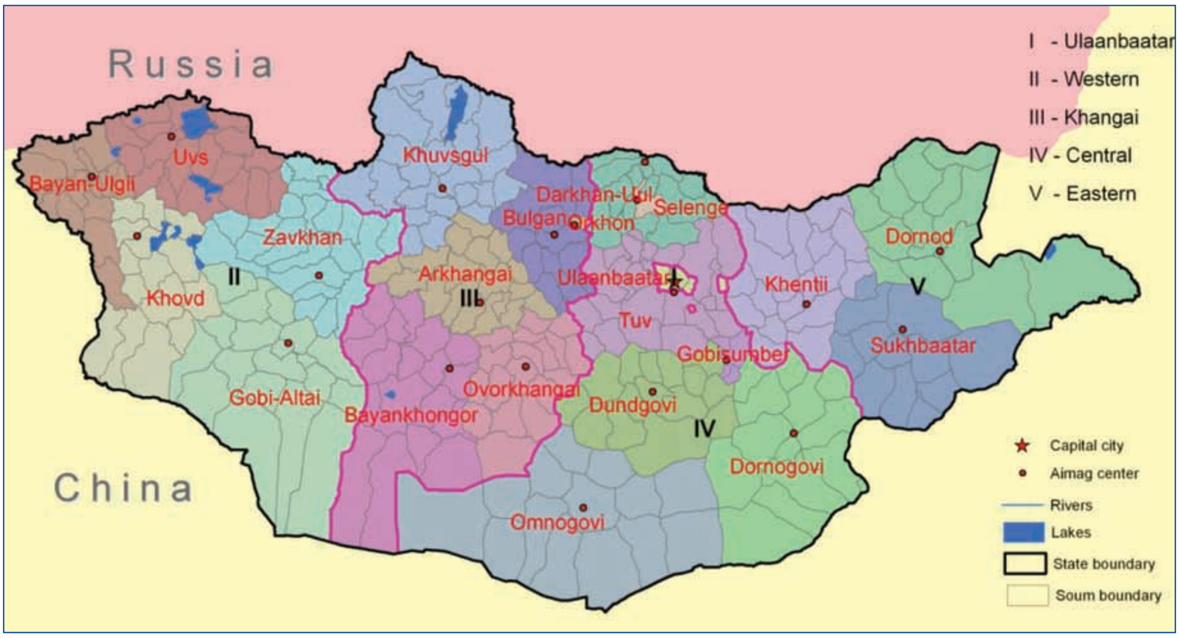


Figure 25. Location of economical regions, aimags and major cities in Mongolia

4.2. Macro-economic development

By the year 2020 the world economy is expected to have expanded by 80% compared to its size in 2000, per capita income will have increased by 50%. Fundamental changes are occurring in the patterns of global production, trade, employment and wages.

Asia is emerging as a global development epicenter in addition to Europe and America with rapidly developing economies and growing populations in India and China. Countries in Asia are becoming more inter-connected in terms of their trade and economic relations, and discussions are underway with regard to establishing the Asian Monetary Fund and introducing a single Asian currency. China, Mongolia's main trading partner, is quickly recovering from the global financial crisis and is the driving force behind the growth of the mining sector in Mongolia.

In Mongolia the economic structure has transformed significantly over the past 15 years. From being a communist country with corresponding economic system, the economy has changed into a market based economy with a strong private sector. Services and agriculture are the biggest contributors to the country's GDP nowadays, while mining is the fastest growing sector.

Mongolia's real GDP growth was between 9 and 10% in 2007 and 2008. This growth rate is the result of the huge expansion in the mining sector that has benefited from increases in international gold and copper prices. Good weather conditions have also contributed to the growth of Mongolia's livestock industry and agricultural production. Nevertheless, in 2009 real GDP decreased with around 1.5%, due to the global financial crisis and the drop in gold and copper prices. Moreover, in 2009 Mongolia's livestock was hugely affected by that year's dzud. Now, the economy is recovering. Preliminary estimates suggest that real GDP grew by 6.1 percent in 2010. For the future, further GDP growth is expected by the IMF, based on the opportunities presented by growing neighbors and considerable mineral reserves.

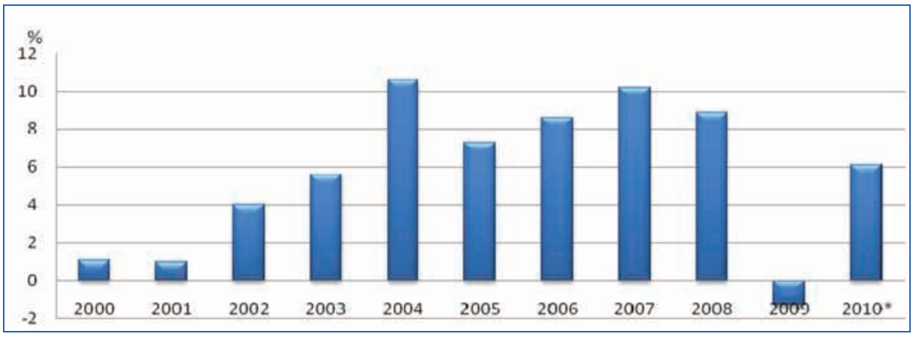


Figure 26. GDP growth of Mongolia in %

A disturbing trend is the continuing upward trend of the consumer prices. Rising local food prices due to the recent dzud and global food prices, also in China and Russia from which Mongolia imports several food products, suggest that continued inflationary pressures can be expected. In addition, Mongolia's booming economy is running into capacity constraints. Finally, strengthening domestic demand was reinforced with the GoM raising public sector wages with 30% and substantial cash handouts to the population. These developments increase demand thereby affecting the inflationary trend.

Another risk to economic growth is the infrastructure, which is of vital importance for growth. Firstly, it is poorly maintained. The budget for operations and maintenance is inadequate to preserve the quality of existing infrastructural works. Secondly, Mongolia has relied on Official Development Assistance (ODA) to finance most of the infrastructure requirements. Grants account for a huge portion of infrastructure finance. As the economy grows, donors will inevitably lose their status as the primary financier.

The main goals of the general economic policy for 2007-2015, as laid down in the Millennium Development Goals Based National Development Strategy, are to achieve the Millennium Development Goals (MDG), attain annual economic growth of at least 14 percent, increase GDP per capita to at least 5,000 USD, and establish the basis for intensive economic development. For 2016-2021 the aim is to increase average annual economic growth to at least 12%, customize and develop a knowledge-based economy, increase GDP per capita to a minimum of 12,000 USD, and to create economic capacity and resources to join the ranks of middle income countries.

4.3. Implications and risks

Expansion of mining will bring important benefits—new investment, jobs, export income, and a surge in government revenue that could fund social and development spending, so as to increase the productive capacity of the economy and reduce poverty. However, the flood of new investment and revenue into this small, narrowly based economy may also aggravate problems. The main challenge is the management of volatile revenue inflows from minerals and to avoid the boom–bust instability that is common in mineral-based economies. For a start, increased demand for labor and materials, plus higher incomes and public spending (notably the cash handouts to Mongolian citizens) and increasing cost of imported fuel are likely to result in double-digit inflation in the coming years. Wages in mining and in the public service are likely to rise. The boost in export earnings increases the "Dutch disease" risk common to mineral-based economies. In this scenario, rapid increases in exports of minerals put upward pressure on the exchange rate and inflation, draw resources away from non-mineral sectors, and generate a stream of government revenue available for subsidies and handouts. This is politically attractive (for the short term), but the outcome will be uncompetitive non-mineral industries and overextended government budgets (particularly when global mineral prices turn down). This will for instance put the cashmere, hides and skins, and meat industry and any other export oriented industry out of business. Also industries for the domestic market will face stronger competition from cheaper imports every time the Tugruk revaluates. Moreover, the higher costs would make it more difficult to diversify the economy away from mining. Indeed, an increase in mining's role would likely amplify the economy's vulnerability to swings in global commodity prices. (Mongolia experienced some of these problems during the copper boom from 2005 to early 2008 and, when copper prices crashed, it suffered recession in 2009) Domestic demand was reinforced with the GoM raising public sector wages with 30% and substantial cash handouts to Mongolian citizens, further enforcing the inflationary trend. Symptoms of a looming "Dutch Disease" have already become apparent.

Managing windfall revenue and smoothing public expenditure will be critical to avoiding such boom and bust cycles. The government has proposed structures to address these issues, in particular the Law on Fiscal Stability. The challenge now is to adopt the law and adhere to its rules. It has also put forward a stabilization fund to manage revenue volatility, but it will be several years before the fund is large enough to help buffer the economy from another copper slump. While steps have been taken to strengthen the central bank's role in maintaining price and banking system stability, more needs to be done, including changes to make inflation a main policy goal.

An immediate risk to economic growth is the infrastructure, which is of vital importance for growth. Firstly, it is poorly maintained. The budget for operations and maintenance is inadequate to preserve the quality of existing infrastructural works. Secondly, Mongolia has relied on Official Development Assistance (ODA) to finance most of the infrastructure requirements. Grants account for a huge portion of infrastructure finance. As the economy grows, and Mongolia approaches the status of a middle income country, grants will no longer be available and interest rates on loans will jump to a higher category. Another major risk is Mongolia's booming economy running into capacity constraints. Both these risks are rapidly becoming a reality.

The "resource curse" (or paradox of plenty) is a real threat hanging over Mongolia. When the above described necessary government measures to curb inflation, stabilize the economy and diversify away from mining are not successful, Mongolia will be joining countries like Nigeria, Venezuela, Angola, Russia and many others whose mineral wealth has resulted in a rapidly increasing gap between the rich and the poor with all its social destabilizing consequences.

For developments in the water sector this may have considerable implications for the expected water demands, e.g. the plan to move the people living in the Ger districts of Ulaanbaatar to apartments that is expected to increase their water use from the present 5-10 l/p/d to jump to 150-200 l/p/d might not materialize because Ger district dwellers cannot afford the costs of living in apartments as their purchasing power is more likely to decrease than to increase.

4.4. Social development

4.4.1. Population

The total population of Mongolia reached 2.78 million in 2010. Since 1990 at first the population increased with an average of 1.5%, with a dip to just over 1% in 2003-2005 and an increase again to almost 2% thereafter. In 2010 the increase was 1.6% (Table 4 and Figure 27).

Population density is the lowest in the world at 1.75 persons per km^2 on average. With the majority of the people living in urban areas the population density in the rural areas is less than 0.5 persons/km^2. The average household size is 3.7 persons. The sex ratio is 94.6 males per 100 females.

About 40% of the population (1.15 million people) lives in the capital Ulaanbaatar. Migration to Ulaanbaatar causes an annual increase of the city's population of 4%. Other major cities are Erdenet (85,000) and Darkhan (77,500), Choibalsan (38,000) and Moron (36,000). Aimag centers typically have 10-40,000 inhabitants, soum centers are much smaller and typically only have 500-5,000 inhabitants. Table 12 gives present (2010) population numbers on water basin level.

As a result of migration the urban population has grown steadily at a rate of 2 - 4% since 1990. The rural population has remained stable at around 1 million people. In 2002 42.6% of the population lived in rural areas, in 2010 this had reduced to 36.7%. This means that the urban areas account for all of the population growth.

Since 1990, key health indicators like life expectancy and infant and child mortality have steadily improved, both due to social changes and to improvement of the health sector. However, serious problems remain, especially in the rural areas. Life expectancy at birth is 68.05 years, 72.26 years for females compared to 64.93 years for males. Child mortality, the probability of dying before reaching the age of 5, was 26 per 1000 live births in 2010. Infant (<1 year) mortality was 20.2 per 1000 live births. In 2010 41.4 thousand occurrences of infection diseases were reported, 30% of which were water related diseases (hepatitis: 22% and diarrhea: 8.3%). Health problems related to the hardness and high concentrations of fluoride and arsenic in the drinking water are reported as well.

Table 4. Population in the period 1990-2010

	Year										
	1990	2000	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total (thous. persons)	2044.0	2373.5	2475.4	2504.0	2533.1	2562.4	2594.8	2635.2	2683.5	2735.8	2780.8
% urban	57.0	57.2	57.4	58.5	59.1	60.2	60.9	60.8	61.8	62.6	63.3
% rural	43.0	42.8	42.6	41.5	40.9	39.8	39.1	39.2	38.2	37.4	36.7

Source: Statistical Yearbook 2010

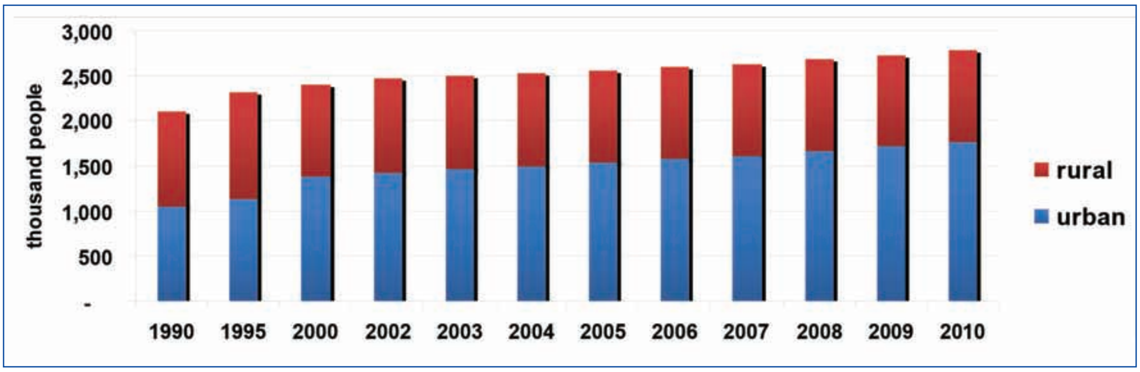


Figure 27. Total, urban and rural population 1990-2010

4.5. Population projections

According to the 2010-population and household census, the NSO of Mongolia has developed three population growth scenarios. Predicted population numbers according to the low, medium and high scenario are given in Table 5 and numbers by water basin level are presented in Table 12.

Table 5. Population projections for the years 2015 and 2021 according to the NSO's low, medium and high population growth scenario

		Population (thous. persons)	
Year		2015	2021
Scenario	High	3007.4	3321.4
	Medium	2975.2	3225.2
	Low	2943.1	3129.0

Urbanization is expected to continue: in 2015 64.5% of the population is expected to live in urban areas, in 2021 this is expected to increase to 67.0%, compared to 63.3% at present (2010).

4.6. Employment and labour resources

In 2010 about 67% of the Mongolian population is of working age: 15 – 60 years old. Nearly 6% is over 60, and the remainder is under 15. About 62% of the working age population or 41% of the total population are economically active. The share of woman in the working age population is 51.6% and 47.1% in the economically active population. Nearly 10% of the economically active population are unemployed. Table 6 gives details on the employment situation in recent years.

Table 6. Employment situation in the period 2006 – 2010

Year	2006	2007	2008	2009	2010
Population of working age ('000)	1619.6	1642.2	1688.7	1704.4	1863.4
Economically active population ('000)	1042.8	1054.0	1071.5	1137.9	1147.1
Number of people employed ('000)	1009.9	1024.1	1041.7	1006.3	1033.7
Number of unemployed people ('000)	n.a.	n.a.	n.a.	131.6	113.4
Labour force participation rate (%)	64.4	64.2	63.5	66.8	61.6
Employment rate (%)	n.a.	n.a.	n.a.	88.4	90.1
Unemployment rate (%)	n.a.	n.a.	n.a.	11.6	9.9

About one third of the people employed is working in the agricultural sector, 16% in the mining and industrial sector and the remainder, or nearly 50%, in the tertiary or services sector. The share of the services sector is growing at the expense of agriculture. Table 7 gives the details.

Table 7. Employment (in '000) by sector in the period 2006-2010

Year	2006	2007	2008	2009	2010
Number of people employed ('000)	1009.9	1024.1	1041.6	1006.3	1033.7
Agriculture ('000)	391.4	385.6	377.6	348.8	346.6
Mining and industry ('000)	175.2	183.148	190.9	162.7	167.9
Services incl. government ('000)	443.2	455.4	473.2	494.8	519.2

4.7. Education, cultural level, custom and religion

Education was one of the important achievements of Mongolia during the socialist era, with education indicators comparable to those of middle income countries, After 1990 the quality of, and access to education deteriorated for a short period, but in recent years the situation improved considerably again: basic education (primary and lower secondary education) is available all over the country, it is compulsory and funded by the state. Gross enrollment among the school-age population is 98% and 97% of the adults is literate.

The progress in meeting the millennium development goals in education is shown in Table 8.

Table 8. Progress on meeting the millennium development goals in education

Year	1990	2000	2006	2008	2010*	MDG
Net enrolment ratio in primary education (%)	95.9	95,0	91.4	91.5	94.7	100
Proportion of children starting grade 1 who reach grade 5 (%)	91	83,6	86.8	92.8	92.9	100
Literacy rates of male and female youth, aged 15–25 (%)	99	97,7	97.7	97.7	-	100
Ratio of girls to boys in primary education	1.03	1.01	0.98	0.97	0.96	1
Ratio of girls to boys in secondary education	1.33	1.2	1.03	1.08	1.07	1
Ratio of girls to boys in higher education	1.56	1.72	1.53	1.54	1.48	1

Source: Government of Mongolia. 2009. The Millennium Development Goals Implementation, Third National Report.
** Statistical yearbook-2010*

Ethnic Mongols account for about 95% of the population and consist of Khalkha and other groups, all distinguished primarily by dialects of the Mongol language. The Khalkha make up 82.4% of the ethnic Mongol population. The remaining 14% include

Oirats, Buryats and others. Turkic peoples: Kazakhs, Tuvans, and Chantuu (Uzbek) constitute 4.5% of Mongolia's population, and the the balance is made up of Russian, Chinese, and Korean.

Fifty three percent of the Mongolians aged 15 and above is Buddhist and 39% Atheist. Islam accounts for 3% and Christianity for 2%. Various forms of shamanism have been widely practiced throughout the history of Mongolia, at present 3% of the population practices shamanism.

The Mongolian culture is largely determined by the Mongol nomadic way of life. Other important influences are from Tibet and Tibetan Buddhism, and from China. Since the 20th century, Russian and, via Russia, European culture have had a strong impact on Mongolia.

> Mongolia is a proud country with a rich history and a cultural legacy. Its rich heritage is marked with customary practices on water that would do the modern day environmentalist proud. The Great Rulings (Ikh Zasag) of the legendary General Chinggis Khan, formed the common law for tribal Mongolia since the 13^{th} century. It imposed a stringent compliance regime for water use. Mongolian tradition forbade the pollution of water. It was believed that naga (the Snake lord) resided in the pure waters of springs and oases. Hence, milk, dairy products, meat or any kind of waste could never be allowed to touch the water It was forbidden to wash in running streams. Water is carried a distance from the river where washing can take place so that residual water would be filtered by the soil before it seeps back into the river.
>
> *Basandorj, Satyajit Singh, 2009,*
> *Rural water supply and sanitation in Mongolia*

As one of the few remaining nomadic cultures in the world, Mongolians live in close contact with nature and the idea of nature worship is firmly embodied in traditions and religion of the people. Centuries old environmental protection rules included official protection of sacred mountains and water bodies. It was forbidden to pollute the environment, rivers and springs and to hunt wild animals in the breeding season. Purity of water resources had to be maintained and according to tradition one should not throw waste into water sources or urinate, spill milk, blood or dirty water next to a water source. Many Mongolians still adhere to these rules.

4.8. Human development level

In Mongolia the Human Development Index (HDI) is used as a measure for social development. Mongolia’s HDI value for 2010 is 0.622, which positions the country in the medium human development category. From 1985 to 2010, Mongolia’s HDI value increased from 0.515 to 0.622, an increase of 21 per cent. Life expectancy at birth increased by over 8 years, mean years of schooling increased by over 1 year and expected years of schooling increased by 3 years. Since 1995 Mongolia’s Gross National Income (GNI) per capita almost doubled to US$ 3,619 per capita classifying the country as a ‘lower middle income country’. Continuing this trend will elevate Mongolia to the group of ‘higher middle income countries’ (GNI > US$ 3,975) as early as 2011 (Table 9).

> **Box 3.**
>
> HDI is an index for assessing long-term progress in three basic dimensions of social development, a long and healthy life, access to knowledge and a decent standard of living,

Table 9. Change in social development indicators, 1980 - 2010

Year	Life expectancy	Years of schooling	GNI per capita (US$)	HDI
1980	56.4	6.5	-	-
1985	58.9	7	2,259	0.515
1990	60.8	7.6	2,132	0.520
1995	62.5	7.7	1,988	0.502
2000	64.2	8.1	2,195	0.539
2005	65.5	8.2	2,765	0.588
2010	67.3	8.3	3,619	0.622

In 2010 the monthly average income per household in Mongolia was 448.0 thousand MNT; 386.6 thousand in rural areas and 498.2 thousand in urban areas. In the period 2006-2010 average household income more than doubled, with incomes in the urban area growing faster than in the rural areas. The minimum subsistence level ranges from 90.9 thousand MNT per month per person in the eastern region to 101.6 thousand MNT per month per person in Ulaanbaatar. With an average family size of 3.7 this equals 336 to 376 thousand MNT per household per month.

Although the Mongolian MDGs aim to reduce poverty by a factor 2 over the period 2007-2015, the number of people living below the poverty line increased in recent years. Reasons are the world economic crisis and the unfavorable winter conditions (dzuds) in recent years. Since 2007/2008 the proportion of the population with the standard of living below the poverty line increased from 35.2% to 39.2%.

Poverty is a fairly recent phenomenon in Mongolia. Before the transition to a market economy there were virtually no poor people. Government and rural collectives supplied everyone with basic goods and ensured access to a full range of public services. After 1990 the privatization of industries and state farms resulted in increasing levels of unemployment. At the same time inflation increased and incomes shrank. Benefits and assistance dried up and people had to bear the cost of health and education services themselves.

Poverty is more common in the rural areas (54.2%) than in the urban areas (32.2%) but increases rapidly in the capital. This is related to the decrease in number of herders and unemployment related migration to the city. In the Western and Khangai region more than half of the population lives below the poverty line, the situation is much better in the central region, where some 30% of the population is poor.

Most vulnerable for poverty are women who are heads of households, members of households with more than four children, families of small herders, unemployed people, people without basic education, and groups like the elderly, the disabled and orphans.

Table 10. Percentage of population living below the poverty line in the period 2002/2003 - 2010

Year		2002/2003	2007/2008	2009	2010
Country average		36.1	35.2	38.7	39.2
Urban		30.3	26.9	30.6	32.2
Rural		43.4	46.6	49.6	54.2
Location	Ulaanbaatar	27.3	21.9	26.7	29.8
	Aimag center	33.9	34.9	37.0	36.2
	Soum center	44.5	42.0	42.6	38.8
	Rural	42.7	49.7	53.2	54.2

Source: NSO

4.9. Current status

Mongolia is on track to achieve education and under-five mortality targets of the Millennium Development Goals (MDGs 2 and 4). Progress has been limited in reducing poverty and unemployment (MDG 1) and gender-based disparities persist (MDG 3). Water scarcity increases the vulnerability of rural populations engaged in nomadic livestock husbandry and arable farming. It also decreases their resilience and that of the ecosystems on which their livelihoods depend. Mongolia's deteriorating water quality causes health problems. Access to safe drinking water and sanitation would improve health, reduce health care costs (MDGs 4-6), boost productivity and increase the return on investments (MDG 1).

In general women are considered responsible for household related water use and men for herding or small business water uses, whereas in reality women are also involved in these productive uses of water. Despite Mongolian women's roles in household water management, they are under-represented at higher levels of water management. In general women are not well represented in higher levels of government (e.g. only 10-15% per cent of parliamentary seats are held by women). Women are more likely to have roles in science and technological fields, related to water management, than in decision-making. This lack of women's representation in decision-making positions is not due to a lack of education or illiteracy: 83 per cent of adult women have a secondary or higher level of education compared to 82 per cent of their male counterparts. Female participation in the labour market is 70 per cent compared to 80 per cent for men.

Overall the HDI index shows significant improvement of the general living conditions over the last 20 years. Still Mongolia only ranks 100th out of 169 countries. Furthermore, not all groups in society equally benefit from the development. It is mainly the urban, middle and upper class that is improving its situation, partly at the expense of the urban and rural poor, and the gap between the affluent urban population and rural poor is widening.

Table 11. Basic socio-economic data

Parameter	Unit	Quantity
Population	people	2,780,800
Population Ulaanbaatar	people	1,130,000
Population other urban areas	people	630,250
Population rural (incl. soum centers)	people	1,020,550
Employment	people	1,033,700
Monthly average income per household	MNT	448,027
Minimum subsistence level per person per month	MNT	90,000 – 1000,000
Poverty headcount index	%	39.2
Livestock number	Animals	32,700,000
Livestock number	sheep head	54,821,400
Pastureland area	1000 ha	112,970.5
Sown agricultural area	1000 ha	315.3
Total area for irrigation	1000 ha	45.2
Sown area for irrigation	1000 ha	37.0
GDP total	bln. MNT	8,255
Agriculture	bln. MNT	1,312
Mining	bln. MNT	1,874
Industry and construction	bln. MNT	1,065

Parameter	Unit	Quantity
Service	bln. MNT	4,004
GDP growth	%	6.1
Mining licenses for exploration	-	3508
Mining licenses for exploitation	-	1291
Mining area licensed for exploration	1000 ha	23,838.8
Mining area licensed for exploitation	1000 ha	1,058.4
Water tariff 2008 (lowest in Tov aimag, highest in 5 aimags)	MNT/m^3	650 - 2000
Water income collected into state budget	bln. MNT	4.6
Investments in water supply and sanitation sector	bln. MNT	15.1
Investments in water supply wells for livestock	bln. MNT	7.4
Investments in irrigation systems	bln. MNT	12.0
Investments in water exploration and protection	bln. MNT	0.9
Investments in flood protection and drainage	bln. MNT	2.1
Investments in hydropower	bln. MNT	0.0

Remark: All data refer to the year 2010 unless otherwise stated

Table 12. Water Basins of Mongolia, population 2010 and prediction

No	Water Basins	Population 2010, thousand persons					Population 2015, thousand persons				Population 2021, thousand persons			
		Total	Share of total, %	Urban	Soum center	Rural	Total	Urban	Soum center	Rural	Total	Urban	Soum center	Rural
1	Selenge	39.1	1.4		21.6	17.5	38.6		21.3	17.3	39.9		22.1	17.9
2	Khuvsgul Lake - Eg	25.0	0.9		10.5	14.5	24.7		10.4	14.3	25.6		10.7	14.8
3	Shishkhid	9.1	0.3		2.7	6.3	9.0		2.7	6.3	9.3		2.8	6.5
4	Delgermurun	58.5	2.1	36.1	3.7	18.6	57.9	35.8	3.7	18.4	60.1	37.1	3.8	19.1
5	Ider	32.2	1.2		10.1	22.1	31.5		9.9	21.6	32.2		10.1	22.1
6	Chuluut	21.5	0.8		5.0	16.5	21.2		5.0	16.2	21.8		5.1	16.7
7	Khanui	20.4	0.7		3.6	16.8	20.1		3.5	16.6	20.6		3.6	17.0
8	Orkhon	244.9	8.9	147.6	43.6	53.7	254.2	157.3	43.6	53.4	272.4	172.0	45.3	55.2
9	Tuul	1,191.4	43.4	1,140.7	20.9	29.8	1,387.2	1,337.3	20.6	29.3	1,552.4	1,501.2	21.1	30.1
10	Kharaa	154.7	5.6	114.3	15.5	24.9	160.8	120.3	15.5	25.0	169.9	128.0	16.1	25.8
11	Eroo	9.9	0.4		7.6	2.3	9.9		7.6	2.3	10.2		7.9	2.4
12	Onon	12.8	0.5		5.0	7.7	12.8		5.0	7.7	13.2		5.2	8.0
13	Ulz	15.1	0.5		7.2	7.9	15.0		7.2	7.8	15.5		7.4	8.1
14	Kherlen	141.0	5.1	84.5	24.5	32.0	145.1	88.8	24.4	31.9	152.5	94.6	25.2	32.8
15	Buir Lake - Khalkh	3.0	0.1		1.8	1.2	3.0		1.8	1.2	3.1		1.9	1.2
16	Menengiin Tal	11.5	0.4		3.7	7.8	11.4		3.7	7.8	11.8		3.8	8.0
17	Umard Goviin Guveet - Khalkhiin D. Tal	160.8	5.9	64.4	31.3	65.1	162.9	65.9	32.1	64.9	169.2	68.8	33.7	66.7
18	Galba – Uush - Doloodiin Govi	49.2	1.8	16.8	10.0	22.4	64.9	31.7	10.3	22.9	85.3	50.7	10.8	23.9
19	Ongi	71.6	2.6	43.7	7.8	20.2	71.1	43.4	7.7	20.0	73.3	44.8	7.9	20.6
20	Altain Uvur Govi	37.9	1.4		9.7	28.1	37.8		9.7	28.1	38.9		10.0	28.9
21	Taats	20.8	0.8		4.3	16.5	20.6		4.3	16.3	21.2		4.4	16.8
22	Orog Lake - Tui	39.3	1.4	26.8	2.6	10.0	38.7	26.4	2.5	9.8	39.9	27.2	2.6	10.1
23	Buuntsagaan Lake – Baidrag	23.1	0.8		4.4	18.7	22.8		4.3	18.4	23.4		4.4	19.0
24	Khyargas Lake – Zavkhan	93.3	3.4	31.5	14.0	47.8	92.4	31.3	13.8	47.3	94.0	31.8	14.0	48.1
25	Khuisiin Govi - Tsetseg Lake	20.5	0.7		4.9	15.6	20.7		4.9	15.7	21.2		5.1	16.1
26	Uench - Bodonch	12.8	0.5		2.3	10.5	12.8		2.3	10.5	13.2		2.4	10.8
27	Bulgan	12.7	0.5		4.1	8.6	12.6		4.1	8.6	13.1		4.2	8.8
28	Khar Lake - Khovd	149.5	5.4	56.2	26.7	66.6	149.1	56.1	26.6	66.4	154.0	57.9	27.5	68.6
29	Uvs Lake - Tes	66.1	2.4	22.9	13.9	29.3	66.4	23.1	13.9	29.3	67.8	23.6	14.2	30.0
Total		2,747.5		1,785.5	323.1	638.9	2,975.2	2,017.4	322.6	635.3	3,225.2	2,237.8	333.3	654.1

Remarks: Urban population includes capital, aimag centers and big urban areas; prediction 2015 and 2021 for medium scenario growth
Total population 2010 is based on soum population as used by NSO; this total population number differs from the total country population because certain population groups are not included, e.g. prisoners, army personnel, etc.

5. Sector development and water demands

5.1. Domestic sector

5.1.1. Development of the domestic water consumption

Access to drinking water services varies significantly in the main cities, the smaller urban centers and the rural areas (Table 13). Private connections are found in the centres of the main cities only. Outside the city centres and in the smaller urban centers water is obtained in containers from kiosks which are supplied from a central system or by water tanker. Improvements by constructing more kiosks were realized in several cities in recent years. In the rural areas people largely depend on wells, springs, rivers, lakes and ponds for their water supply.

The MDG Based Comprehensive National Development Strategy aims to provide 70% of the population in cities and settlement areas with water from the water supply network by 2015. Moving ger residents to apartment areas and connecting kiosks in the ger areas of Ulaanbaatar to the water supply network are policies supporting this objective. In Ulaanbaatar 75,000 to 80,000 apartments are to be constructed, whereas in a number of districts in the ger area 'apartment micro-regions' will be developed. The final goal is to increase the share of apartment dwellers in Ulaanbaatar to 80% by 2020. Another 25,000 apartments are planned in the aimag centers.

Improvement of the water supply and sanitation services is a policy objective of the Mongolian government. Projects are implemented and the access to water is expected to improve in the future. The change in access to water as it is based on projections prepared by MRTCUD is presented in Table 13.

Table 13. Percentage of the population having access to various water supply sources

Water source		2008	2010	2015	2021
Central water system	Apartments connected	20.7	21.7	29.8	33.3
	Ger districts supplied from connected kiosks	12.0	14.5	17.1	18.7
Water transportation	Ger districts supplied from kiosks or direct from water vendors	23.0	22.8	17.3	18.2
Protected sources	Wells, springs	11.0	12.9	14.2	15.7
Unprotected sources	Wells, springs	20.8	20.7	15.7	11.5
Other sources	Unknown water use	12.5	7.5	5.9	2.6
Total		100.0	100.0	100.0	100.0
Total improved sources		66.7	71.8	78.4	85.8
Total unimproved sources		33.3	28.2	21.6	14.2

The consumption of drinking water is characterized by a large discrepancy between people living in apartments on the one hand and people living in urban and rural ger areas on the other hand. The water consumption in apartments reaches up to 200-400 liters per person per day, which is among the highest in the world, while the daily water consumption of ger area residents as well as rural herders is 5-10 liters per person on average. This is below the minimum consumption as recommended by the World Health Organization. The main reason for the low consumption is the limited access to drinking water, with kiosks that are not open all the time and long walking distances because of the limited number of kiosks. Table 14 shows the actual and the norm drinking water consumption in liters per person per day. The actual water consumption was obtained from water supply companies. The norm water consumption was used to calculate the water demand. Future norms were estimated based on projection of trends and international norms.

Table 14. Per person drinking water consumption norm in Mongolia according to source

<table>
<tr><th colspan="3" rowspan="2">Water source</th><th colspan="4">Water consumption (l/person/day)</th></tr>
<tr><th>Actual</th><th colspan="3">Norm</th></tr>
<tr><th colspan="3"></th><th>2010</th><th>2010</th><th>2015</th><th>2021</th></tr>
<tr><td rowspan="6">Central water system</td><td rowspan="4">Apartments connected to water supply, sanitation and hot water supply</td><td>Ulaanbaatar</td><td>237*</td><td rowspan="4">230</td><td rowspan="4">200</td><td rowspan="4">160</td></tr>
<tr><td>Erdenet</td><td>250</td></tr>
<tr><td>Darkhan</td><td>226</td></tr>
<tr><td>Other cities</td><td>200-400</td></tr>
<tr><td colspan="2">Apartments connected to water supply and sanitation without hot water supply</td><td>175</td><td>175</td><td>170</td><td>160</td></tr>
<tr><td colspan="2">Ger districts supplied from connected kiosks</td><td>8.8*</td><td>10</td><td>25</td><td>30</td></tr>
<tr><td>Water transportation</td><td colspan="2">Ger districts supplied from kiosks or direct from water vendors</td><td>6.9*</td><td>8</td><td>15</td><td>20</td></tr>
<tr><td>Protected sources</td><td colspan="2">Wells, springs, rivers, ponds</td><td>6.7</td><td>8</td><td>15</td><td>20</td></tr>
<tr><td>Unprotected sources</td><td colspan="2">Wells, springs, rivers, ponds</td><td>6</td><td>8</td><td>10</td><td>15</td></tr>
</table>

*Source: * Ulaanbaatar city USUG summary report, 2010*

Population growth, ongoing migration and changes in access to water and per person water consumption will determine the future domestic water demand. The three scenarios used to calculate future domestic water demand are explained in the box below.

Figure 28 shows the current and future urban and rural drinking water consumption. The urban drinking water consumption covers all main cities; the rural demand covers soum centers and rural areas. The calculated total domestic water demand is presented in Table 23. The domestic water demand by water basin is presented in Table 25, Table 26 and Table 27.

Domestic water demand scenarios:

Low scenario: Population growth and urbanization according to the NSO low scenario (3A). The number of connections is assumed to be 5% lower than in the medium scenario. The drinking water consumption norms are the same as in the medium scenario.

Medium scenario: Population growth and urbanization according to the NSO medium scenario (2B) and distribution of the users over the various sources as projected by MRTCUD. Water consumption by apartment dwellers decreases to 160 l/day/person in 2021; water consumption by users of kiosks and protected sources increases to 15-30 l/day/person in 2021.

High scenario: Population growth and urbanization according to the NSO high scenario (1B). The number of connections is assumed to be 10% higher than in the medium scenario. The drinking water consumption norms are the same as in the medium scenario.

Most of the increase in water consumption is the result of an increasing demand in the urban areas. The increase after 2015 is expected to be smaller due to a significant lower water consumption norm in the urban areas. In the rural areas the demand is expected to continue growing until 2021 with only a very small difference in demand between the three scenarios.

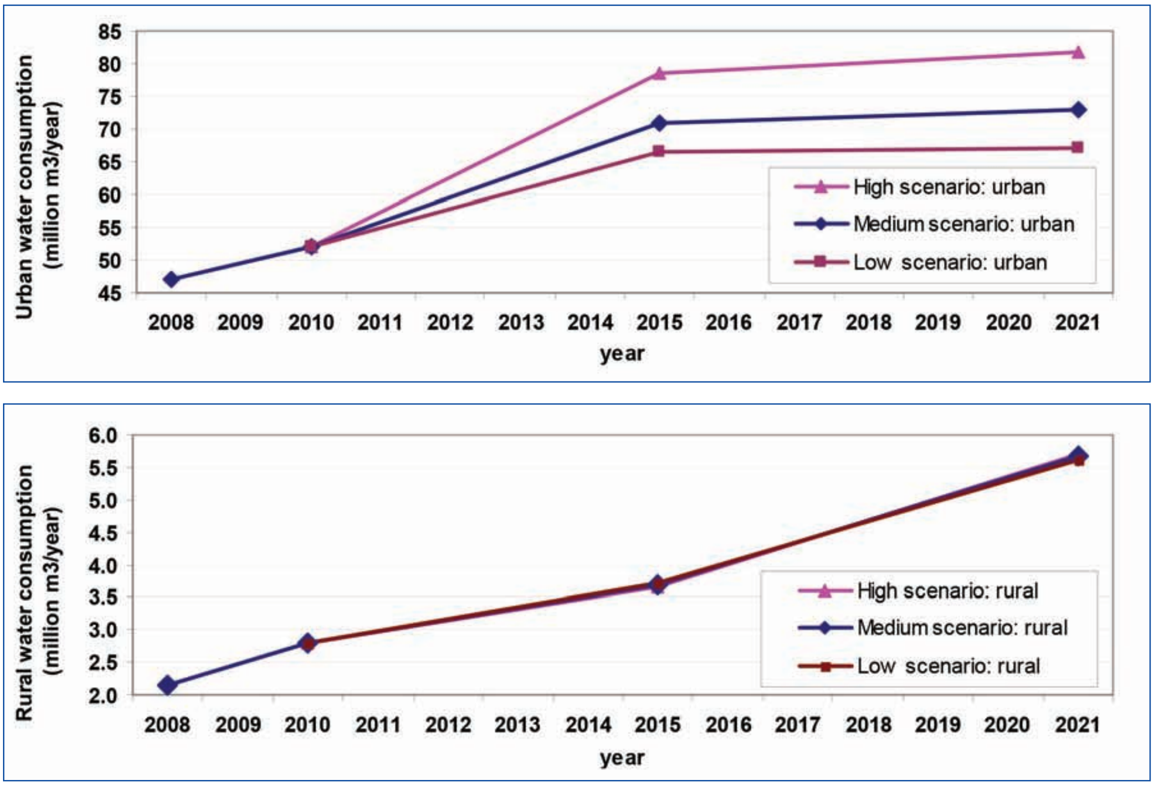


Figure 28. Projected urban and rural domestic water consumption (2008-2021)

5.1.2. Domestic water supply systems

Drinking water supply systems use groundwater as water source. The supply systems in cities consist of well fields, water treatment, pumping stations, reservoirs, distribution and transmission pipes and kiosks. The supply systems in smaller urban centers consist of a few wells, little storage, some private connections and one or more kiosks. Rural water supplies usually consist of one well.

Ulaanbaatar has the largest water supply system and the largest drinking water consumption volume in Mongolia. It is in operation since 1959. Both in Ulaanbaatar and other cities many improvements and extensions have been undertaken to the urban water supply systems in recent years. New water sources were developed, pipelines and storage facilities were extended and water supply points were added. Still many of the water supply facilities are old and urgently need replacement. Water losses from outdated pipes and fittings are a major concern.

Some improvements have been made to the rural water supply in recent years. New boreholes were drilled and water supply points were added. But the number is small compared to the large number of boreholes that got out of operation since 1990. In many areas open hand dug wells are the only groundwater source available.

5.1.3. Drinking water quality

The quality of the groundwater used as water source is generally good, although cases of too high total dissolved solids (TDS) content, too high hardness, too high concentrations of arsenic and too high or too low concentrations of iodide and fluoride occur. Incidents of pollution affecting drinking water quality are rare, and only a few cases of bacteriological contamination of urban water supplies have been reported. Persistent organic pollutants, nutrients and heavy metals originating from industrial discharges and insufficient waste water treatment are a threat to the quality of water sources in urban areas on the longer term.

In recent years much attention was given to reduce the high TDS concentrations and the hardness of the drinking water, but many softening systems installed at boreholes are no longer operational due to poor maintenance. In rural areas wells and boreholes used for drinking water supply are often not protected by fencing and water polluted by animal waste may easily return to the well or borehole and contaminate the source.

5.1.4. Water tariffs

Drinking water users have to pay a water tariff. The tariffs used in 2010 range from 250 to 1304 MNT/m^3 for apartments with water meters, 400 to 3485 MNT/m^3 for apartments without water meters and 1000 to 3000 MNT/m^3 for water collected from kiosks in aimag centers. The tariffs paid at kiosks in soum centers are often higher and may go up to 5000 MNT/m^3. Generally the tariffs are higher in areas with limited water resources and lower in areas with abundant water resources. In Ulaanbaatar the tariff is 318 MNT/m^3 for apartments with water meters, 3202 MNT/per month/per person for apartments without water meters and 1000-2000 MNT/m^3 for water collected from kiosks. The revenue goes to the water supply companies. The tariffs do not cover actual costs of the domestic water and consequently the investment and operational costs of water supply and sanitation facilities cannot be recovered.

5.1.5. Municipal waste water and sanitation

Municipal waste water treatment plants are present in most cities but few of these are working efficiently. They mainly aim at treating organic pollution generally using a combination of mechanical and biological treatment consisting of aeration, sedimentation and chlorination. The plants in general are not designed to remove nutrients like nitrogen or phosphor. Most treatment plants discharge their treated effluent to a nearby river or to infiltration fields.

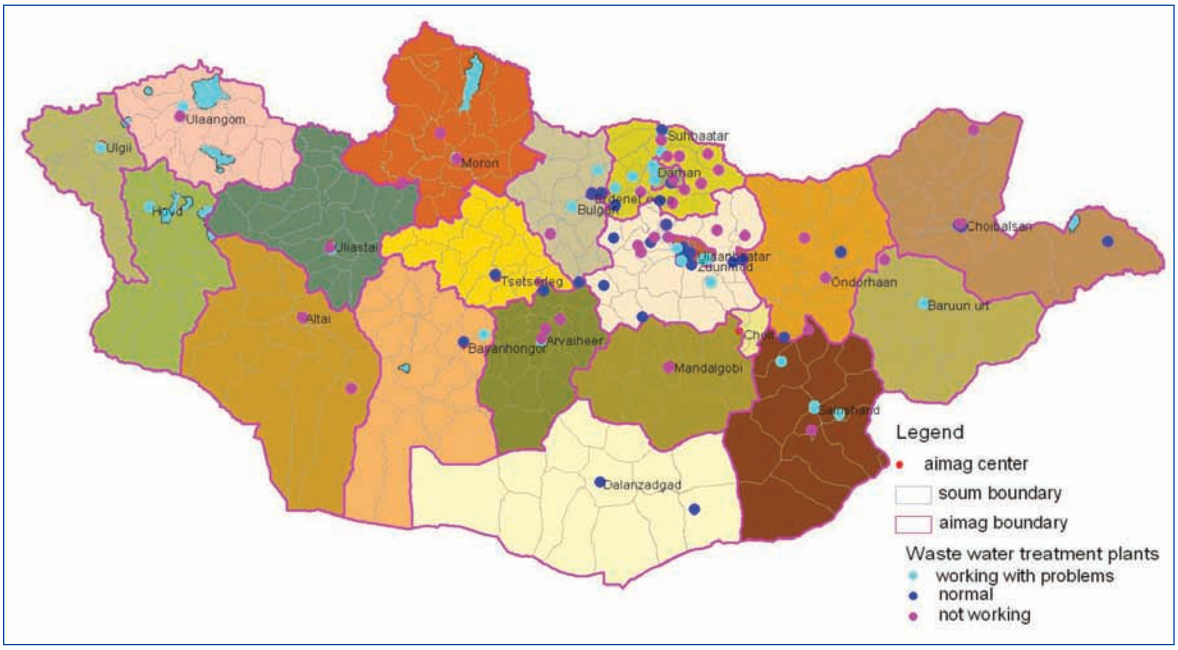


Figure 29. Location of waste water treatment plants

There are 117 WWTPs treating waste water of which 86 treat municipal water and 29 also treat industrial waste water. Of the WWTPs 32 are working, 41 are working abnormal and 44 are not working. Many WWTPs have fallen into disuse due to a lack of funds for the operation and maintenance. Also equipment is old and needs replacement.

The capacity of the WWTPs ranges from small plants treating a few hundred m^3/day to big plants treating 16,000 m^3/day (Darkhan) or 160,000 m^3/day (Ulaanbaatar).

5.2. Agricultural sector

5.2.1. Development of the agricultural production

Agriculture is an important economic sector in terms of employment, export revenues and production of GDP. Within the sector, two sub-sectors can be distinguished, the livestock sector and the crop producing sector.

Agricultural land occupies 73.9% or 115.5 million ha of the country's land area. Pasture land used for nomadic livestock herding and hay making accounts for more than 98% or 113 million ha of the agricultural area, crop production is practiced on a very limited area: about 0.9 million ha or 0.8% of the actual agricultural area.

In 1990, agricultural production made up 33.4% of GDP, in 2000 it was 29.3%. The severe dzud's in 2000-2002 and in 2010 took a considerable number of livestock and negatively affected production growth. Presently agriculture accounts for about 15% of the country's GDP and over 30% of the workforce is involved in agriculture. Of this figure, 80% is accounted for by the livestock sector.

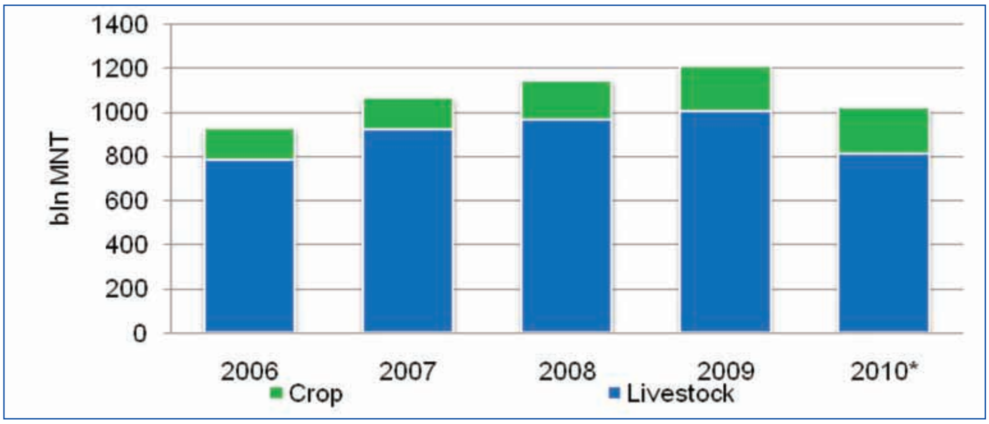


Figure 30. Agricultural production at 2005 constant prices

The main agricultural products are meat, hides and skins, sheep and cashmere wool, milk and eggs, cereals, potatoes and vegetables. Wool of sheep and goats (cashmere) and meat and meat products are the most important export products. Exports are increasing.

5.2.2. Livestock sector

Pasture livestock herding is the core in the historic development of the nation's civilization. Livestock herding as a traditional way of life has adapted to the harsh climatic conditions and has overcome natural disasters and water deficiencies. The sector has also overcome hardships in the economic transition (lack of livestock production management, running down of wells) with relatively few losses and has been successfully adapting to market economy relations. Nationwide data shows that the sector employs 347,000 persons and provides livelihood to even more people.

Livestock numbers have a tendency to increase with dramatic decreases due to dzuds occurring (Table 15 and Figure 32). By 2000, there were 30.2 million head of livestock in the country, a number that decreased due to the dzuds in the years 2001 and 2002. In 2009 the livestock number reached 44.0 million which was reduced to 32.7 million after the dzud of 2010.

Table 15. Livestock numbers and composition: historic and projected

	Total number of livestock (million)	Number of sheep (million)	Number of goats (million)	Number of cattle (million)	Number of horses (million)	Number of camels (million)
2000	30.2	13.9	10.3	3.1	2.7	0.3
2002	23.9	10.6	9.1	1.9	2.0	0.3
2004	28.0	11.7	12.2	1.8	2.0	0.3
2006	34.8	14.8	15.5	2.2	2.1	0.3
2008	43.3	18.4	20.0	2.5	2.2	0.3
2009	44.0	19.3	19.7	2.6	2.2	0.3
2010	32.7	14.5	13.9	2.2	1.9	0.3
2012	33.7	15.1	13.5	2.6	2.2	0.3
2015	36.1	16.4	13.5	3.5	2.5	0.3
2021	35.6	16.1	11.4	4.9	2.9	0.3

Source: MFALI; number of livestock at end of year

The composition of the total livestock has changed also during the years (Figure 31): the percentage of camels, horses, cattle and sheep decreased, while the percentage of goats increased. The increasing number of goats is related to the high demand for cashmere wool.

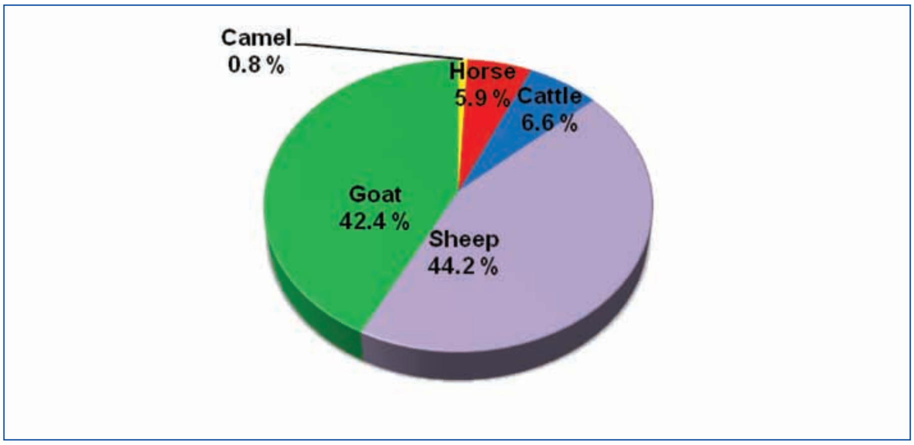


Figure 31. Composition of livestock in 2010

The increasing numbers of livestock and the on-going changes in the traditional nomadic lifestyle have lead to pastureland degradation. Due to the tendency to settle in soum centers and cities, pastures near urban centers suffer from overgrazing. Furthermore, because of water shortage and the decline of number of wells in livestock herding areas, herders stay longer near water points and use them during all 4 seasons, so increasing the pressure on the land. Last, but not least, the increased number of goats, with their environmentally destructive grazing habits, has resulted in further land degradation.

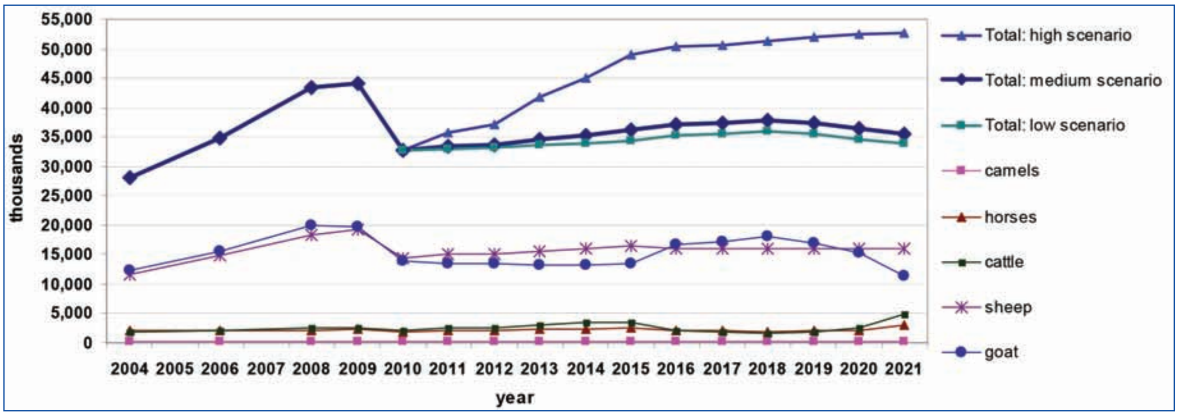


Figure 32. Historic, actual and projected livestock numbers in Mongolia, 2004 - 2021

National and aimag governments are taking initiatives to combat pasture degradation by reducing the number of animals and closing areas to restore grazing conditions. Programs to construct new wells or to rehabilitate existing wells are undertaken as well. Livestock densities are highest in the central region and lowest in the southern and eastern regions reflecting the natural pasture land condition (Figure 33).

In 1990, 65.4% of the pasture area was provided with water from about 38.3 thousand wells and 4.1 thousand reservoirs with a capacity 39.4 thous. m^3. However, since 1990 the number of wells used for livestock watering greatly reduced due to maintenance problems. In 2000, there were 30.9 thousand wells from which 5.8 thousand was broken and 21.7 thousand located in the pasture. Since 2000, new wells were constructed and broken down wells were rehabilitated. In 2009, totally 39.3 thousand wells were operational for livestock watering and from which 26.8 thousand located in the pasture. In addition, around 500 reservoirs and ponds with a capacity of 92,500 m^3 are used for livestock water supply. Programs to regulate the ownership, operation and maintenance of water supply facilities are being implemented to resolve the maintenance issue.

In 2010, the new policy: the 'Mongolian National Livestock Programme' was adopted. The objective of the program is to develop a livestock sector that is adaptable to changing climatic and social conditions, that is economically viable and competitive in the market economy, supplies safe and healthy food to the population, delivers quality raw materials to processing industries, and supports export earnings.

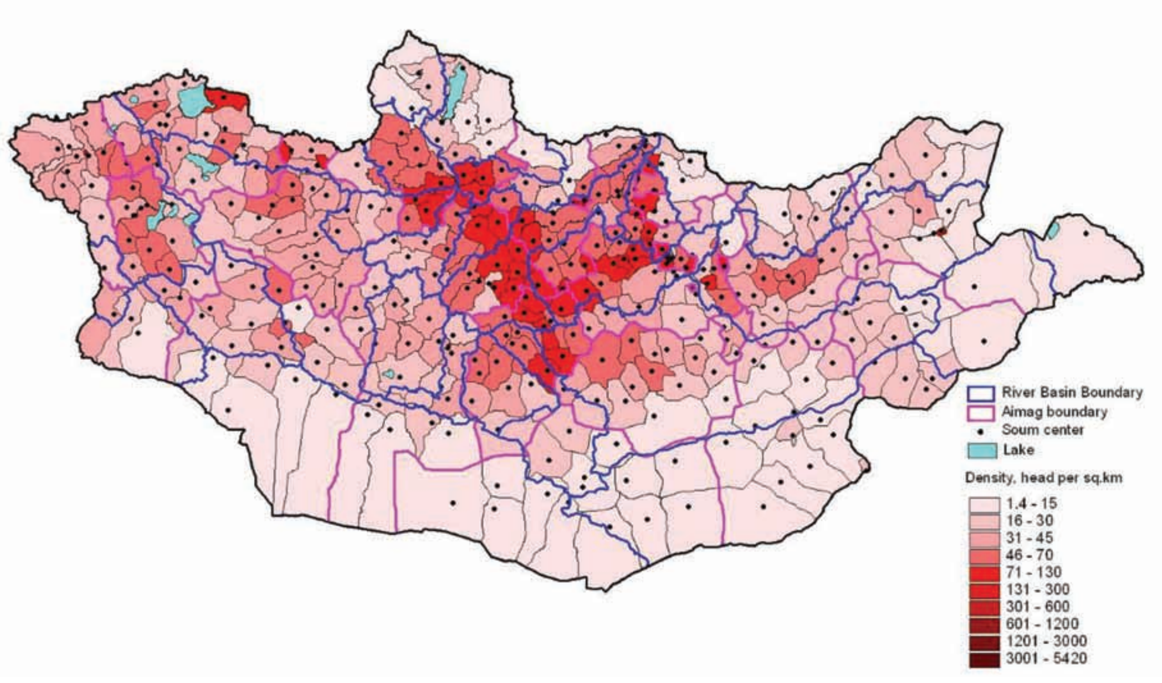


Figure 33. Livestock density in head/km²

The programme aims to intensify groundwater exploration to find new groundwater sources and develop new water wells. The number of wells to become operational in the period 2010-2021 is more than 7,000. Cost sharing and transfer of responsibility for use, protection and maintenance of wells with and to the users (herder groups and local communities) is aimed for in order to increase ownership.

The future water demand for livestock watering depends on the number of head and the composition of the stock. MFALI assumes that measures to protect the grazing potential of the pastures will be successful and assumes a reduced growth in animal numbers in the coming years. The number of livestock is thought to reach 35.6 million in 2021. In 2021 45.1% of the livestock population will be sheep, 32.0% goat, 13.8% cattle, 8.2% horse and 0.9% camel. Land degradation is considered to limit further growth.

The projection of livestock numbers by MFALI is considered as medium scenario. The applied scenarios are explained in the box below.

Livestock sector development scenarios:

Low scenario: The projection by MFALI is reduced by 5%;

Medium scenario: Successful implementation of measures to protect the pasture lands against degradation and reduced growth in number of livestock to 35.6 million in 2021 (MFALI);

High scenario: In case of good climate conditions, construction of new water supply wells and an increase in fodder production makes further growth of the sector possible; the number of livestock is expected to reach 52.6 mln in 2021.

Figure 34 shows the historic and future total livestock water demand. The calculated total livestock water demand is presented in Table 23. The livestock water demand was calculated based on the livestock numbers and livestock water use estimates per animal type. The livestock water demand in the water basins in 2015 and 2021 is given in Table 25, Table 26 and Table 27.

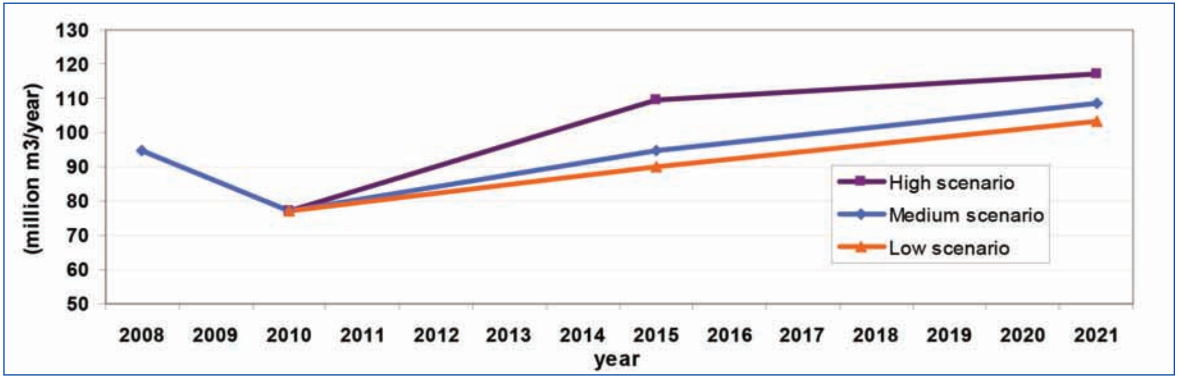


Figure 34. Projected livestock water demand (2008-2021)

The small difference in water demand between the scenarios can be explained by the fact that the difference in livestock numbers is mainly caused by the number of sheep and goats which use a small quantity of water per animal and less by the bigger animals which use more water per animal.

5.2.3. Crops and irrigation sector

Mongolia has always been a country of pastureland and nomadic herders. Nevertheless, crop production has been practiced throughout history.

Of the total agricultural area only 0.8% is used for crop production. The dry climate and the long winters limit the growing period to 80-100 days in the north and 120-140 days in the south and make conditions for crop growing unfavorable. The main crop growing region is the central-northern part of the country. Cereals are the most important crop followed by potatoes and vegetables.

Of the total cropped area of 315,300 ha in 2010, 259,200 ha is planted with cereals and about 20,800 ha with potatoes and vegetables. Another 11,100 ha is used for forage growing and the balance, some 25,100 ha is planted with oil cops and fruit trees. In 2010 Mongolian agriculture produced sufficient wheat and potatoes to satisfy the domestic demand. The demand for vegetables was covered for 54%.

The lack of precipitation stimulated irrigated agriculture since ancient times. Irrigation is mainly in the form of supplementary irrigation, when precipitation is insufficient to sustain the crop. In 1990, crop irrigation in Mongolia was well developed. The irrigated area was 91,000 ha, of which more than 90% was irrigated with surface water, the remainder with groundwater. In 1998 the area had decreased to about 5,000 ha. Since 2003 the irrigated area gradually increased to 37,567 ha (about 10% of the actually cropped area) in 2010.

Developments in irrigated agriculture are uncertain. Various policy documents state different goals. In the 'National Crop Rehabilitation Plan-III' it was planned to increase the irrigated crop area to 54,200 ha in 2010, partly through rehabilitation of existing schemes, partly through construction of new systems.

There are also plans to increase the production of sea buckthorn and wheat. In the MDG-based National Development Strategy the goal was set to increase the crop yield by providing irrigation in 30% of the total crop areas in Mongolia. It means that approximately 60,000 ha area will have to be irrigated. According to the Seabuckthorn Programme implemented by the Government of Mongolia, it was planned to plant seabuckthorn in 20,000 ha area and this will be successfully only in case of use of irrigation.

Irrigation sector development scenarios:

Low scenario: Continuation of the linear growth 1998-2010, the irrigated area is projected to reach 63,000 ha in 2021;

Medium scenario: Increase in irrigated area to 80,000 ha in 2018 and 100,000 thousand ha in 2023 (MIA);

High scenario: Execution of all plans mentioned in the various policy documents projects, the irrigated area will reach 137,000 ha in 2021.

MIA planned to extend the irrigated area in the period 2010-2021, partly by constructing new systems (34,200 ha), partly by rehabilitation of existing, non operational schemes. This would bring the total irrigated area in 2018 to 80,000 ha and 100,000 ha in 2023. The projection by MIA is considered as the medium scenario. The applied scenarios are explained in the box below.

Figure 35 shows the historic and future total irrigation water demand. The calculated total irrigation water demand is presented in Table 23. The demand was calculated based on the irrigated areas of the major crops and using crop water requirements by region. The water demand by irrigation is directly related to the area irrigated and the significant difference in area between the scenarios is reflected clearly in the projected water demand. The irrigation water demand in the water basins in 2015 and 2021 is given in Table 25, Table 26 and Table 27.

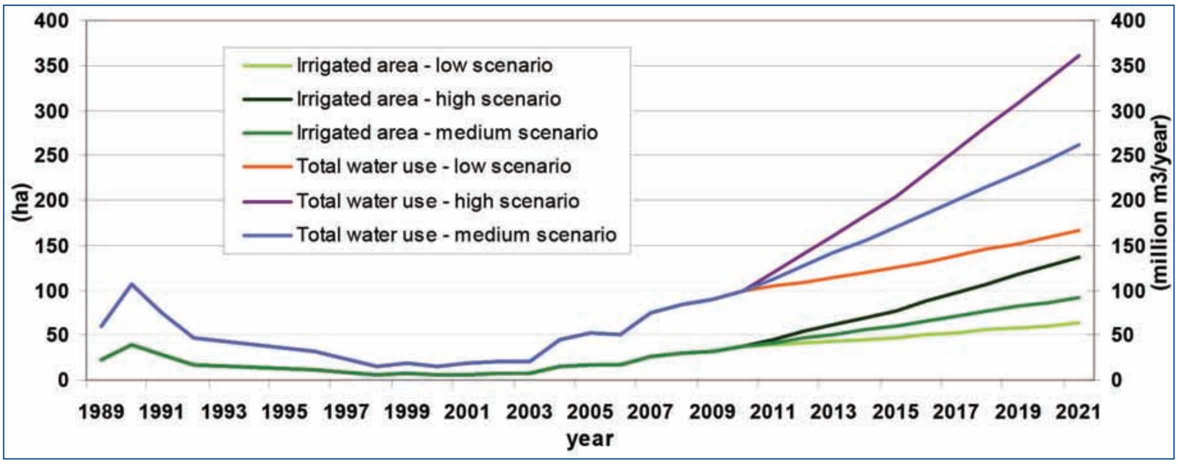


Figure 35. Historic and projected irrigated area and crop water use (1990-2008)

5.3. Industrial sector

5.3.1. Development of the industrial sector

The Mongolian industrial sector is divided for the calculation of the water demand into the following sub-sectors: mining and quarrying (coal, copper, gold, metals, etc.), heavy industries (steel, oil), manufacturing (light and food industries: meat processing, textiles, food and beverages, etc.) and construction.

Before 1990, the industrial sector was 100% state owned and accounted for about 36% of GDP. The sector was an important employer and exporter. Between 1990 and 2000 the sector's share in the GDP fell to 20%. Particularly heavy hit was the manufacturing sector. In recent years the sector recovered, in 2010 the sector produced 35.6% of total GDP, 63.8% of which was accounted for by the mining and quarrying sub-sector. The manufacturing sector is still in poor shape and produced only 8.5% of total GDP.

Table 16. Industrial production, at current prices, billion MNT

Sub-sector	2006	2007	2008	2009	2010
Mining and quarrying	1627.6	1938.9	1981.5	2157.9	3150.7
Manufacturing	499.7	877.7	1214.1	1164.4	932.4
Energy production	199.9	244.0	318.4	351.6	446.2
Construction	266.8	389.4	508.2	279.4	350.8
Total	2594.0	3450.0	4022.2	3953.3	4880.1

Source: NSO

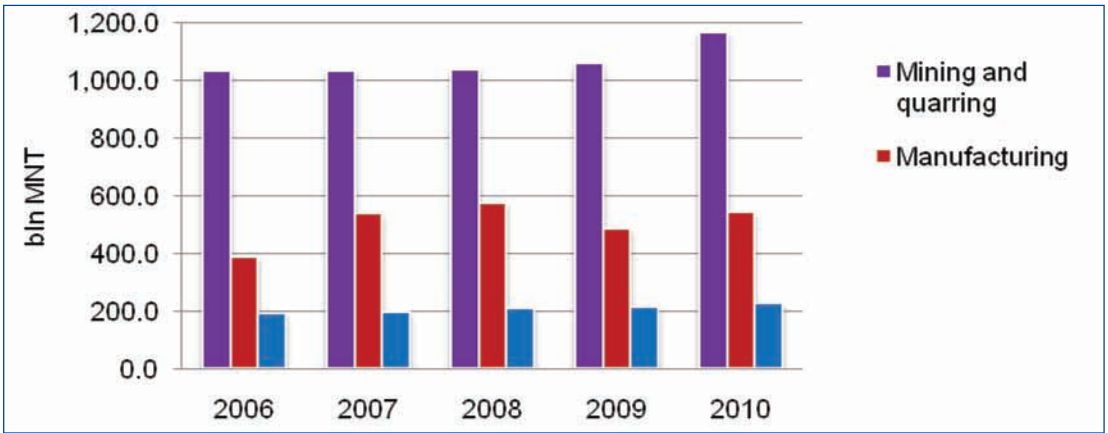


Figure 36. Industrial production, at 2005 constant prices

The main industrial areas with manufacturing and construction industries are at Ulaanbaatar, Darkhan and Erdenet. Mining typically takes place in remote areas of the country. Most industries receive water from the centralized water supply system. In addition, groundwater abstracted from private wells is used. The introduction of a water fee for piped water resulted in an increase in the use of private wells.

5.3.2. Mining and quarrying

The mining industry is rapidly developing as the backbone and leading sector of the country's economy. There are about 200 mining industries that have a license from the Mineral, Natural Oil Authority to perform their mining activities. Large new mines are being developed in the south Gobi (Oyu Tolgoi - copper, Tavan Tolgoi - coal, Ovoot Tolgoi - coal) requiring development of new water sources. In 2010 the mining sector produced 22.7% of GDP, 66.7% of gross industrial production and 81% of gross export value. Over 34 thousand people are employed in the sector.

Table 17. Share of the mining and quarrying sub-sector in the Mongolian economy (at current prices)

Share in % of mining sector in economy	2006	2007	2008	2009	2010
GDP	30.0	27.4	20.6	19.8	22.7
Industrial production	69.9	63.4	56.4	62.7	66.7
Export value	67.9	66.8	60.3	66.4	81.0

Source: NSO

The main mineral resources are copper, coal, gold, molybdenum, iron, tin, nickel, zinc, uranium and oil. Exports are mostly of raw materials and minerals. The environmental impact of the mining industry is significant. Change in landscape (re-direction of rivers, open mining, construction of new settlements), over-abstracting of water sources, inefficient water use due to old processing techniques, and water pollution due to absence of waste water treatment facilities are major concerns.

Figure 37. Location of major mines in Mongolia

Table 18. List of strategically important mineral deposits with their reserve size

Name of Deposit	Location: aimag, soum	Reserve size
Tavan Tolgoi	Omnogovi, Tsogtstsetseii	6.42 tril. ton coal
Nariin Sukhait	Omnogovi, Gurvantes	90.79 mil. ton coal
Baganuur	Ulaanbaatar, Baganuur	512.8 mil. ton coal
Shivee Ovoo	Gobisumber, Shivee Ovoo	564 mil. ton coal
Mardai	Dornod, Dashbalbar	1,104 ton uranium
Dornod	Dornod, Dashbalbar	58,933 ton uranium
Gurvanbulag	Dornod, Dashbalbar	16,073 ton uranium
Tomortei	Selenge, Khuder	229.3 mil. ton iron ore
Oyu Tolgoi	Omnogovi, Khanbogd	45 mil. ton copper, 1,838 ton gold 401,000 ton molybdenum 12,000 ton silver
Tsagaan Suvarga	Dornogovi, Mandakh	1.28 mil. ton copper 43,600 ton molybdenum
Erdenet	Orkhon, Erdenet	3.2 mil. ton copper,
Burenkhaan	Khuvsgul, Burentogtokh Alag Erene	40.5 mil. ton phosphorus
Boroo	Selenge, Bayangol	22 ton gold
Tomortein Ovoo	Sukhbaatar, Bukhbaatar	820,000 ton zinc
Asgat	Bayan-Ulgii, Nogoon Nuur	2,247 ton silver

Most mining and quarrying industries require water for their operations. Even those mines that do not wash their products need significant quantities of water for dust management, drilling and human consumption. Most operations are insensitive to water quality, which generally makes reuse possible. Reuse will differ significantly from mine to mine but detailed information on the reuse water quantity is not available. High quality water is only needed for drinking water supply to labour camps and offices.

The actual water use of the mining industry was estimated at 94 million m^3 in 2006, substantially lower than the amount allowed by permits (143 million m^3). In the years

2008 - 2010 the water use was estimated even lower. Data collection on water use by mines was started in 2008 and the accuracy and comparison of these estimates probably suffers from a lack of procedures for data collection and processing. The water use by mines assumes that 70% of the abstracted water is reused.

Water supply for mining activities is the responsibility of the mining companies themselves. Water sources used are boreholes and surface water but the situation varies. For example, in the north the mining industry at Erdenet has sufficient water resources from the Selenge River, while the water demand of the Boroo mine, which gets from wells near the Boroo River exceeds the water resources available on site. In the Gobi area many mines have insufficient water available and exploit limited non-renewable groundwater resources. Many placer gold mines, especially in Bayankhongor and Gobi-Altai provinces, have inadequate water.

The development of the mining industry largely depends on the development of world market prices of the minerals. Given the worldwide interest in mineral resources, and more specifically the interest of China, it is very likely that a significant growth in mineral output in the medium term is to be expected. The development of two prominent deposits located in Southern Mongolia, Oyu Tolgoi (gold and copper, scheduled to open in 2013) and Tavan Tolgoi (the largest undeveloped coalfield in the world), poses serious challenges to the water sector of Southern Mongolia. Other foreseen activities before 2015 are the exploitation of coal and bitumen deposits in Choir and Nyalga, copper deposits at Tsagaan Suvarga and metal ore in Tumurtein Ovoo. Furthermore the silver and metal deposits in Asgat are to be developed and support will be provided to the exploitation of the Ulaan Uul, Khovd River and Tsunkheg tungsten steel deposits in the Western region.

Other future developments are related to developing an iron ore extraction and concentration industry to exploit the Tumurtei, Khust Uul, Bayan Gol, Tumur Tolgoi deposits in the Darkhan and Selenge region and the exploitation of the gold deposits of Gatsuurt and Bayan-Airag.

Currently under discussion is the exploitation of the Mardai, Gurvanbulag, Dornod uranium deposits in the Dornod Region and the concurrent increase of the capacity of the associated metal industries in Tumurtein Ovoo, Ulaan and Tsav.

With regards to quarrying, is it is planned to fully meet the demand for construction materials, e.g. cement and chalk, by domestic reserves and substitute import.

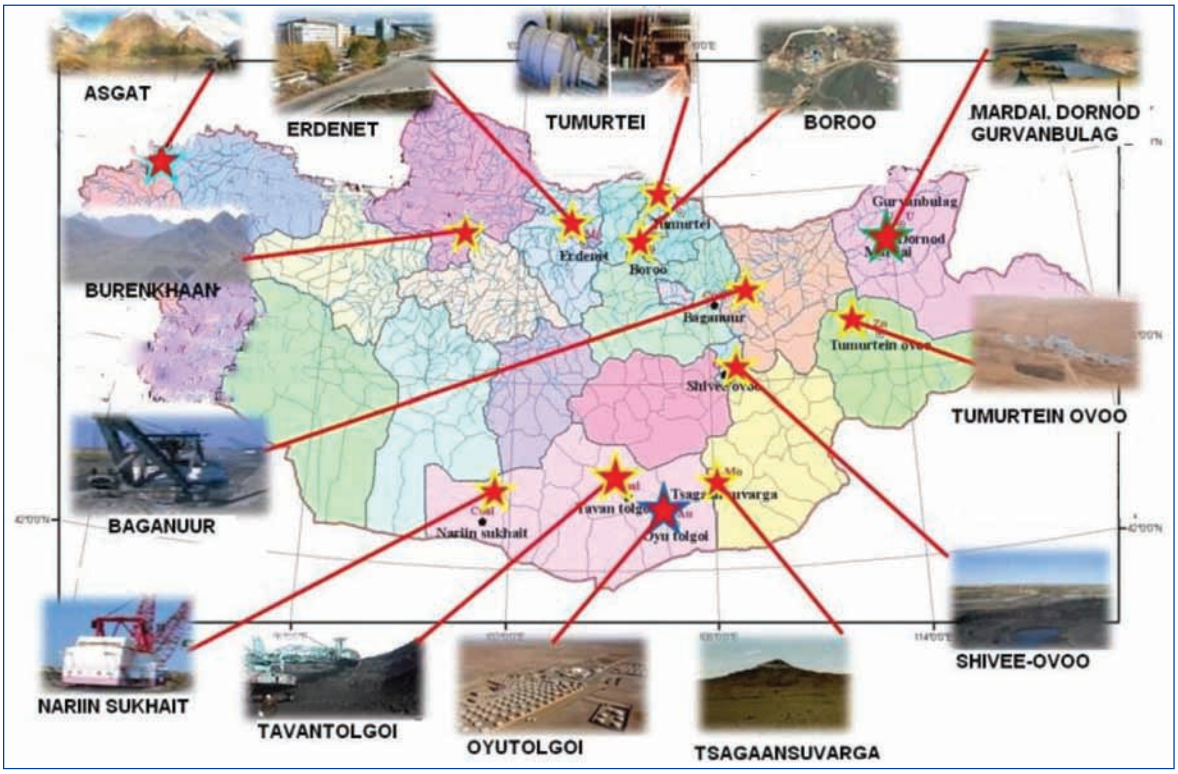


Figure 38. Location and characteristics of planned developments in the mining industry

The ongoing and planned developments are concentrated in the Southern Gobi region, Dornod region, Darkhan-Selenge region, Western region, Sainshand-Shivee Ovoo region and the Ulaanbaatar region. Water will be supplied from ground and surface water resources. To meet the water demand of the mines in the Gobi, water needs to be transported over considerable distances. At Oyu Tolgoi the distance to the nearest groundwater deposit, Gunii Hooloi, is about 50 km. Surface water diversion from the Orkhon River and the Kherlen River is considered to augment the limited groundwater resources. These diversion projects may have significant hydrological and environmental impacts on the rivers, and will require large investments and high operational costs.

The estimated water demand of the major mines in 2015 and 2021 is presented in Table 19. The largest demands are expected at Erdenet, Oyu Tolgoi and Tavan Tolgoi. This water demand is used as part of the total mining water demand estimate of the medium scenario. The water demand of the smaller mines not listed in Table 19 is projected using growth estimates obtained from MRA. The assumptions used in the three scenarios are listed below.

Mining sector development scenarios:

Low scenario: Growth of new mines 20% lower than MMRE estimates; existing mines 3% growth per year;

Medium scenario: Growth of new mines according MMRE estimates; existing mines 10.5% growth per year

High scenario: Growth of new mines 20% higher than MMRE estimates; existing mines 23% growth per year.

The calculated total water demand is presented in Figure 39 and in Table 23. The uncertainty in the future water demand by the mines is reflected by the three scenarios. The total water demand of the high scenario is 3.5 times the total water demand of the low scenario.

Table 19. Water demand estimate of some major mines (2015, 2021)

No	Name of mine	Aimag	Water Basin	Water demand (million m³/year)	
				2015	2021
1	Asgat	Bayan-Ulgii	Khar Lake - Khovd	0.5	0.5
2	Tsagaan Suvarga	Dornogovi	Galba-Uush Doloodiin Govi	7	9.4
3	Mardai	Dornod	Ulz	2.1	2.1
4	Tsav	Dornod	Ulz	0.44	0.44
5	Ulaan	Dornod	Ulz	7	9.6
6	Tamsag	Dornod	Menengiin Tal	1.2	1.4
7	Oyu Tolgoi	Omnogovi	Galba-Uush Doloodiin Govi	9.5	12.9
8	Tavan Tolgoi	Omnogovi	Galba-Uush Doloodiin Govi	5.2	14.5
9	Nariin Sukhait	Omnogovi	Altain Uvur Govi	1.7	3.4
10	Olon Ovoot	Omnogovi	Ongi	0.9	0.9
11	Boroo	Selenge	Kharaa	2	3
12	Tumurtein	Selenge	Eroo	0.1	0.1
13	Altai Dornod Mongol	Tuv	Tuul	1.5	1
14	Monpolimet	Tuv	Tuul	1.5	1
15	Shijir Alt	Tuv	Tuul	2.5	1.5
16	Burenkhaan	Khuvsgul	Delgermurun		
17	Baganuur	Ulaanbaatar	Kherlen	5	5
18	Erdenet	Orkhon	Selenge	15	15
19	Shivee Ovoo	Gobisumber	Umard Goviin Guveet KDT	2.4	2.4
20	Choir, Nyalga	Gobisumber	Umard Goviin Guveet KDT	0.5	0.5
Total				66.04	84.64

Sources: Water Authority, Mineral Resources Authority, Technical requirements of Oyu Tolgoi, Tsagaan Suvarga, Tavan Tolgoi, Choir Nyalga, Tsagaan Tsav.

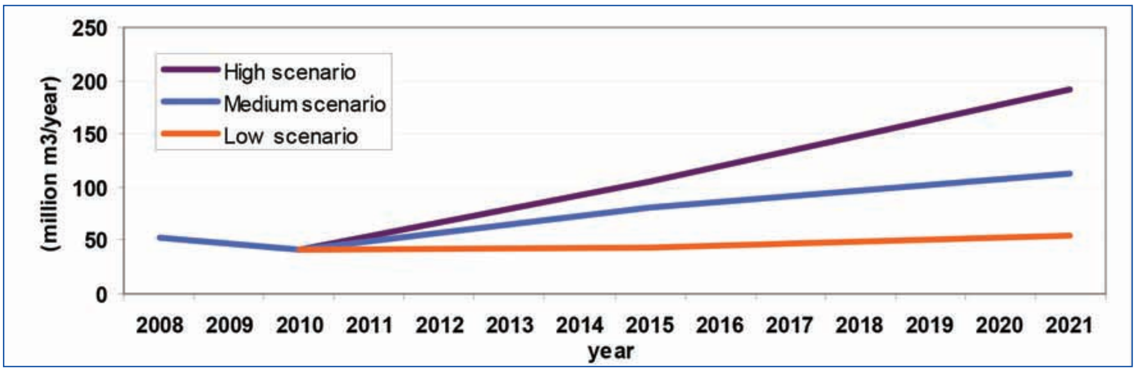


Figure 39. Projected total mining water demand (2008-2021)

The water demand by the mining and quarrying industry per water basin is given in Table 25, Table 26 and Table 27.

5.3.3. Heavy industries

The heavy industries comprise mining ore processing, steel and oil industries. Most of the industries are located in Ulaanbaatar (metallurgical and repair enterprises, machine and equipment repair industries), Darkhan (steel factory) and Erdenet (concentrator processing ore). The water supply facilities at the heavy industries are often arranged independently. In Erdenet the copper mine transports water from the Selenge River 65 km to the north. In Darkhan the industries use water from the central water supply. In Ulaanbaatar the industries either have their own water supply or obtain water from the central water system.

With the opening of new mines the government is planning to process more of the minerals inside Mongolia. New concentrator and other processing industries are planned near these mines. Sainshand is dedicated as one of the new industrial centers.

The water use by the heavy industries was calculated using industrial output and water use norms; actual water use data are not available. The water use in Ulaanbaatar in 2010 was estimated at 0.25 and 0.3 million m^3/year because data was not available on industrial output or on actual water use.

Heavy, manufacturing and construction industries sector development scenarios:

Low scenario: The growth of the water use is assumed to be a continuation of the observed trend: 4% growth

Medium scenario: The growth of the industrial water use is equal to the growth specified in the regional development programs: 6.9% growth

High scenario: The growth of the industrial water use is based on the trends described in the MDG comprehensive policy documents: 12.6% growth.

The future water demand of the heavy industries was estimated using projections based on the industrial growth rates until 2015 as specified in the regional development programs and by extending these until 2021 using the targets specified in the MDGs based CNDS.

The calculated total water demand of the heavy industries is presented in Table 23. The water demand per water basin in 2010 is given in Table 25.

5.3.4. Manufacturing and construction industries

The manufacturing industries comprise the food and beverages industry, the textile, leather and fur industry and other small industries. The sector has shown a steady growth since 2000, except for the years 2004, 2005 and 2009. Ulaanbaatar is an important center for the manufacturing industry. Other important industrial centers are Darkhan and Erdenet. Outside these cities industrial activities are concentrated at aimag centers.

Economic development has resulted in a significant increase in industries involved in manufacturing construction materials. Currently, there are 500 construction material preparation factories in the country. There is no overview of the water use of these industries. Probably most industries have their own water supply. Separate water treatment facilities are not known to exist.

Manufacturing industries use water mainly as process water; construction industries use water mainly for material preparation. Industries use water either from the central water supply or from private wells, to reduce service fee costs. A good permit and monitoring system controlling industrial water use is lacking. Processing techniques are commonly outdated and waste water treatment is often lacking.

The water use by the manufacturing and construction industries was calculated using industrial output and water use norms; actual water use data are not complete. The future water demand was estimated similar to the heavy industries. The calculated total water demand is presented in Table 23. The water demand per water basin in 2010 is given in Table 25.

It is expected that new industries will use water more efficient than old industries thanks to improved technologies. Also, increase of fees on water use and waste water production will stimulate industries to invest more in water efficient technologies. Water reuse will also contribute significantly to the reduction in water use. However the impact of these initiatives on more efficient water use is not yet known with accuracy and was therefore not yet included in the water demand estimate.

5.3.5. Industrial waste water treatment

Industries either directly dispatch their waste water into the sewer, treat the waste water on-site or dispatch the waste water to a dedicated industrial waste water treatment plant. The Khargia plant in Ulaanbaatar is an example of a dedicated industrial waste water treatment plant as it collects and treats the industrial effluent from more than 20 industries (mainly tanneries). The plant is in a bad condition, but plans have been made to improve the facility. Another dedicated industrial waste water treatment plant exists in Darkhan with one large tannery connected.

Some industries have waste water treatment facilities on site, such as MCS Coca-Cola. They treat the waste water from the factory, reuse this and discharge the waste water to the sewer. Many industries however do not have treatment on-site or are not connected to a dedicated industrial waste water treatment plant. These industries often discharge the waste water untreated to the central sewage system causing problems at the waste water treatment plants (WTTP), because the treatment processes at these plants are designed for domestic waste water and not for industrial waste water.

5.4. Energy sector

5.4.1. Development of the energy production

There are two types of power plants serving the Mongolian energy demand, combined heat and electricity power plants and hydropower plants. Total current capacity is 863.7 MW, total energy production in 2010 was 4312.8 million kWh and 8362.5 thousand Gcal thermal energy, worth 209.2 billion MNT at 2005 constant prices. More than 95% of the energy production is produced by the 7 coal fired plants, implicating that the share of hydro power and solar/wind power is limited. Power production is insufficient to meet the domestic demand and electricity, about 4-10% of the total demand, is imported from Russia. At present 3 aimag and about 20 soum centers have not yet been connected to the national power grid. In some rural areas electricity is generated by small scale solar or wind energy systems.

The energy system of Mongolia needs extension to keep pace with the increasing demand for energy in the country. Thermo consumption is expected to increase with over 1000 Gcal and electricity consumption with over 700 MW until the year 2020. New power stations are planned in Ulaanbaatar (>100 MW), Moron and Ukhaa Khudag. These stations are expected to be operational in 2015. Besides, the capacity of Dornod will be increased and the Darkhan and Erdenet power plants will be renovated.

The planning of new hydropower stations is on-going. In 1994, the Institute of Water Policy of Mongolia estimated the gross theoretical hydropower production capacity for all rivers with a runoff of more than 1 m^3/s at 6400 MW, the actual potential is 20% to 60% of this estimate. A total of 81 potential dam sites were identified in the past. Current plans aim to build new hydropower stations at Chargait on the Delgermurun (58 MW) and at Erdeneburen on the Khovd River (65 MW). After 2015 hydropower plants are considered on the Selenge and Orkhon Rivers.

With an average annual insolation of 4.3 – 4.7 kWh/m^2, the potential for solar energy is very high. Other renewable energy sources available are wind energy and geo-thermal energy. A specific policy on developing these energy sources has to be developed as yet.

5.4.2. Combined heat and electricity power plants

Three of the 7 combined heat and electricity power stations are located in Ulaanbaatar. The power stations use water for cooling purposes. Hot water is produced as a by-product of the electricity production and is supplied to the urban areas. The plants use water from groundwater abstracted from the power plants well fields.

Table 20 Capacity and water use of heat and electricity power plants

Name	Capacity MW	Gross generation		Water use (mln m^3/year)
		Electricity , mln kWh	Thermal energy, thous. Gkal	
Ulaanbaatar II	21.5	106.7	163.1	2.0
Ulaanbaatar III	136	532.5	1801.5	9.4
Ulaanbaatar IV	560	2533.5	3025.3	10.7
Darkhan	48	206.9	153.0	3.9
Erdenet	28.8	108.2	494.1	1.2
Choibalsan	36	99.6	203.7	2.9
Dalanzadgad	5.4	12.9	16.0	0.8
Total	835.7	3603.7	6156.8	30.9

Source: www.mmre.energy.mn

The future water demand of the heat and electricity power stations was estimated using projections based on the industrial growth rates until 2015 as specified in the regional development programs and by extending these until 2021 using the targets specified in the MDG. The applied scenarios are explained in the box below.

Energy sector development scenarios:

Low scenario: The growth of the energy sector is assumed to be a continuation of the observed trend: 2.5% growth

Medium scenario: The growth of the energy sector is equal to the growth specified in the regional development programs: 6% growth

High scenario: The growth of the energy sector is based on the trends described in the MDG comprehensive policy documents: 10.2% growth.

The calculated total water demand of the heat and electricity power stations is presented in Table 23. The water demand per water basin in 2010 is given in Table 25.

5.4.3. Hydropower plants

There are two big and nine small hydropower plants (HPP) with a total capacity of 28.0 MW. Only the two big HPP at Taishir and Durgun operate all year, the small HPP operate during the summer season only. The annual average energy production is about 113 million kWh which is about 6.5% of the total energy production.

Table 21. Hydropower plants in Mongolia

Name	Aimag	River name	Year of construction	Capacity (kW)	Annual energy production (mln kWh)	Annual water use 2008-2010 (mln m^3)
Operational plants						
Zavkhan Mandal	Zavkhan	Galuutai	2009	110	-	-
Tsetsen Uul	Zavkhan	Khungui	2009	150	-	-
Taishir	Gobi-Altai	Zavkhan	2008	11,000	37.0	230
Durgun	Khovd	Chono-Kharaikh	2008	12,000	38.7	690
Uench	Khovd	Uench	2006	960	1.5	n.a.
Tosontsengel	Zavkhan	Ider	2006	375	22.0	78
Erdenebulgan	Khuvsgul	Eg	2006	200	4.4	27
Guulin	Gobi-Altai	Zavkhan	1998	400	0.9	6

Name	Aimag	River name	Year of construction	Capacity (kW)	Annual energy production (mln kWh)	Annual water use 2008-2010 (mln m^3)
Bogdiin gol	Zavkhan	Bogdiin gol	1997	2,000	6.0	35
Not working						
Kharkhorin	Ovorkhangai	Orkhon	1959	528	1.1	-
Jigj	Uvs	Jigj	1989	200	0.4	-
Mankhan	Khovd	North Tsenkher	1998	150	0.4	-
Munkhkhairkhan	Khovd	Tsenkher	2003	150	0.4	-
Total				27,963	113.0	1,066

The water use by hydropower needs to be treated separately from the other water uses because this water is not consumed and water quality is not affected. The hydropower water use is not added to the total water use because the water is available again for use after release from the reservoir. In reality the water use by hydropower is not known exactly but may be estimated based on the produced energy in each HPP. The water use shown in Table 21 is based on estimates of the years 2008-2010, the latter year including the water use by the Taishir and Durgun HPP.

5.5. Municipal services sector

The municipal services water use includes water use by public services (schools, government offices, hospitals), water use by the commercial services sector (hotels, restaurants, shops, bath houses) and water use for urban green areas.

Schools, hospitals and government offices are usually connected to the central water supply system although some have private water supply facilities. Bath houses, shops, hotels, restaurants and other commercial services usually are also connected to the central water supply system. Total water use in 2010 by public and commercial services was about 17% of the total urban domestic water consumption. Waste water produced by the municipal water users is commonly discharged through the sewerage system or in the small urban centers to septic tanks.

The green areas of Ulaanbaatar, Darkhan, Erdenet and other cities are watered from April to August, while one last charge irrigation before winter usually in October. According to the limited available information, 2.5 million m^3 water is used annually.

In the future the municipal services water demand is expected to grow. Three scenarios were used as explained in the box below.

Municipal services water demand scenarios:

Low scenario: The water demand for public services is expected to grow at 50% of the rate of the medium scenario; the commercial services water demand is expected to grow at 4.5% annually; the green area water demand is expected to grow at 80% of the rate of the medium scenario.

Medium scenario: The water demand for public services is expected to grow at 1.4% equal to the population growth rate; the commercial services water demand growth rate is expected to equal the GDP growth rate, as estimated in regional development programs: 7.6%; the green area water demand is expected to double in 2015 and to quadruple in 2021;

High scenario: The water demand for public services is expected to grow at 4%; the commercial services water demand is expected to grow at 14.5%; the green area water demand is expected to grow at 120% of the rate of the medium scenario.

Table 23 summarizes the historic and future municipal services water demand. Details on the municipal water demand in the water basins in 2015 and 2021 are given in Table 25, Table 26 and Table 27.

5.6. Tourism sector

The tourist industry in Mongolia is an important economic sector. The direct contribution to the GDP was 6% in 2004 and about 3.5% in 2011. The total contribution however is higher when including indirect and induced effects and is estimated at 8.9% of GDP in 2011. The relative contribution to the GDP is decreasing due to the strong growth of the GDP but absolute numbers are increasing. In 2010 more than 456 thousand tourists visited the country, almost twice as much as in 2005. The total income generated by the sector was 282 mln US$ in 2011.

Tourist camps are often built along lakeshores and rivers, near historic places or at mineral spas. Detailed data about water use and sanitation is lacking. Most tourist camps and resorts have drilled their own wells for water supply. They may be a source of pollution in case waste water treatment facilities are absent or malfunctioning.

Based on the number of tourists, their average length of stay and water use, the total water use of the sector is estimated at 0.8 million m^3/year. The future water demand is calculated based on the expected increase in tourists, given the worldwide trend that more and more people can afford to travel. The national policy aims to accelerate the development of tourism by improving the quality of services and diversification of the attractions.

Tourism sector demand scenarios:

Low scenario: The growth is 20% lower than the medium scenario.

Medium scenario: The number of tourists increases according to MDGs based CNDS to 1 million in 2015 and 2.5 million in 2021;

High scenario: The growth is 20% higher than the medium scenario.

Table 23 summarizes the historic and future tourism water demand. The tourism water demand in the water basins in 2010 is given in Table 25.

5.7. Roads and transport sector

The economic development of Mongolia is also reflected in the ongoing improvement of the road and railway network. Water for roads is mainly needed during construction; railways need a more permanent water supply. The quantities involved are relatively small and often do not compete with other water users. A new international airport is planned near Zuunmod which will create a relatively small water demand in this area. The total water demand for roads and transport is estimated at 2.5 million m^3 in 2008 and is assumed to grow to 5 million m^3 in 2021.

The Ulaanbaatar Railway water supply brigade is responsible for supplying organizations and entities located along the railway. The Ulaanbaatar Railway distributes in total 1.5 million m^3 water a year. The sources of water are located along the railway line at the major railway stations. New sources of water will be needed for the planned railway line connecting the mines in Omnogovi with the eastern part of the country. The quantity involved however is expected to be small.

For roads water is used on a temporary basis during construction. Water is abstracted from various sources such as wells and reservoirs. In 2008-2010 about 0.3 million m^3 water was used for road construction.

5.8. Defence sector

The water supply to army barracks and border police stations is organized independently. Army areas usually have their own water sources which are not shared with others. The water demand originating from these areas is unknown because exact numbers of staff and other water users are not available. The quantities involved are relatively small and they do not compete with other water users. Therefore no demand was included from the defense sector in the water demand estimation.

5.9. Water use to conserve the environment

5.9.1. Environmental flow

The concept of environmental flow is introduced in recent years to determine the flow regime required in rivers to maintain healthy ecological conditions. The methodology requires knowledge on the relation between ecology and flow regime to allow conclusions on acceptable changes in river flows due to interventions such as building dams or diversions. Research on the requirements of vegetation, insects, fishes and other water dependent organisms is ongoing in Mongolia but is considered insufficient to make conclusive decisions on the required environmental flow for individual rivers.

Davaa and Myagmarjav (1999) have made a first attempt to estimate the minimum flow requirement in rivers. They provide a table with maximum acceptable abstractions as percentage of the river flow in the major rivers of Mongolia. The percentages vary between 3 and 15% of the flow and were determined on hydrological grounds.

The environmental flow is not included as element in the water demand calculation but is considered when calculating the available surface water resources as part of the water balance (see Chapter 7.2.2 and Table 2).

5.9.2. Green Belt Programme

Under the Green Belt Programme 250 thousand hectares in a 2700 km long and 600 m wide zone in the north Gobi are to be planted with trees between 2005 and 2035. Only 535 ha trees were planted in 2005-2008. About 0.12 million m^3 water was used to water them during their first year. In 2008-2010 an additional 2125 ha was established. Until now implementation of the program proved difficult due to logistical and financial problems.

The water demand by the Green Belt Programme is not clear and was not included in the total estimate because the volume is expected to be negligible.

5.10. Flood protection

The flood protection construction is a facility that is built to protect urban areas and important infrastructure from flood damage. Many cities, aimag and soum centers, airports and railway stations have flood protection constructions (Table 22).

Floods cause damage to materials and population. Floods occurred at Ulaanbaatar in 1966, 1982, 1994, 2000 and 2009.

Most of the flood protection dams and channels were built between 1973 and 1990 years. Nowadays many dams' slope concrete panels and stone bindings are broken and looted. Channels are filled with rubbish, obstructing flow and reducing flood water-flow capacity.

Photo 1. Tuul river flood protection dam

Photo 2. Uliastai river flood channel

Photo 3. Khailaast flood protection dam

Photo 4. Chingeltei flood channel

Table 22. Urban areas and infrastructure with flood protection dams and channels

City	Aimag center	Soum center	Infrastructure
Ulaanbaatar, Darkhan, Erdenet	Tsetserleg, Bulgan, Govi-Altai, Zavkhan, Tuv, Selenge, Uvs, Khovd, Khuvsgul	Bulgan aimag: Khangal, Gobi-Altai aimag: Altai, Delger, Chandmani, Tuv aimag: Bayan Tsogt, Selenge aimag: Zuunburen, Uvs aimag: Turgen, Khovd aimag: Bulgan, Buyant, Uench, Khuvsgul aimag: Erdenebulgan	Chingis Khan airport in UB city, Omnogovi, Ovorkhangai aimag airport, Sukhbaatar city railway station

Additional flood protection constructions are built at state-owned industries. The city, aimag or soum departments are responsible for these flood protection constructions.

5.11. Water demand overview

The calculated water demand during the years 2008 – 2021 is presented in Table 23. The table includes all major water users. The biggest water use currently is the agricultural sector. In the future mining will be a major water user (Figure 41).

The water use by hydropower is treated separately from the other water uses because this water is not consumed and water quality is not affected. The total water use by hydropower in 2010 is estimated at 1,066 million m^3.

Table 23. Overview of water use (2008, 2010) and projected water demand (2015, 2021) for low, medium and high scenarios

Sector	Sub-sector	Total water demand (million m³/year)							
		2008	2010	2015			2021		
				Low	Medium	High	Low	Medium	High
Domestic	Urban	46.9	51.9	66.4	70.9	78.6	67.2	72.9	81.8
	Rural	2.6	3.2	4.1	4.0	4.0	5.9	6.0	6.0
Agriculture	Livestock	94.7	76.9	90.2	94.9	109.4	103.1	108.6	117.3
	Irrigation	83.5	98.7	125.0	169.8	203.2	165.5	260.8	360.0
Industries	Mining	49.4	41.5	52.5	81.1	103.5	61.8	111.1	187.8
	Heavy industries	1.3	1.3	1.6	1.8	2.3	2.0	2.7	4.7
	Manufacturing	2.2	3.6	4.4	5.1	6.6	5.6	7.6	13.5
	Construction	1.0	1.2	1.6	2.0	2.4	2.1	3.2	4.5
Energy	Power plants	35.2	33.4	37.8	44.7	54.3	43.9	63.5	97.3
Municipal	Commercial services	3.7	3.9	4.8	5.6	7.7	6.3	8.7	17.2
	Public services	5.3	5.5	5.8	5.9	6.7	6.0	6.5	8.5
	Green areas	0.3	2.5	2.6	2.6	2.7	2.7	2.9	3.0
Tourism		0.6	0.8	1.2	1.4	1.6	2.7	3.4	4.0
Roads, transport		2.3	2.7	3.2	3.6	4.1	4.1	4.5	5.0
Total		329.0	327.1	401.2	493.4	587.1	478.9	662.4	910.6

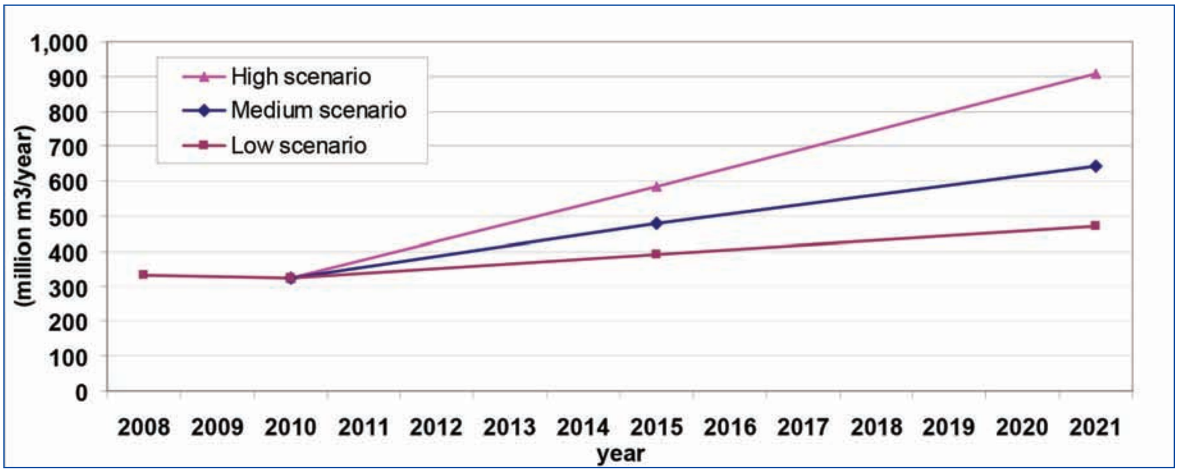


Figure 40. Projected total water demand (2008-2021)

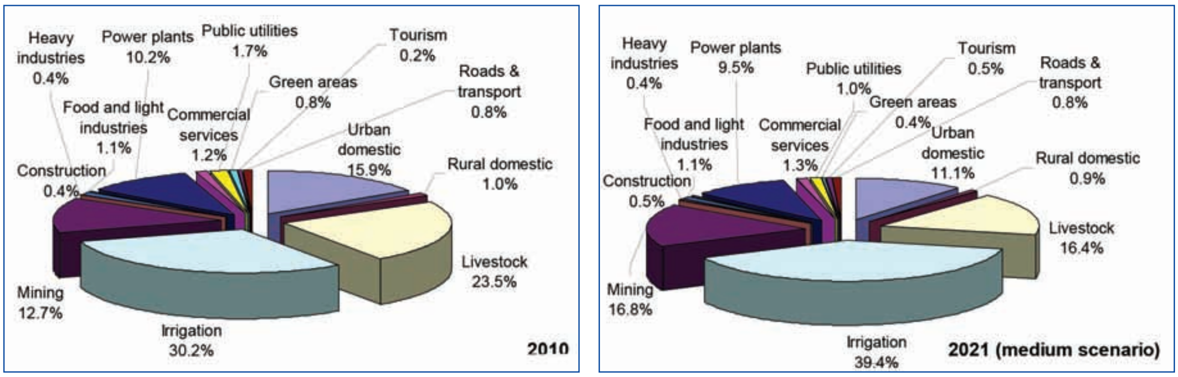


Figure 41. Distribution of the water demand in 2010 and 2021 (medium scenario)

Table 24. Water demand scenarios assumptions

Overview of applied growth rates and assumptions underlying the demand projections			
	Low scenario	Medium scenario	High scenario
Drinking water use			
Population growth	2010-2015: 1.17% 2015-2021: 1.03%	2010-2015: 1.38% 2015-2021: 1.20%	2010-2015: 1.51% 2015-2021: 1.28%
% urban population in 2021	69.4 %	70.7 %	71.9 %
Private connections and connected kiosks	2015: 45.9% 2021: 53.6%	2015: 48.3% 2021: 56.4%	2015: 53.5% 2021: 62.2%
Consumption norm (see Table 14)	Change of norm similar as medium scenario	Norm lower for connections and higher for not connected water users	Change of norm similar as medium scenario
Municipal water use			
Utilities	0.7% growth	1.4% growth	4% growth
Services	4.5% growth	7.6% growth	14.5% growth
Industrial water use			
Manufacturing	4% growth	6.9% growth	12.6% growth
Heavy industries	4% growth	6.9% growth	12.6% growth
Construction	4% growth	6.9% growth	10% growth
Mines – existing Mines – new	3% growth 50% lower than MMRE estimates	10.5% growth According MMRE estimates	23% growth 20% higher than MMRE estimates
Energy	2.5% growth	6% growth	10.2% growth
Livestock water use			
Livestock numbers	5% lower than medium scenario	Projection according MFALI	Projection according Davaadorj G. (2010)
Consumption norm	Norm unchanged	Norm unchanged	Norm unchanged
Irrigation water use			
Irrigated area *	According trend 1998-2010, 63,000 ha in 2021: 2010-2015: 4.8% 2015-2021: 4.8%	Projection according MFALI, 92,000 ha in 2021: 2010-2015: 9.8% 2015-2021: 7.4%	Projection according Davaadorj G. (2010) , 137,000 ha in 2021: 2010-2015: 15.5 % 2015-2021: 10%
Crop water requirement	Unchanged	Unchanged	Unchanged
Tourism water use			
Water demand growth	20% lower than medium scenario	2010-2015: 14.9% 2015-2021: 16.5%	20% higher than medium scenario
Green areas water use			
Water use	20% lower than medium scenario	2010-2015: 8% 2015-2021: 12%	20% higher than medium scenario

* planning of cultivated area by aimag for the years 2015 and 2021; due to shift in crops with higher water requirement annual increase in water demand is 11.45%

Table 25. Water use and water consumption by water basin in the year 2010

№	Name of basin	Drinking and domestic water for population				Utility services (hospital, school, office)	Public services	Industries						Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Tourism	Green area	Grand total
		Urban settlement, town and aimag centre	Soum centre	Rural area	Total			Light industry	Heavy industry	Energy	Construction and building material industry	Road and transport	Total						
1	Selenge	0.00	0.06	0.05	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.03	2.83	13.71	0.05	0.00	16.85
2	Khuvsgul Lake - Eg	0.00	0.03	0.04	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.06	1.94	0.18	0.09	0.00	2.45
3	Shishkhid	0.00	0.01	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.00	0.65	0.00	0.02	0.00	0.81
4	Delgermurun	0.29	0.01	0.05	0.36	0.15	0.01	0.02	0.00	0.04	0.00	0.06	0.12	0.00	2.41	0.00	0.02	0.00	3.07
5	Ider	0.00	0.03	0.06	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.00	1.75	0.56	0.00	0.00	2.52
6	Chuluut	0.00	0.01	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.00	2.06	0.00	0.02	0.00	2.21
7	Khanui	0.00	0.01	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.00	2.45	0.00	0.00	0.00	2.57
8	Orkhon	4.16	0.48	0.16	4.80	0.54	0.10	0.26	0.00	1.70	0.50	0.00	2.47	16.54	7.31	12.26	0.01	0.15	44.17
9	Tuul	38.77	0.06	0.09	38.92	3.34	3.59	3.00	0.30	22.78	0.40	0.00	26.47	5.74	6.39	3.54	0.09	2.15	90.23
10	Kharaa	3.94	0.05	0.07	4.05	0.22	0.03	0.04	0.59	3.90	0.28	0.12	4.93	4.11	2.72	10.97	0.05	0.01	27.08
11	Eroo	0.00	0.02	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.67	0.54	1.97	0.00	0.00	3.33
12	Onon	0.00	0.01	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.04	1.38	0.00	0.05	0.00	1.62
13	Ulz	0.00	0.02	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	3.43	1.29	0.00	0.00	0.00	4.89
14	Kherlen	1.20	0.07	0.09	1.37	0.21	0.01	0.07	0.00	3.18	0.00	0.12	3.37	6.71	6.49	5.42	0.05	0.01	23.65
15	Buir Lake - Khalkh	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.00	0.21	0.56	0.00	0.01	0.91
16	Menengiin Tal	0.00	0.01	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.86	1.35	0.00	0.00	0.01	2.37
17	Umard Goviin Guveet - Kh. D. T.	1.55	0.09	0.19	1.83	0.23	0.04	0.12	0.38	0.33	0.00	0.12	0.95	0.36	7.83	0.73	0.05	0.01	12.03
18	Galba – Uush - Doloodiin Govi	0.05	0.03	0.07	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.51	4.09	0.25	0.05	0.01	5.17
19	Ongi	0.42	0.02	0.06	0.50	0.19	0.01	0.01	0.00	0.92	0.00	0.06	0.99	1.22	1.49	0.87	0.02	0.01	5.30
20	Altain Uvur Govi	0.00	0.03	0.08	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.06	2.96	2.89	0.02	0.01	6.17
21	Taats	0.00	0.01	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.00	1.32	0.26	0.02	0.01	1.72
22	Orog Lake - Tui	0.31	0.01	0.03	0.35	0.11	0.02	0.00	0.00	0.12	0.00	0.06	0.18	0.00	1.22	2.21	0.02	0.01	4.11
23	Buuntsagaan Lake – Baidrag	0.00	0.01	0.05	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	1.04	1.68	1.61	0.02	0.01	4.49
24	Khyargas Lake – Zavkhan	0.34	0.04	0.14	0.52	0.19	0.01	0.06	0.00	0.29	0.00	0.12	0.47	0.05	4.27	10.99	0.02	0.01	16.52
25	Khuisiin Govi - Tsetseg Lake	0.00	0.01	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.00	1.53	5.90	0.02	0.01	7.64
26	Uench - Bodonch	0.00	0.01	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.42	0.00	0.01	1.14
27	Bulgan	0.00	0.01	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.12	0.00	0.34	1.59	0.00	0.01	2.10
28	Khar Lake - Khovd	0.62	0.08	0.19	0.89	0.26	0.04	0.02	0.00	0.10	0.00	0.12	0.24	0.00	4.89	10.19	0.09	0.01	16.61
29	Uvs Lake - Tes	0.28	0.04	0.09	0.41	0.11	0.01	0.04	0.00	0.08	0.00	0.12	0.24	0.03	2.86	11.64	0.09	0.01	15.40
	Grand total	**51.93**	**1.30**	**1.87**	**55.09**	**5.55**	**3.87**	**3.65**	**1.27**	**33.43**	**1.19**	**2.70**	**42.23**	**41.46**	**76.93**	**98.70**	**0.82**	**2.47**	**327.12**

Table 26. Water demand by water basin in the year 2015

№	Name of basin	2015, low scenario							2015, medium scenario							2015, high scenario						
		Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total	Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total	Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total
1	Selenge	0.15	0.08	0.14	0.03	3.63	17.36	21.40	0.15	0.09	0.16	0.04	3.83	23.59	27.86	0.15	0.11	0.18	0.07	4.28	28.23	33.02
2	Khuvsgul Lake - Eg	0.10	0.16	0.14	0.07	2.52	0.23	3.21	0.10	0.18	0.16	0.09	2.65	0.31	3.49	0.10	0.21	0.18	0.16	2.76	0.37	3.77
3	Shishkhid	0.03	0.03	0.14	0.00	0.95	0.00	1.16	0.03	0.04	0.16	0.00	1.00	0.00	1.23	0.03	0.04	0.18	0.00	1.03	0.00	1.28
4	Delgermurun	0.59	0.22	0.14	0.00	2.97	0.00	3.91	0.62	0.23	0.16	0.00	3.13	0.00	4.13	0.66	0.26	0.19	0.00	3.61	0.00	4.73
5	Ider	0.12	0.00	0.14	0.00	2.23	0.71	3.20	0.12	0.00	0.16	0.00	2.35	0.96	3.59	0.12	0.00	0.18	0.00	2.67	1.15	4.12
6	Chuluut	0.08	0.03	0.07	0.00	2.82	0.00	3.00	0.08	0.04	0.08	0.00	2.97	0.00	3.17	0.08	0.04	0.09	0.00	3.07	0.00	3.28
7	Khanui	0.08	0.00	0.07	0.00	3.19	0.00	3.34	0.08	0.00	0.08	0.00	3.36	0.00	3.51	0.07	0.00	0.09	0.00	3.73	0.00	3.89
8	Orkhon	6.62	0.81	3.06	18.07	9.90	15.52	53.98	7.02	0.90	3.72	17.34	10.42	21.09	60.49	7.68	1.09	4.57	19.00	11.56	25.24	69.15
9	Tuul	48.59	10.19	30.27	4.10	8.37	4.48	105.99	51.93	11.01	35.64	7.40	8.81	6.08	120.87	57.72	13.38	43.63	10.00	10.08	7.28	142.10
10	Kharaa	4.46	0.35	5.66	1.94	3.74	13.89	30.04	4.75	0.38	6.65	3.33	3.93	18.88	37.93	5.25	0.44	8.11	4.74	4.23	22.60	45.35
11	Eroo	0.04	0.00	0.14	0.83	0.74	2.50	4.25	0.04	0.00	0.16	1.20	0.78	3.40	5.58	0.04	0.00	0.18	2.01	0.85	4.06	7.14
12	Onon	0.05	0.08	0.14	0.05	1.74	0.00	2.06	0.05	0.09	0.16	0.07	1.83	0.00	2.20	0.05	0.11	0.18	0.12	1.96	0.00	2.42
13	Ulz	0.06	0.00	0.14	5.73	1.79	0.00	7.72	0.06	0.00	0.16	10.91	1.88	0.00	13.01	0.06	0.00	0.18	14.07	2.05	0.00	16.36
14	Kherlen	2.03	0.33	3.83	5.07	6.80	6.87	24.92	2.14	0.35	4.52	8.65	7.16	9.33	32.14	2.33	0.40	5.48	12.38	8.34	11.17	40.10
15	Buir Lake - Khalkh	0.01	0.02	0.14	0.00	0.32	0.71	1.19	0.01	0.02	0.16	0.00	0.33	0.96	1.48	0.01	0.02	0.18	0.00	0.34	1.15	1.69
16	Menengiin Tal	0.04	0.02	0.14	0.61	1.13	0.00	1.94	0.04	0.02	0.16	1.21	1.19	0.00	2.62	0.04	0.02	0.18	1.49	1.37	0.00	3.10
17	Umard Goviin Guveet - Kh. D. T.	2.45	0.39	1.12	1.87	6.49	0.92	13.23	2.58	0.42	1.30	3.49	6.83	1.25	15.87	2.78	0.49	1.62	4.58	8.53	1.50	19.51
18	Galba – Uush - Doloodiin Govi	0.25	0.10	0.14	10.87	3.73	0.32	15.40	0.25	0.11	0.16	21.73	3.93	0.43	26.60	0.25	0.12	0.18	26.75	4.52	0.52	32.34
19	Ongi	0.81	0.26	1.12	0.90	1.79	1.10	5.99	0.85	0.28	1.32	1.55	1.88	1.50	7.37	0.92	0.32	1.60	2.21	2.15	1.79	8.98
20	Altain Uvur Govi	0.14	0.05	0.14	0.85	3.19	3.66	8.04	0.14	0.05	0.16	1.70	3.36	4.97	10.39	0.14	0.06	0.18	2.09	4.22	5.95	12.64
21	Taats	0.08	0.05	0.07	0.00	1.57	0.32	2.09	0.08	0.05	0.08	0.00	1.65	0.44	2.30	0.08	0.06	0.09	0.00	2.02	0.53	2.77
22	Orog Lake - Tui	0.55	0.18	0.21	0.00	1.57	2.80	5.30	0.58	0.19	0.24	0.00	1.65	3.80	6.46	0.63	0.22	0.29	0.00	1.92	4.55	7.61
23	Buuntsagaan Lake – Baidrag	0.09	0.05	0.07	1.21	2.05	2.03	5.50	0.09	0.05	0.08	1.72	2.16	2.76	6.86	0.08	0.06	0.09	2.94	2.61	3.30	9.08
24	Khyargas Lake – Zavkhan	0.80	0.25	0.54	0.06	5.04	13.91	20.60	0.83	0.27	0.63	0.09	5.30	18.90	26.02	0.88	0.30	0.76	0.15	6.46	22.62	31.17
25	Khuisiin Govi - Tsetseg Lake	0.08	0.05	0.14	0.00	1.83	7.46	9.56	0.08	0.05	0.16	0.00	1.93	10.14	12.36	0.08	0.06	0.18	0.00	2.33	12.14	14.79
26	Uench - Bodonch	0.05	0.02	0.00	0.00	0.81	0.53	1.40	0.05	0.02	0.00	0.00	0.85	0.72	1.63	0.05	0.02	0.00	0.00	1.02	0.86	1.94
27	Bulgan	0.05	0.02	0.14	0.00	0.42	2.01	2.63	0.05	0.02	0.16	0.00	0.44	2.73	3.40	0.05	0.02	0.18	0.00	0.51	3.27	4.03
28	Khar Lake - Khovd	1.38	0.41	0.27	0.25	5.39	12.90	20.60	1.44	0.44	0.32	0.50	5.67	17.53	25.89	1.53	0.51	0.37	0.62	6.93	20.98	30.94
29	Uvs Lake - Tes	0.65	0.22	0.28	0.03	3.46	14.74	19.39	0.68	0.24	0.33	0.05	3.64	20.04	24.97	0.73	0.27	0.39	0.08	4.24	23.98	29.68
	Total	**70.42**	**14.34**	**48.60**	**52.53**	**90.17**	**124.95**	**401.02**	**74.91**	**15.49**	**57.22**	**81.07**	**94.92**	**169.82**	**493.43**	**82.60**	**18.61**	**69.71**	**103.45**	**109.40**	**203.23**	**587.00**

Table 27. Water demand by water basin in the year 2021

№	Name of basin	2021, low scenario							2021, medium scenario							2021, high scenario						
		Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total	Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total	Drinking and domestic water for population	Utility service & tourism & green area	Industry, energy, construction, road and transport	Mining (mine and processing)	Livestock (pastoral and farming)	Irrigated area	Grand total
1	Selenge	0.23	0.18	0.18	0.03	4.35	23.00	27.97	0.23	0.23	0.20	0.08	4.57	36.23	41.53	0.24	0.27	0.22	0.25	4.57	50.01	55.56
2	Khuvsgul Lake - Eg	0.15	0.36	0.18	0.08	3.18	0.30	4.25	0.15	0.45	0.20	0.17	3.35	0.47	4.79	0.15	0.54	0.22	0.55	2.94	0.65	5.05
3	Shishkhid	0.05	0.07	0.18	0.00	1.24	0.00	1.54	0.05	0.09	0.20	0.00	1.30	0.00	1.65	0.05	0.11	0.22	0.00	1.13	0.00	1.51
4	Delgermurun	0.74	0.28	0.17	0.00	3.43	0.00	4.62	0.79	0.32	0.21	0.00	3.61	0.00	4.94	0.86	0.42	0.30	0.00	3.84	0.00	5.42
5	Ider	0.18	0.00	0.18	0.00	2.61	0.93	3.91	0.18	0.00	0.20	0.00	2.75	1.47	4.60	0.18	0.00	0.22	0.00	2.86	2.03	5.29
6	Chuluut	0.12	0.07	0.09	0.00	3.62	0.00	3.90	0.12	0.09	0.10	0.00	3.81	0.00	4.12	0.12	0.11	0.11	0.00	3.34	0.00	3.68
7	Khanui	0.11	0.00	0.09	0.00	3.79	0.00	3.99	0.12	0.00	0.10	0.00	3.99	0.00	4.20	0.12	0.00	0.11	0.00	4.02	0.00	4.25
8	Orkhon	7.00	0.87	3.72	16.37	11.99	20.56	60.51	7.53	1.04	5.56	18.36	12.62	32.39	77.51	8.31	1.51	8.50	27.14	12.55	44.72	102.71
9	Tuul	47.97	11.82	35.58	3.30	9.80	5.93	114.40	52.08	14.31	50.94	7.00	10.32	9.34	143.99	58.48	23.45	79.60	15.50	10.87	12.90	200.80
10	Kharaa	4.58	0.48	6.70	2.62	4.67	18.41	37.45	4.95	0.57	9.50	5.43	4.91	29.00	54.35	5.54	0.76	14.69	11.58	4.60	40.03	77.20
11	Eroo	0.06	0.00	0.18	0.98	0.92	3.31	5.45	0.06	0.00	0.20	2.11	0.97	5.22	8.56	0.06	0.00	0.22	6.65	0.92	7.20	15.06
12	Onon	0.08	0.18	0.18	0.06	2.12	0.00	2.62	0.08	0.23	0.20	0.13	2.23	0.00	2.86	0.08	0.27	0.22	0.41	2.07	0.00	3.05
13	Ulz	0.09	0.00	0.18	7.22	2.18	0.00	9.67	0.09	0.00	0.20	14.63	2.29	0.00	17.21	0.09	0.00	0.22	23.03	2.23	0.00	25.57
14	Kherlen	2.31	0.45	4.46	5.57	7.30	9.10	29.19	2.47	0.53	6.39	11.64	7.68	14.33	43.05	2.73	0.69	9.74	27.74	8.52	19.78	69.21
15	Buir Lake - Khalkh	0.02	0.03	0.18	0.00	0.41	0.93	1.57	0.02	0.03	0.20	0.00	0.43	1.47	2.15	0.02	0.04	0.22	0.00	0.37	2.03	2.68
16	Menengiin Tal	0.07	0.03	0.18	0.71	1.12	0.00	2.10	0.07	0.03	0.20	1.42	1.18	0.00	2.90	0.07	0.04	0.22	1.78	1.35	0.00	3.45
17	Umard Goviin Guveet - Kh. D. T.	2.88	0.53	1.38	1.95	6.41	1.22	14.36	3.08	0.62	1.87	3.98	6.74	1.92	18.22	3.35	0.86	3.02	7.08	9.17	2.65	26.13
18	Galba – Uush - Doloodiin Govi	0.47	0.21	0.18	18.43	3.92	0.42	23.63	0.49	0.26	0.20	36.86	4.12	0.67	42.59	0.50	0.31	0.22	45.46	4.88	0.92	52.29
19	Ongi	1.01	0.33	1.31	0.99	2.04	1.46	7.13	1.08	0.38	1.86	2.07	2.14	2.30	9.83	1.17	0.50	2.82	4.92	2.34	3.17	14.93
20	Altain Uvur Govi	0.22	0.10	0.18	1.70	3.30	4.85	10.34	0.22	0.12	0.20	3.40	3.47	7.64	15.05	0.22	0.14	0.22	4.18	4.42	10.55	19.73
21	Taats	0.12	0.10	0.09	0.00	1.72	0.43	2.46	0.12	0.12	0.10	0.00	1.81	0.68	2.83	0.12	0.14	0.11	0.00	2.15	0.94	3.46
22	Orog Lake - Tui	0.67	0.24	0.25	0.00	1.85	3.70	6.71	0.72	0.28	0.33	0.00	1.94	5.83	9.11	0.79	0.38	0.47	0.00	2.06	8.06	11.75
23	Buuntsagaan Lake – Baidrag	0.13	0.10	0.09	1.44	2.32	2.69	6.77	0.13	0.12	0.10	3.13	2.44	4.24	10.16	0.13	0.14	0.11	10.17	2.76	5.85	19.17
24	Khyargas Lake – Zavkhan	1.02	0.32	0.65	0.07	5.51	18.43	26.00	1.07	0.36	0.87	0.16	5.80	29.02	37.29	1.17	0.48	1.28	0.51	6.96	40.07	50.47
25	Khuisiin Govi - Tsetseg Lake	0.12	0.10	0.18	0.00	2.02	9.89	12.31	0.12	0.12	0.20	0.00	2.13	15.58	18.15	0.12	0.14	0.22	0.00	2.50	21.51	24.49
26	Uench - Bodonch	0.07	0.03	0.00	0.00	0.90	0.70	1.70	0.07	0.03	0.00	0.00	0.94	1.10	2.15	0.07	0.04	0.00	0.00	1.06	1.52	2.70
27	Bulgan	0.07	0.03	0.18	0.00	0.48	2.66	3.43	0.07	0.03	0.20	0.00	0.51	4.20	5.01	0.08	0.04	0.22	0.00	0.53	5.79	6.66
28	Khar Lake - Khovd	1.76	0.55	0.34	0.25	5.91	17.09	25.90	1.86	0.65	0.43	0.50	6.23	26.92	36.57	2.01	0.88	0.58	0.62	7.51	37.16	48.75
29	Uvs Lake - Tes	0.82	0.34	0.35	0.04	4.03	19.53	25.11	0.87	0.40	0.44	0.08	4.24	30.77	36.81	0.94	0.51	0.62	0.27	4.76	42.48	49.58
	Total	**73.12**	**17.76**	**57.62**	**61.81**	**103.13**	**165.55**	**478.98**	**78.91**	**21.40**	**81.41**	**111.13**	**108.56**	**260.77**	**662.19**	**87.78**	**32.76**	**124.91**	**187.83**	**117.29**	**360.03**	**910.61**

PART D – THE POLICY AND DEVELOPMENT CONTEXT

6. Institutional, legal and policy settings

The Integrated Water Management Plan of Mongolia (IWM Plan) is an official document of the government of Mongolia that describes what the government is planning to do in the water sector up to the year 2021. Activities in the water sector should primarily be aimed to support the government in achieving the six development goals as formulated in its MDG-based Comprehensive National Development Strategy. This chapter describes the context for IWM Plan and how the IWM Plan supports these national development objectives with respect to water. The IWM Plan takes the year 2010 as the base year and also the surveys and research for this part of the report were carried out with reference to the base year. However since 2010 and notably in 2012 some major changes have taken place in particular with respect to the institutional structures. Where possible these changes have been taken into account or at least are being acknowledged in this chapter. The issues involved and the planned activities (the national water strategy) to address these issues are described in next chapters. Some of the issues identified may already have been addressed by these recent changes, which can only be considered as a positive development.

Terms and terminology are not always consistent in texts on policy and institutional development. For proper understanding Box 4 provides the definitions for some of these terms as they are used in this document.

Box 4. Definitions of terms

Vision: how we like to see the world in future (based on a dream).

Mission: statement of the purpose of the IWRM Plan, spelling out its overall goal and providing the framework or context for the strategies to be formulated.

Goals: what we aim to accomplish on the long term – goals are general, intangible, not quantifiable and not measurable (based on ideas).

Strategic goals: the long-term goals defined to achieve the results that are formulated in the mission.

Objectives: What we want to achieve on the short term – objectives are specific, tangible, quantified and measurable (based on facts).

Challenges: The present situation or state of things that is unsatisfactory and needs to be addressed; in most cases a combination of several issues.

Issues: What we need to overcome if the present or future situation is not (yet) what we set out to achieve (our objective). An issue can either be a problem that needs to be solved or an ambition we want to achieve.

Measures: Activities proposed specifically to (help) overcome an issue; measures can be of any kind: infrastructural, managerial, economic, institutional, etc. – measures are specific in quantities, time and resources.

Strategies: Logical combinations of the measures that we have to take

Scenarios: Developments exogenous to, but having an impact on, the water system. We can make various assumptions on how these will develop in future (e.g. climate change, population growth, economic development).

6.1. Institutional setting

6.1.1. General

In 1992, the first Mongolian democratic constitution was ratified after almost a century of Soviet modeled single party communist rule with a strongly hierarchical and centralized system of government. Following its new constitution Mongolia has become a parliamentary republic. The President and the members of the State Great Khural (parliament) are elected for tenures of four years. In 2010 the government consisted of 11 ministries; after the installation of the new government in 2012 that became 16.

Table 28. Changes in Government structure as per August 2012

<table>
<tr><th colspan="2">Previously (2008 – 2012)</th><th colspan="2">Effective August 2012</th></tr>
<tr><td>Prime Minister</td><td></td><td>Prime Minister</td><td></td></tr>
<tr><td>First Deputy Prime Minister</td><td></td><td rowspan="2">Deputy Prime Minister</td><td></td></tr>
<tr><td>Deputy Prime Minister</td><td></td><td></td></tr>
<tr><td>Minister of the Cabinet Office</td><td></td><td>Minister of the Cabinet Office</td><td></td></tr>
<tr><td rowspan="2">Ministry of Nature, Environment and Tourism</td><td rowspan="2">MNET</td><td>Ministry of Environment and Green Development</td><td>MEGD</td></tr>
<tr><td>Ministry of Culture, Sports and Tourism</td><td>MCST</td></tr>
<tr><td>Ministry of Education, Culture and Science</td><td>MECS</td><td>Ministry of Education and Science</td><td>MES</td></tr>
<tr><td rowspan="2">Ministry of Foreign Affairs and Trade</td><td rowspan="2">MFAT</td><td>Ministry of Foreign Affairs</td><td>MFA</td></tr>
<tr><td>Ministry of Economic Development</td><td>MED</td></tr>
<tr><td>Ministry of Finance</td><td>MF</td><td>Ministry of Finance</td><td>MF</td></tr>
<tr><td>Ministry of Justice and Home Affairs</td><td>MJHA</td><td>Ministry of Justice</td><td>MJ</td></tr>
<tr><td rowspan="2">Ministry of Roads, Transportation, Construction and Urban Development</td><td rowspan="2">MRTCUD</td><td>Ministry of Construction and Urban Development</td><td>MCUD</td></tr>
<tr><td>Ministry of Roads and Transportation</td><td>MRT</td></tr>
<tr><td>Ministry of Defence</td><td>MD</td><td>Ministry of Defence</td><td>MD</td></tr>
<tr><td rowspan="2">Ministry of Mineral Resources and Energy</td><td rowspan="2">MMRE</td><td>Ministry of Mining</td><td>MM</td></tr>
<tr><td>Ministry of Energy</td><td>ME</td></tr>
<tr><td>Ministry of Food, Agriculture and Light Industry</td><td>MFALI</td><td>Ministry of Industry and Agriculture</td><td>MIA</td></tr>
<tr><td rowspan="2">Ministry of Social Welfare and Labour</td><td rowspan="2">MSWL</td><td>Ministry of Population Development and Social Welfare</td><td>MPDSW</td></tr>
<tr><td>Ministry of Labour</td><td>ML</td></tr>
<tr><td>Ministry of Health</td><td>MH</td><td>Ministry of Health</td><td>MH</td></tr>
</table>

Since 1990 the country has been making a transition towards a market economy. Nevertheless most of the administrative layers of government dating back to the communist era have remained in place; although the strongly hierarchical system of governing has eased somewhat.

Administratively Mongolia is divided into 21 aimags (provinces) and one municipality (the capital city). Aimags are subdivided in soums and soums in bags. The capital city Ulaanbaatar is divided into districts and further subdivided into khoroos. Local Khurals (parliaments) are elected in each of the Aimags and the capital City. On the next lower administrative level they are elected by Soums and the urban Districts.

The water sector in Mongolia is institutionally complex. At least six ministries are involved in the management of the water sector in one way or the other. Their roles have evolved historically over a long period of time including some major institutional restructuring. With regard to IWRM some significant changes were the establishment of the Water Authority in 2005 under the then Ministry of Nature and Environment and the institutional embedding of basin management in the Law on Water (2004). The establishment of the National Water Committee in 1999 was another important steppingstone for IWRM as well and the whole of Article 4 in the Law on Water (2012) is dedicated to IWRM.

Some 13 main agencies and more minor ones are involved in various aspects of water sector planning and management, often with overlaps and sometimes leaving gaps.

The next chapter presents an overview of the institutional situation with the main actors at national and the local levels. Further details may be found in the Assessment Report 'Institutional Analysis of the Water Sector in Mongolia'.

6.1.2. Institutional landscape at the national level

The Government Law (*1993*) places water issues under the responsibility of the Minister of the then Ministry of Nature and Environment, and more precisely the Ministry's Department of Environment and Natural Resources (Government Resolution 65, 2008). This Department is "*…in charge of water policy development and seeking synergy between policy and legal texts, and ensuring its implementation*". This present Integrated Water Management Plan is prepared under the responsibility of this Ministry, which was renamed in 2008 as the Ministry of Nature, Environment and Tourism (MNET), and in 2012 changed again to become the Ministry of Environment and Green Development (MEGD). The same Ministry is also in charge of preparing the Environmental Master Plan and National Environmental Action Plan, which best ensures that these two plans are complementary and mutually reinforcing.

Most of the ministries are represented in the local administrations at the aimag and the soum levels. The changes in the Government after the elections of 2012 are likely to cause some restructuring at the local level as well.

These ministries and institutions may be considered the key actors in water management in Mongolia and most are responsible for the water management related to their own sector. They enjoy a considerable degree of autonomy for handling their water management issues.

Recent changes

In September 2012 the newly formed government resulting from the elections in June 2012 resolved to disband the Water Authority and transferred its tasks and responsibilities to the new Department for Coordination of Policy Implementation of the Ministry of Environment and Green Development. The National Water Committee was made a permanent body chaired by the Prime Minister. After these changes take effect the institutional structure of the water sector in Mongolia takes shape as depicted in Figure 42.

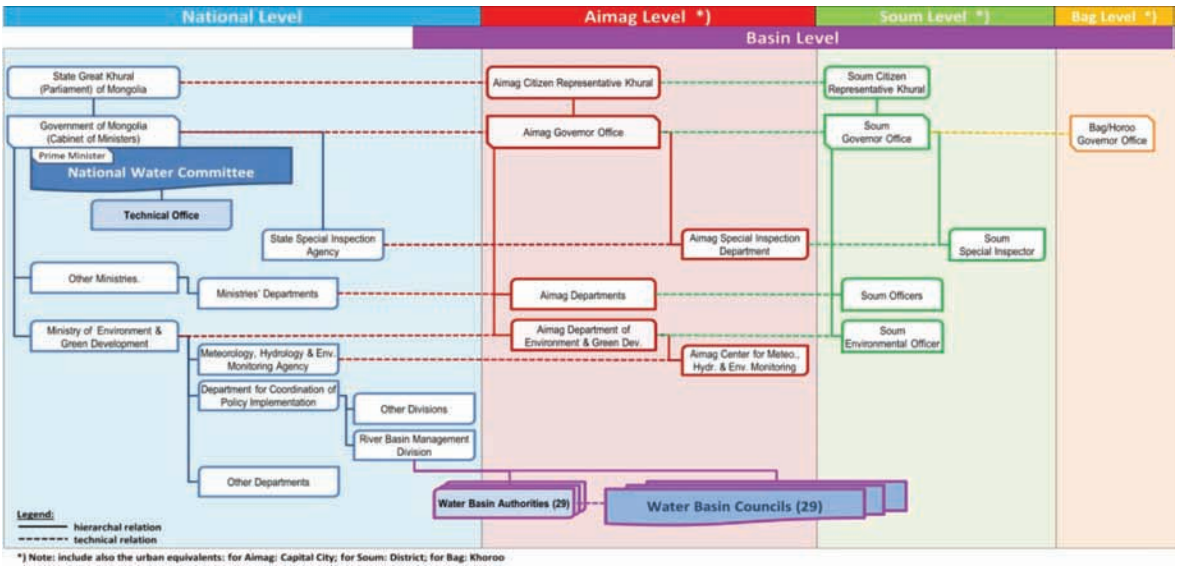


Figure 42. Simplified institutional structure of the Water Sector in Mongolia (as per 2012)

Another new development is the government's initiative to establish a state owned corporation for water resource management ('MGL Water') that will have branches at the Aimags and rural locations, to be responsible for operation and maintenance services of state owned facilities. Public and private sector entities are envisioned to cooperate in this new State Corporation.

It is too early to make an assessment of the functioning of these new structures and arrangements.

6.1.3. Institutional landscape at the local level

Local governments

Most ministries and also a number of government agencies have a representation at the local levels. These local offices of the ministries are answerable to their ministry but also to the local (Aimag or Soum) Governor. The key role of the local Governors is preparing budgets for implementation of activities like water supply, water resources restoration and effective use, protection of water quality, and prevention from water-related disasters. The Governors are responsible for coordination between the various sectors and are mandated to issue all sorts of licenses and permits.

At aimag level the MNET was previously represented by the Departments of Nature, Environment and Tourism that, amongst others, were in charge of water issues and reported to the Governors' offices, the MNET and the Water Authority. This situation is expected to continue after the government restructuring in 2012 with the new equivalent institutions. Other ministries and institutes have local offices that carry out some specific water management tasks. The State Inspection Agency operates in a decentralized way as well and is involved in monitoring and enforcing. Although the Aimag Tax Division is responsible for collecting water use fees, checking on payment of the water use fees is done by the Special Inspection Department.

Water basin organizations

The Law on Water (2004) has introduced the legal basis for basin management and the legal mandate of Water Basin Organizations was described in Article 19. The Law is quite specific on the composition of the Basin Council, as it is called. The modified law, the Law on Water (2012), further clarifies a number unresolved issues and introduces Water Basin Authorities, which are technical offices operating with professional support and guidance from the Water Authority and responsible for implementation of all water management activities within the respective water basins.

In the context of the "Strengthening IWRM in Mongolia" project the MNET established the boundaries of 29 Water Basins covering the whole of Mongolia (Ministerial Order # 332, 2009). Some ten of these basins in the south of Mongolia do not have sufficiently reliable surface water resources (the shaded areas in Figure 43). In these basins, groundwater is of prime importance.

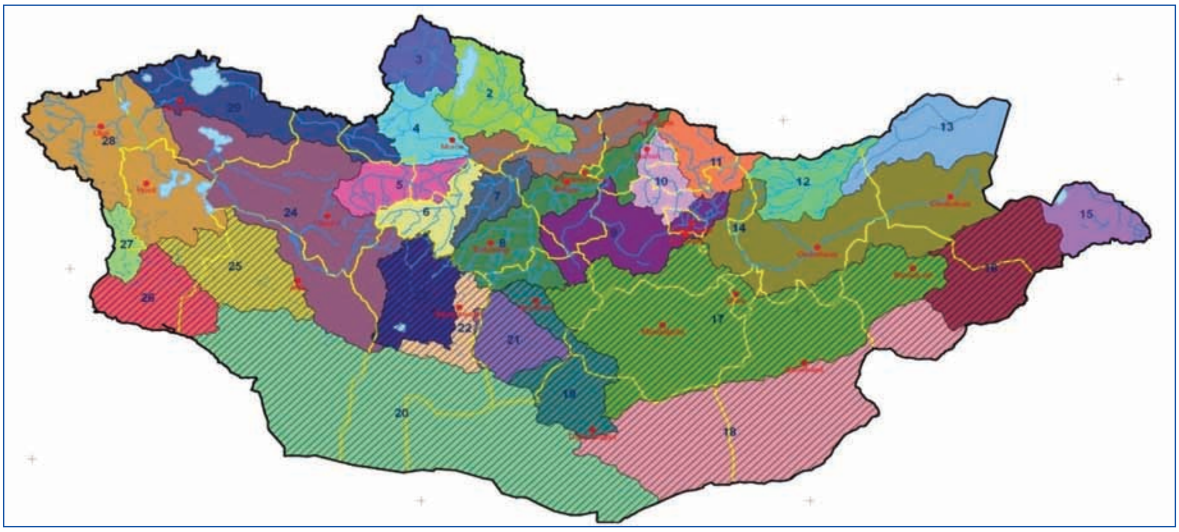


Figure 43. Water Basins (29) in Mongolia

By January 2012 a total of 6 Water Basin Councils and 11 sub-councils had been established since 2006. These Water Basin Councils have been established with support from international donor organizations, NGOs and projects; they are young organizations that still have to further develop their capabilities in the field of IWRM. The WA was involved in these WBCs in two ways:

- as the agency responsible for supporting, guiding and training WBCs
- as member, or in some cases even chairperson, of WBCs.

Recent changes

The first Water Basin Authority - for the Tuul Basin – has been established in October 2012. Under the new government structure (September 2012) the Water Basin Councils and Water Basin Authorities will be the responsibility of the new River Basin Management Division in the Ministry of Environment and Green Development (see Figure 42).

RESOLUTION OF THE GOVERNMENT OF MONGOLIA

June 13, 2012 No. 203 Ulaanbaatar City

ABOUT THE APPROVAL OF THE KHATAN TUUL PROGRAMME

The Government of Mongolia **RESOLVES** to:

1. Approve the Khatan Tuul Programme according to the Appendix No. 1 and the programme's first phase work plan (2012 to 2016) according to the Appendix No. 2.
2. Assign the Minister of Nature, Environment and Tourism and Director of the National Water Committee D. Tsogtbaatar and the Minister of Road, Transportation, Construction and Urban Development Ts. Dashdorj and the Mayor of Ulaanbaatar city G. Munkhbayar to conduct the implementation of the programme, make a cross-sectoral coordination and monitor the implementation of the programme.
3. Assign the Minister of Nature, Environment and Tourism D. Tsogtbaatar and the Minister of Finance D. Khayankhyarvaa and the Minister of Road, Transportation, Construction and Urban Development Ts. Dashdorj and the Mayor of Ulaanbaatar city G. Munkhbayar and the provincial governor to reflect the measures for the implementation of the programme in the main directions for the socio-economic development every year and ensure to fund the programme from the state budget and other financial sources.
4. Assign the Minister of Nature, Environment and Tourism D. Tsogtbaatar to establish the Tuul River Basin Administration, and approve and enforce its action plan, institutional structure and job positions.

PRIME MINISTER OF MONGOLIA S. BATBOLD

MINISTER OF NATURE, ENVIRONMENT AND TOURISM D. TSOGTBAATAR

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RESOLUTION OF THE GOVERNMENT OF MONGOLIA

July 25, 2012 No. 254 Ulaanbaatar City

About the measures to be taken for the River Basin Administrations

Based on the Article 9 Clause 5 of the Law of Mongolia on State and Local Properties, the Article 4 Clause10 of the Law of Mongolia on Water and the Article 11 Clause 1.3 of the Mongolian Budget Law, the Government of Mongolia **RESOLVES** to:

1. Assign the Minister of Nature, Environment and Tourism D. Tsogtbaatar to establish the River Basin Administrations and the Minister of Finance D. Khayankhyarvaa to set and enforce the standard limit for the norm and normative of the River Basin Administrations' budget cost and their organisational structures and job positions.
2. Assign the Minister of Nature, Environment and Tourism D. Tsogtbaatar and the Minister of Finance D. Khayankhyarvaa to reflect the required operating cost for the River Basin Administrations in the amendment to be made in the state budget for 2012 and ensure its reflection in the state budget every year.
3. Assign the State Property Committee to provide offices for the River Basin Administrations.

PRIME MINISTER OF MONGOLIA S. BATBOLD

THE MINISTER OF NATURE, ENVIRONMENT AND TOURISM D. TSOGTBAATAR

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The establishment of the Tuul River Basin Authority has created a situation in which it would be able to timely address the crucial issues in the water sector of Mongolia. In recent years, the sharp increase in water use and consumption of Ulaanbaatar city is contributing to water shortages and pollution of the Tuul River.

Table 29. List of the established and planned River Basin Authoritics

N	Name of the River basin Administration	Office location	Date of established	Number of staffs
1.	Tuul river basin Authority	Ulaanbaatar city	2012.10.10	22
2.	Khyargas lake-Zavkhan river basin Authority	Zavkhan province, Uliastai city	2013.03.14	10
3.	Khar lake-Khov river basin Authority	Khovd province, Khovd city	2013.03.14	8
4.	Selenge river basin Authority	Orkhon province, Erdenet city	2013.08.14	8
5.	Yeroo river basin Authority	Selenge province, Yeroo soum	2013.08.15	7
6.	Ongi river basin Authority	Uvurkhangai province, Arvaikheer soum	2013.08.15	6
7.	Onon river basin Authority	Khentii province, Batshireet soum	2013.08.15	6
8.	Ulz river basin Authority	Dornod province, Bayandun soum	2013.07.22	6
9.	Ubs lake-Tes river basin Authority	Uvs province, Ulaangom city	2013.07.19	8
10.	Orkhon river basin Authority	Arkhangai province, Erdenebulgan soum	2013.07.30	10
11.	Kharaa river basin Authority	Darkhan-Uul province, Darkhan city	2013.09.30	9
12.	Khuvsgul lake-Eg river basin Authority	Khuvsgul province, Murun city	2013.09.30	8
13.	Buuntsagaan lake-Baidrag river basin Authority	Bayankhongor province, Bayankhongor city	2013.10.18	7
14.	Buir lake-Khalkh river basin Authority	Dornod province, Choibalsan city	2013.09.30	7
15.	Kherlen river basin Authority	Ulaanbaatar city, Baganuur district	2013.09.30	
16.	Umard gobi Guveet-Khalkh Dundad Tal basin administration	Gobi-Sumber province, Sumber soum	2013.10.17	12
17.	Altain Uvur gobi basin administration	Umnugobi province, Dalanzadgad city	2013.10.17 2014.01.13	12
18.	Galba-Uush-Dolood gobi basin administration	Dornogobi province, Sainshand city	2013.10.17	12
19.	Bulgan river basin Authority	Khovd province, Bulgan soum	2013.08.15	6
20.	Khanui river basin Authority	Bulgan province, Bayan-Agt soum	2014.01.24	6
21.	Orog lake-Tui river basin Authority	Bayankhongor province, Bayankhongor city	2014.01.24	6
22.	Shishkhed river basin Authority	Khuvsgul province, Ulaan-Uul soum	2014.01.24	6
23.	Delgermurun basin Authority	Khuvsgul province, Murun city	2013.09.30	6
24.	Khuis gov-Tsetseg lake basin Authority	Gobi-Altai province, Altai city	2014.01.24	6
25.	Menen tal basin administration	Sukhbaatar province, Baruun-Urt city	To establish in 2014	
26.	Ider river basin Authority	Zavkhan province, Tosontsengel soum	To establish in 2014	
27.	Chuluut river basin Authority	Arkhnagai province, Tsetserleg city	To establish in 2014	
28.	Uyench-Bodonch river basin Authority	Khovd province, Altai soum	To establish in 2014	
29	Taats river basin Authority	Uvurkhangai province, Arvaikheer soum	To establish in 2014	

6.1.4. Private sector and non-government organizations

Private sector involvement in the water sector is limited to implementation tasks. Consultancy firms are deployed for feasibility studies, surveys, designs and supervision for water infrastructure works, and for studies and impact assessments for planning and assessments. Contractors are hired to carry out surveys, works and maintenance. Large mining companies explore ground water aquifers and construct boreholes and reticulation for exploitation and distribution. They often provide nearby villages with water points from their source and charge a fee. In aimag and soum centers water distribution and wastewater collection and treatment is often managed by private companies. In large cities the Housing Service Companies (OSNAAG) are, among other services, responsible for the water distribution and fee collection within housing blocks. The private sector is not involved in decision making processes on water management.

Involvement of the NGOs in the environmental sector has been growing over past decade in Mongolia. By 2009 the number of workers for environmental protection in civil society organizations was estimated to be 4 times the number of civil servants serving in the environmental field. NGOs have been in particular successful in implementing management plans in protected areas and in mobilizing the public in demands for protection measures.

Figure 44. Environmental NGOs and their distribution over the aimags

Most of the 549 registered NGOs focus on a specific aspect, but are nevertheless a force to be reckoned with when it comes to civil mobilization. More than half of the NGOs have their base in Ulaanbaatar, but the remaining 40% are fairly equally distributed over the aimags (see Figure 44). At the national level most NGOs of significance are united in one of the two major umbrella organizations: the Coalition of Movements for Environmental Conservation or the Mongolian Environmental Civil Council. By joining forces in this way the NGOs manage to significantly influence decision-making on environmental issues. In 2009, Environmental NGOs were actively involved in the development of at least five environmental laws of which the Law on Prohibition of Mineral Prospecting Exploration in River Basin Areas and Forest Areas that was passed by the Parliament in 2009 may be considered their ultimate success.

6.1.5. Institutional analysis

An institutional analysis was made of the water sector in Mongolia that included a broad survey among the 65 actors identified for being involved in water management. From the viewpoint of IWRM, water management should always be looked at in close conjunction with land management and environmental management as these are strongly interrelated. Therefore the survey also covered land management and environmental management functions and actors – for as far as they have a bearing on water. The analysis revealed that almost all of the water management functions that need to be performed in the context of IWRM are indeed covered and assigned. Only a very small number of less significant functions were not taken care of. On the other hand however, the survey revealed a great deal of overlap of functions being performed by several institutions.

The performance assessment of the water management functions in the water sector (see Figure 45) indicates weak performance in just over 20% of the cases. The most important constraint for optimal performance is lack of proper equipment and inadequate financial resources. Also shortage of qualified staff forms a serious hindrance. For land management and environmental management these indicators are slightly better. Further details of the institutional analysis may be found in the assessment report ‘Institutional Analysis of the Water Sector in Mongolia’.

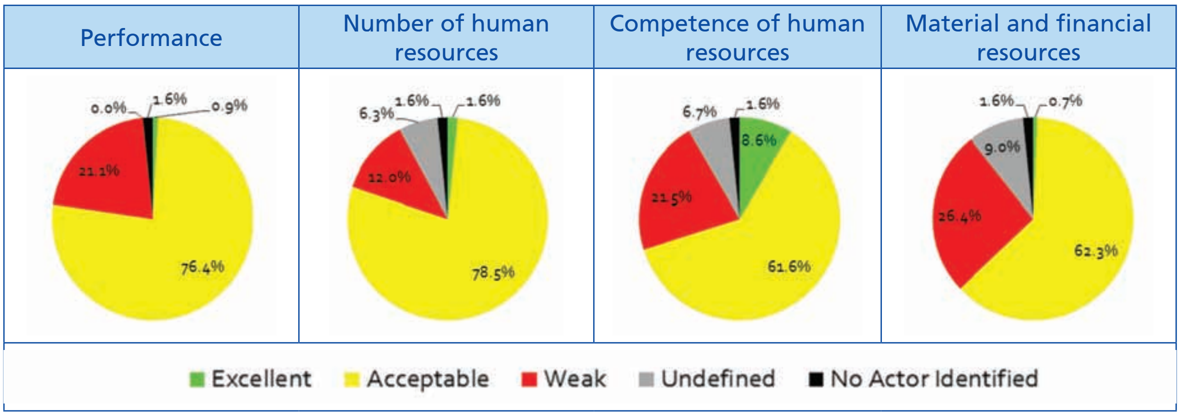


Figure 45. Function performance by actors in the water sector

Crucial in IWRM are the coordinating bodies and their performance. The institutions which have a formal responsibility for coordination in water management are:

- the Government of Mongolia (i.e. the Cabinet)
- the Ministry of Nature, Environment and Tourism (now the Ministry of Environment and Green Development)
- the Water Authority (now absorbed in the MEGD’s new Department for Coordination of Policy Implementation)
- the National Water Committee
- the Aimag and Soum Governors
- Water Basin Councils

Across the board coordination is not effective yet. The main reason is that those given the responsibility to coordinate do not have authority over those they are expected to coordinate. The Cabinet coordinates at policy level in conjunction with the Parliament, but at this level of government it cannot be expected that the detailed coordination required for integrated water management takes place. At the most the Government and Parliament may be expected to provide political commitment and policy consistency in support of IWRM.

Coordination by the MNET of activities related to water management by other ministries (MFALI, MMRE and MRTCUD) proved to be ineffective as MNET was not in a position to direct its fellow ministries, who in practice are each much more powerful than MNET. The Water Authority and the National Water Committee were in an even less commanding position. The Aimag and Soum Governors are only successful in coordination activates within their own control, but are not effective in coordinating activities by state level organizations in their Aimag or Soum. Water Basin Councils are still too few and too immature to establish their position as coordinating bodies.

The National Water Committee

The National Water Committee could be considered the most coordination-oriented among all the above mentioned organizations. Besides some responsibilities regarding monitoring, coordination is by far its chief responsibility as is clearly reflected in its organizational structure. The NWC has two levels of coordination:

i. a committee comprised of the State Secretaries of respective Ministries and some NGO and private sector representatives (Minister's decree, 2009), and

ii. an operational group that advises on crucial issues to the committee of the State Secretaries; this group is operational on an ad-hoc basis

However, the legal basis for the NWC is still weak, having been established by ministerial decree on temporary basis for the duration of the National Water Program. Consequently it lacked the authority essential for effective coordination and giving direction. Hence the act of coordination did not transcend the level of exchanging information. No decisions can be taken by the National Water Committee that are binding to all members. Only the recent amendments made in the Law on Water (2012) have transformed the National Water Committee to a permanent body with its mandate vested in the Law and elevated its hierarchal position by placing it under the chairmanship of the Prime Minister.

The Water Authority

Although the Water Authority was disbanded in August 2012, its establishment in 2005 and subsequent performance do have institutional significance as it is a manifestation of a progressive development of the water sector. Because at the time of writing the new institutions that absorbed the Water Authority are still being established and cannot yet be assessed, the Water Authority is discussed here on the assumption that its mandates, responsibilities and tasks will be transferred to the new institutional set up in one way or the other.

At the time the institutional analyses were made in 2010 the Water Authority was a young organization still in the process of building its capacity to adequately take on all the tasks assigned to it by law. The total number of staff in 2011 was some 41 persons, not including the part-time staff of the Science & Technology Board.

A pivotal role in water management was foreseen for the Water Authority. The Water Authority was established in 2005 and its legal mandate was vested in the Law on Water (2004) and further enhanced in the Law on Water (2012). It is the implementing agency of the Law on Water and is tasked to "*…provide professional and managerial service in implementation of state policy on proper utilization, protection and restoration of water resources in Mongolia*". Considering that at least three other former major ministries (MFALI, MRTCUD, MMRE) dominated the water sector the WA could only be successful when it took on a strong coordinating role. In its short time of existence the WA has been unsuccessful in establishing itself at this coordinator position.

Also crucial in the context of IWRM was the WA's responsibility for establishing Water Basin Organizations and providing them with professional guidance. The WA does not have decentralized branches at the local levels, but the new Law on Water (2012) introduced the concept of Water Basin Authorities, which are technical offices at the basin level and would technically be answerable to the WA.

In the course of the government restructuring after the parliamentary elections in June 2012 the Water Authority was disbanded on 27 August 2012. Most of its tasks are transferred to the Department for Coordination of Policy Implementation of the newly named Ministry of Environment and Green Development. The newly established River

Basin Management Division in the ministry may be appreciated as an important step forward towards a basin management approach for water management, which is an important pillar of IWRM.

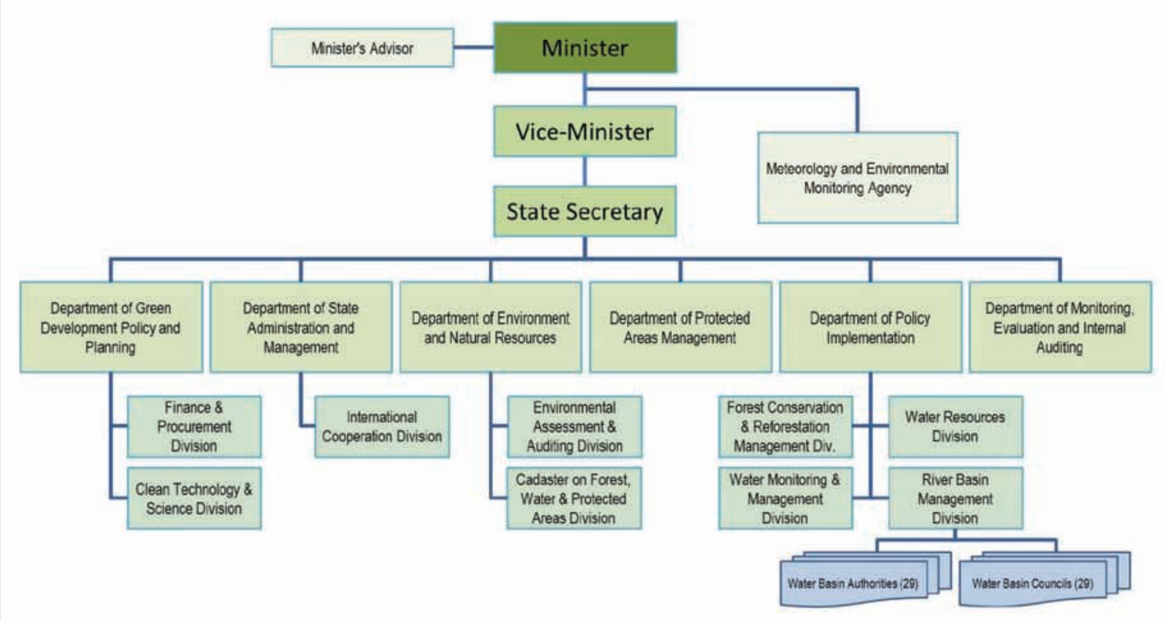


Figure 46. Organizational structure of the Ministry of Environment and Green Development (as per 2012)

6.1.6. Crucial institutional issues

During recent years a number of major steps forward have been made towards the introduction of IWRM in Mongolia, the most prominent of which are the legal embedding of Water Basin Councils and Water Basin Authorities and the elevation of the National Water Committee to become a permanent institution under the Prime Minister. However there are numerous issues that remain to be resolved, the most important and urgent ones are mentioned here.

Also in Mongolia the common issue occurs that Water Basins almost by definition cross administrative boundaries which always cause some friction over mandates, authority, responsibilities and financial resources. When left unaddressed such issues have the potential to seriously paralyze water management.

A considerable degree of overlapping has been observed. Similar functions are performed by different actors without coordination. This results in duplication, contradiction and competition, leading to an inefficient use of valuable human and financial resources. Performance of water management functions was found to be seriously hampered by the shortage of adequately capable staff, budget constraints and the lack of proper means and equipment.

With regard to the principle on subsidiarity, decentralization to the lowest possible governmental level and state disengagement, it has to be concluded that many water management functions have indeed been decentralized to local levels, but by far most water management functions are still fully controlled by government administration. IWRM bodies like Water Basin Councils and Authorities are new and will remain for some time rather immature to take on their responsibilities. Transferring tasks from government administration offices to IWRM bodies, civil society or private sector organizations has not really commenced yet.

However, the all overriding issue is the lack of effective coordination. Despite several institutions having responsibilities for coordination, none of these have the capacity or the authority to actually coordinate any major aspect of water management in Mongolia, which is dominated by a handful of strong ministries each of which is in a position to pursue its own agenda and priorities, without any horizontal accountability.

At a slightly lower level the lack of coordination authority is clearly manifested by the jungle of data and information. Data are collected by more than a dozen organizations, most of which specialize in a specific field. From there on these data are treated as assets owned by that particular institution or even a particular specialist. Third parties trying to obtain existing data (e.g. for planning purposes) face major difficulties to get these data, even for organizations within the same ministry. As a result plans are often prepared with sub-optimal data sets and there is a lot of duplication in data collection, which is an unacceptable waste of public funds.

6.2. Legal setting

6.2.1. Existing laws and regulations

In Mongolia, currently 50 laws regulate the protection of the environment; the proper use of natural resources and the restoration of available resources. These laws concern the management of air, water, land, forest, animals, mineral resources, etc. in Mongolia. There are ten laws that specifically regulate the effective use, protection and restoration of water resources, water use fees and water supply (see Table 30).

Table 30. Laws directly related to water resources (as per December 2012)

No	Name of law	Promulgated	Last amended
1	Environment Protection Law	1995-03-30	2008-01-31
2	Law on Water (2012) *)	2012-05-17	2012-08-17
3	Law on Land	2002-06-07	2010-07-01
4	Law on Food	1999-10-07	2003-05-15
5	Law on Meteorology and Environment Monitoring	1997-11-13	2003-01-02
6	Law on Urban Water Supply, Sanitation Sewerage Use	2011-10-06	
7	Law on Water Transportation	2003-11-28	2011-01-20
8	Law on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas	2009-07-16	
9	Law on fees for natural resource use (renewed)	2012-05-17	
10	Law on Water Pollution Fee	2012-05-17	
Note: *) replacing Law on Water (2004)			

The Law on Water of 17 May 2012 (and its predecessor the Law on Water of 22 April 2004), serves as an umbrella law for water resources management. These laws introduced a number of important new concepts, for example:

- The law defines the mandates of the State organizations that are in charge of development and adoption of integrated water resources management plans;
- The law introduces the concept of Water Basin Councils and Water Basin Authorities, opening the way for decentralization of water management and facilitating involvement of citizens in water management;
- The law provides the legal basis for the introduction of IWRM and establishes an institutional framework that includes a better positioning of some vital IWRM organizations.
- The law opens the way for the private sector to engage in water management activities e.g. through state corporations and PPP arrangements.

Important by-laws were developed after the promulgation of the Law on Water (2004) like for Water Basin Councils (Ministerial order of Environment No 187, year 2006), Registration of Water Resources (Ministerial order of Environment No 269, year 2006), Water Database (Ministerial Order of Environment No 180, year 2006) and Water Use Licensing (Ministerial Order of Environment No 298, year 2006). However, the existing legislation on water in Mongolia still leaves room for improvement in particular for facilitating IWRM.

There are some 50 laws related to environmental management. The umbrella law is the Environment Protection Law, adopted in 1995. In Article 3 of the Environment Protection Law, water is mentioned in the list of resources to be protected. Specific laws are formulated to protect the natural resources and to regulate the proper use of these resources, ensuring the ecological balance. Specifically the discharge of wastewater is regulated in the Environmental legislation.

Law enforcement is the main domain of the State Inspection Agency and its decentralized offices at aimag and soum level. Law enforcement generally is weak due to lack of technical expertise and the small number of staff compared to the area that needs to be covered, while the penalties seem to be too small to deter offenders.

6.2.2. Legal basis for institutional setting

Besides the Law on Water (2012) - having replaced the Law on Water (2004) - the Constitution of Mongolia, the Parliament Law, the Government Law, the Law on Environmental Protection, the Law on Fees for the Use of Water and Mineral Water, the Law on Urban Water Supply, Sanitation and Sewerage Use, etc. complement the legal basis for the existing institutional setting in the water sector.

The legal mandate for the Water Authority was based on the Law on Water (2004) and was further enhanced by the Law on Water (2012), which states that the Government Agency in charge of water issues (the Water Authority) shall operate within the Ministry in charge of Nature and Environment. The Law on Water (2004) also required the establishment of Water Basin Councils (WBC) in identified water basins. The Law further specifies the responsibilities of the Water Authority and the WBCs including the main IWRM tasks such as water resources assessment, planning of water resources, monitoring, protection, research, etc. The tasks and responsibilities however, focus on implementation and policy making responsibilities are not well specified.

The Law on Water states that Water Basin Councils will develop the Water Basin Water Management Plans, and submit the draft plan to the respective level Citizen's Representative Khurals for approval and monitoring of its implementation. Water Basin Authorities have been introduced in the Law on Water (2012) as the technical professional offices for water management at the basin level. Water Basin Authorities' resort under the River Basin Management Division of the Ministry of Environment and Green Development as are the Water Basin Councils. The Water Basin Authorities are expected to play a decisive role in the formation of Water Basin Councils

6.2.3. Legal basis for water pricing and abstraction

Financing of investments, operation and maintenance in the water sector is a thorny issue in almost every country that requires striking a political balance between treating water as an economical good on the one hand and as a social right on the other hand. When applied in smart ways water fee and water tariff systems may be effective tools to regulate water usage, however the same systems may deprive the poor and vulnerable from access to safe water.

The Law on Water does provide regulations for water utilizing and exploration. Depending on the purpose for water utilization the Law on Water distinguishes "water consumers" and "water users". Water consumers are exempted from paying water use fees, although, depending on how they receive their water, they may be charged a service fee. Water users are charged a water use fee. The Law on Fees for Natural Resource Use specifies the fees to be paid for the use of water.

Box 5. Water users vs water consumers

"**Water consumers**" are the citizens, economic entities and organizations who utilize water or the water environment for non-profit purposes such as drinking, household needs, herding and agriculture; Water consumers are exempted from paying water use fees, although, depending on how they receive their water, they are charged a service fee. Water consumers also include, crop production, livestock water supply and domestic water consumption

"**Water users**" are those who use water or the water environment for profit in the industry and services sectors. Water users are charged a water use fee.

Soum and District Citizens' Representatives' Khural used to set the related water service tariff according to the Law on Water that was approved in 2004. But according to the Law on Urban Water Supply, Sanitation and Sewerage Use that was newly approved in 2011, the Regulatory Council for Urban Water Supply, Sanitation and Sewerage Use and Service is now responsible for setting water service tariffs and water supply, sanitation and sewerage use and service tariffs In 2008 water consumers in the various aimags were charged a tariff ranging from 650 to 2000 MNT/ m^3, which does not cover the real costs of water, and in cases not even the O&M costs.

The Law on Fees for Natural Resource Use specifies that 55% of the water use fees collected is to be spent on water management and protection and in addition a similar amount is to be allocated for water management and protection from the State Budget. In practice however, this doesn't happen and the water management activities are generally paid from State budget. In 2010 the State Budget earned a total amount of 4.6 bln. MNT from water use fees, which was an increase of about 50% over the previous years.

The Law on Water regulates permitting for water consumers and water users as detailed in Table 31. Two different organizations are involved in the processing and issuing of the permit. Permits for water use also include rain/snow water harvesting, establishing ponds and excavating trenches. Payment of the water use fees are made through the local tax offices.

Table 31. Permitting for water use

Water use	Organization to receive, process and approve application	Organization to issue permit
> 100 m^3/day	MEGD	Water Basin Authority
50 – 100 m^3/day	Water Basin Authority	Aimag and Ulaanbaatar Environmental Department
< 50 m^3/day	Aimag and Ulaanbaatar Environmental Department	Soum and district governor

Already in the Law on Water (2004) in Article 30 and again with more detail in Articles 20 and 21 of the Law on Water (2012) it is stated that citizens, economic entities and organizations that pollute water shall be subjected to a water pollution compensation fee and that the amount of that compensation would be set by law. The Law on Water Pollution Payment dealing with this issue was adopted on May 17, 2012. There are no more legal obstacles to implement and enforce the 'polluter-pays' principle.

6.2.4. Crucial legal issues

Although the amended Law on Water (2012) includes a number of major improvements in the legal basis for IWRM, there remain a number of issues to be resolved or improved.

Definitions of the terminologies: The same terms used in different laws and sometimes in the same law are not always used in a consistent manner and the absence of proper definitions for terms leads to multi-interpretable clauses in the laws that seriously impede enforcement.

Regulations on water use: the distinction between 'water users' and 'water consumers' is a sensitive issue, in particular because it separates those who pay and those who do not have to pay water use fees. However, there are solid grounds to re-categorize agriculture and herding as water users instead of water consumers and charge water use fees as these clearly are economic activities. A step further is even to consider abolishing the whole distinction between these two categories.

Laws and legal documents regarding water management organizations focus much on mandates, and less on responsibilities and accountability. Specifically with regard to IWRM the concept of coordination remains ill-defined and is not adequately supported by punitive powers for those not abiding by coordinating decisions. Even after the considerable improvements carried through in the Law on Water (2012) there is still a lot of ambiguity with regard to Water Basin Councils and Water Basin Authorities, their status, their financial resources and their accountabilities.

The existing laws do not adequately provide for dispute resolution mechanisms; IWRM in itself is basically a conflict management tool and for IWRM to be successful there need to be mechanisms in place for stakeholders to resolve their disputes irrespective of whether the stakeholder is an individual citizen, a private company or a government institution.

Water pricing and financing of water management remain issues that have not been resolved yet. In particular financing of Water Basin Councils till now is only based on project related funding and no sustainable mechanism has been put in place.

The principle of polluters paying for the pollution they cause has been adopted and the law provides for it, but implementation is not yet effective.

Enforcement of laws and regulations remains problematic in a number of fields, e.g. channeling the required 55% of the water use fee income to protection and restoration of water sources and supplementing this with an equal amount from the state budget is clearly stated in the law but nevertheless is not implemented, without any consequences for those responsible. It is generally felt that penalties are too low to act as a deterrent and law enforcers cannot count on being backed up by the legal system when they charge offenders. Too many offenders escaping punishment or offenders laughingly paying the nominal fine, go back to commit the same offence again, severely undermining the law. Such laws become toothless and its effect and purpose are lost.

6.3. Policy and development setting

6.3.1. National development policy

In 2008 the Parliament of Mongolia adopted the "MDGs-based Comprehensive National Development Strategy of Mongolia (*CNDS - ref. State Great Khural Resolution Nr. 12, 2008*). This development strategy, aiming at the year 2021, provides the default framework for all sector planning.

The vision for Mongolia's national development strategy by the year 2021 was formulated as:

Mongolia is a country of contentment with vast lands, abundant natural resources, admirable history and glorious future. We, Mongols, shall respect our history and culture; have our national dignity, be highly educated and confident in ourselves so as to realize our desires and aspirations, live comfortable, prosperous and contented in our homeland. Mongolia's development is a guarantee of its security and independence. The root source of its development lies in the national unity.

The National Development Strategy is based on six national development goals:

1. Achieve the Millennium Development Goals and provide for an all-round development of Mongolian people.
2. Intensively develop export-oriented, private sector-led, high technology-driven manufacturing and services.
3. Exploit mineral deposits of strategic importance, generate and accumulate savings, ensure intensive and high economic growth, and develop modern processing industry.
4. Ensure intensive development of the country's regions, their infrastructure, and reduce urban-rural development disparities.
5. Create a sustainable environment for development by promoting capacities and means on adaptation to climate change, terminating imbalances in the country's ecosystems and protecting them.
6. Consolidate further political democracy, foster a transparent, accountable, just system free from corruption and red tape.

The National Development Strategy identifies four broad policy fields to address these goals as shown in Figure 47.

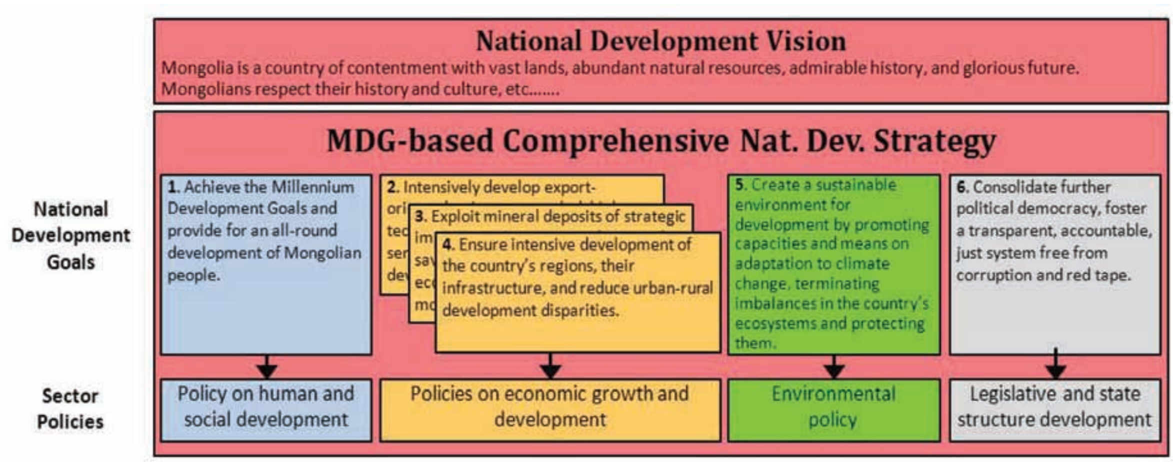


Figure 47. Broad sector policies addressing the development goals

6.3.2. Sector policies

In its resolution # 12 (2008) the State Khural imposed on all of the sectors to develop their respective sector programs in line with the MDGs-based Comprehensive National Development Strategy of Mongolia. Some of these have been completed or even been approved by parliament already, like the National Water Program (see box 6), while others are still in various stages of preparation. Nevertheless, all sectors are still implementing policies and programs that have been formulated earlier and will remain in force. Several of these policies and programs relate directly or indirectly to water resources management. All sector programs and policies that have a bearing on water management are listed in Table 32. The following paragraphs summarize the main policy elements.

Box 6. National Water Program

The NWP was prepared by the NWC in 2010 with involvement of other line ministries, and approved by parliament in 2010. The Program has set 6 strategic goals. For each strategic goal a considerable number of measures has been identified, for the short (2011-2015) and for the long term (2016-2021). These measures incorporate many, but not all, of the measures concerning water management issues that are proposed in the various sector programs being prepared. In general it can be concluded that the NWP incorporates most if not all proposed measures from other sector programs that involve infrastructure and source protection activities. Typically, measures from the sector programs concerning capacity building, private sector involvement, legal issues, etc. did not find their way into the NWP. As a result, NWP is biased towards infrastructural works and, although it does include awareness' raising as an important activity, the NWP doesn't touch upon institutional measures, let alone institutional reform.

Table 32. National and Sector Policies related to Water

Documents approved by the Mongolian Parliament are referenced: SIKh-*xxx* and documents approved by the Government of Mongolia are referenced: GOM-*xxx*

Policy Documents	Reference	Period of implementation	Sectors					
Title			Agriculture	Energy	Environment	Forestry	Mining	Urban Dev.
Development concept of Mongolia	SIKh-26	1996-2020						X
State Policy on Ecology		1997-2020			X			
Sustainable Development Program of Mongolia in the XXI[st] century	GOM-82	1998-2015		X			X	X
National Program on Specially Protected Areas		1998-2015			X			
Policy of Mongolian State on apartment buildings	SIKh -25	1999						X
Water National Program		1999-2010 2010-2021	X	X	X		X	X
100,000 solar ger program	GOM-158	2000-2010		X				
Geological Information Fund of Mongolia program	GOM-183	2001-2010					X	
National Program on Food Supply, Security and Nutrition	GOM-242	2001-2010	X		X			
Master plan for development of building construction sector		2001-2010						X
Regional Development Plan of Mongolia	SIKh -57-2001	2001-2010 2020		X			X	X
Environmental Action Program		2001-2015			X			
National program for apartment buildings	GOM-58	2002-2006						X
Development Program of the Meteorological and Hydrological Services up to 2015.		2002-2015			X			
Master plan of Ulaanbaatar city till 2020	GOM-2002	2002-2020	X		X			X

Policy Documents Title	Reference	Period of implementation	Sectors					
			Agriculture	Energy	Environment	Forestry	Mining	Urban Dev.
State Policy on Food and Agriculture	SIKh -29	2003-2015	X		X			
Master plan for development of the Support Center in the Region	SIKh -01	2003-2020						X
Master plan for organization of the land of Mongolia	GOM-264	2003-2023						X
Water Reform 21 Actions Framework	GOM-57	2004-2025		X	X		X	X
Development Program for Ulaanbaatar City Region	GOM-	2005-2015	X		X			
Development program for the western region	GOM-202-1	2005-2015	X	X	X		X	X
Development program of the Khangai region	GOM-202-2	2005-2015	X	X	X		X	X
Development program of the Central Region	GOM-202-3	2005-2015	X	X	X		X	X
Development program for the East region	GOM-202-4	2005-2015	X	X	X		X	X
National program for environment and health	GOM-245	2005-2015						X
Millennium Development Goals MDGs	SIKh-25	2005-2015	X	X	X	X	X	X
Green Belt Program	GOM-44-2005	2005-2015 2015-2025 2025-2035			X	X		
State Policy on Water	GOM-1	2005-2020			X			X
National Program on Renewable Energy	SIKh-32	2005-2020		X	X			
Master plan for the development of "40 000 apartment buildings" program implementation	GOM-200	2006-2010						X
Program for sanitation facilities	GOM-246	2006-2016			X			X
Mongolian energy system program	SIKh-10	2007-2012 2013-2022 2023-2040		X				
Sub program of apartment buildings for state employees	GOM-221	2007-2015						X
Master plan for development of construction material industry	GOM-222	2007-2015						X
Master Plan of Water Supply and Waste Water of Ulaanbaatar City		2007-2020			X			X
Water program for Selenge aimag	Selenge AKh	2007-2021	X		X			
Development Program for Selenge Aimag	Selenge AKh-38-2007	2007-2021	X		X			
MDGs-based Comprehensive National Development Strategy	SIKh -12	2007-2021	X	X	X	X	X	X
Third Arable Farming National Program	GOM-70	2008-2010	X		X			
Orientation for privatization of the urban services sector	GOM-182	2008-2012						X
Government Action Plan	SIKh-35	2008-2012	X	X	X		X	X
Orientation for 2009-2015 for investment planning from the Mongolia Development Fund towards improvement of economical capacity of Mongolia	GOM-184	2008-2015						X
Animal Fodder National Program	GOM-283	2008-2015	X		X			
Safe drinking water supply to the population program	GOM-84	2008-2015			X			X
Program to transfer ger areas in Ulaanbaatar city to apartment building micro region	GOM-303	2008-2020			X			X
Development Program for Tov Aimag	Tov AKh-02-2008	2008-2023	X		X			

Policy Documents Title	Reference	Period of implementation	Sectors					
			Agriculture	Energy	Environment	Forestry	Mining	Urban Dev.
Transport strategy document	draft	2009						X
Action plan of GOM and its implementation plan	GOM-01	2009-2012						X
Framework for Development of the Economy and Social Sectors	SIKh-36	2009-2012	X	X	X		X	
National Program on Food Security	GOM-32	2009-2016	X		X			
State policy on herders	SIKh -39	2009-2020	X		X			
State policy on railway transportation	SIKh -32-2010	2010-3 stages						X
Measures to take on development of the geology and mining sector	GOM-103	2010					X	
State policy on industry of high technology	SIKh -34-2010	2010						X
Framework for Development of the Economy and Social Sectors	SIKh-79	2010					X	
New Innovation Medium Term Program		2010-2014						X
National Program on Desertification	GOM-90-2010	2010-2015 2016-2020			X	X		
Seabuckthorn National Program	GOM-60-2010	2010-2016				X		
National development project for development of mineral resource sector till 2021	draft	2010-2021					X	
State policy on development of mineral resources sector	draft	2010-2021					X	
National Action Program on Climate Change		2011-2021			X			
Coal program	draft						X	
National program for reducing earthquake disaster	GOM-157-2009							X
National Forest Program						X		

6.4. Crucial development issues related to water

6.4.1. Crucial economic issues

The Mongolian economy has traditionally been based on agriculture (nomadic pastoralism). In the past the GDP-growth was driven by the agricultural sector and was affected heavily by severe winters (dzuds) and summer droughts, e.g. the 1999-2002 dzud resulted in a reduction of the GDP in 2000 and 2001. Also the severe 2009-2010 winter caused a shrinking GDP.

More recently the mining sector developed as the more important driver of economy. Mongolia has vast mineral reserves which, if managed properly, should be able to sustain the country's continued economic development. The World Bank estimates that Mongolia's mineral reserves could make Mongolia's economy one of the fastest growing in the world in the coming years.

An important challenge will be to avoid what economists call the 'Dutch disease' or 'natural resource curse' that has affected other resource-rich countries. This natural resource curse includes diverse problems like high inflation, too fast growing government budgets, weakening of the traditional economic sectors, corruption, and environmental degradation. Another important constraint is the land-locked status and underdeveloped domestic transportation network. All goods leaving or entering Mongolia must traverse the territory of either China or Russia. Also in other respects Mongolia's economy continues to be heavily influenced by its neighbors. For example, Mongolia purchases almost all of its petroleum products from Russia as well as about 10% of its electricity.

The main goal of the general economic policy for 2007-2015 is to achieve the Millennium Development Goals (MDG), attain annual economic growth of at least 14%, increase the GDP per capita to at least $5,000 and establish the basis for intensive economic development. For 2016-2021 the aim is to maintain an average annual economic growth of at least 12%, customize and develop a knowledge-based economy, increase the GDP per capita to a minimum of $12,000 and to create economic capacity and resources to join the ranks of middle income countries.

The expected fast growth of the GDP over the next years will shift the balance between various water users and potentially lead to degradation of both surface and ground water quality and quantity. The economic growth will be driven by large-scale mining projects primarily in the water-scarce south Gobi region; these will require large amounts of water for operations (primarily from underground aquifers) and to meet the needs of a large influx of workers. Plans to expand agricultural crop production will lead to widespread use of fertilizer, which could potentially further degrade water quality. In pursuit of a share of the wealth promised by the country's mineral potential a steep increase of the migration from the rural areas to population centers or newly developing industrial (mining) centers is to be expected. The provision of services, like water supply, solid waste management and waste water treatment is unlikely to keep up with this trend. This poses a potentially serious threat to the water resources at these locations with regard to water quantity as well as water quality.

6.4.2. Crucial social issues

In recent decades Mongolia's Human Development Index (HDI) has steadily increased. Presently Mongolia ranks 100 out of 169 countries and is considered a medium human development country. Life expectancy at birth increased considerable as did the mean years of schooling and the Gross National Income (GNI) per capita is rising.

However a number of issues persist: the number of people living below the poverty line increased in recent years, as did the gap between the affluent urban population and rural poor. Morbidity and mortality of children in rural areas and prevailing mortality in poor households and ger districts still raise concerns. Water related infectious diseases like hepatitis and diarrhea occur frequently, in 2010 12.5 thousand occurrences of these diseases were reported.

An important cause of these problems is the poor water supply and sanitation condition both in urban and rural areas. According to the MDG Implementation, Third National Report (2009) people in 115 soums of 17 aimags consume water which does not meet the standard requirements. Only three quarters of urban population and one third of rural population have access to sanitation that meets hygiene standards. Furthermore the average daily water consumption of ger area residents and rural herders of 5 to 10 liter is below the minimum consumption as recommended by the World Health Organization.

By improving the water supply, both in terms of quantity and quality, and in the urban as well as rural areas, the IWM Plan will contribute to improving the situation and contribute to MDG target #16 aiming to reduce the proportion of people without sustainable access to safe drinking water and basic sanitation.

From an historic and cultural point of view it can be stated that Mongolia has one of the few remaining nomadic cultures in the world. The poor maintenance and deterioration of many of the water supply points in the rural areas has contributed to the migration of herders to urban centers. Improvement of the water supply in (remote) rural areas will contribute to reverse this trend and support continuation of the nomadic lifestyle.

6.4.3. Crucial issues in food and agriculture

The food intake of the average Mongolian person constitutes mainly meat and flour products, and remains characterized by a low rate of consumption of fruits and vegetables. According to the report on malnutrition Mongolia's population has a malnutrition level of 25- 35%, whereas key indicators of poor nutrition and food consumption such as low-weight births, stunting, underweight, rachitis and anemia among the under-five-year-old children are still high and not decreasing at significant rates. In 2008 Mongolia still needed to import 70% of its wheat and 100% of its rice and sugar requirements and the global food price increases and rising costs of transporting have had an adverse effect on the nutrition and livelihood of vulnerable groups of the population.

Food safety is another important issue: according to the 2007 statistics, only 6.4% of the meat and 2.2% of the milk consumed were industrially processed, whereas other food products were processed without due veterinary and hygiene control. A National Program for Food Security (2009-2016) aims to improve the situation. The overall goal of the program is to ensure a sustainable supply of nutritious, secure and accessible food, which enables a healthy livelihood and high labor productivity of the population.

Back in 1989 Mongolia used 76% of its agricultural crop lands and the use was effective and beneficial. Mongolia was able to meet the domestic food demand and even to export wheat. After 1990 the situation dramatically changed for the worse only to take a turn for the better from 2000 and by 2010 Mongolia produced 100% of its wheat, 100% of its potato and 54% of its vegetable requirements using 50% of the arable land. The climate, mainly the short growing season and uneven distribution of rainfall, does pose a risk for rain-fed cropping, but by 2010 only some 37,000 ha is irrigated. Irrigation infrastructure is poorly maintained.

Pasture livestock husbandry plays an important role in the economy, employment and export revenues. The country is self-sufficient in meat and has an exportable surplus. After 1990 Russian import of Mongolian meat halted and developing of new markets has proven to be very difficult, mainly due to deteriorating hygienic processing conditions. Increasing numbers of livestock, changes in composition of the herds and herding practices increase the pressure on the land and have resulted in degradation of pastureland and desertification. The decrease in the number of operational wells for livestock watering, due to poor maintenance and unresolved ownership disputes, exacerbates this problem and hampers the development of the sector. A new Government policy on agriculture: the 'Mongolian National Livestock Program (2010)' aims to develop a livestock sector that is adaptable to changing climatic and social conditions and that is economically viable and competitive in the market economy, supplies safe and healthy food to the population, delivers quality raw materials to processing industries, and supports export earnings.

The NMWP will support to achieve MDG target 2: reduce by six times, between 1990 and 2015, the proportion of people who suffer from malnutrition.

6.4.4. Crucial environmental issues

Human activities, harsh winters, hot summers, and low rainfall put pressure on Mongolia's natural resources. Urbanization has accelerated rapidly, but environmental infrastructure, regulation and enforcement have not kept pace. As a result the urban environment has degraded considerably. Urban air quality is very poor due to increasing pollution from household heating, power generation, industry, and transport. In the database of the World Health Organization Ulaanbaatar ranks second on the list of world cities with high levels of air pollution with a level of airborne particles smaller than 10 micrometers that is four times the world average. Particulate matter and gaseous pollutants pose very serious health risks. Sanitation and sewerage coverage in the urban areas is very low, causing widespread contamination of surface and groundwater. Waste collection and management is very poorly organized.

Industrial development and lacking or poorly functioning water treatment facilities result in increasing levels of harmful pollutants being discharged to the soil, groundwater and surface water. Mining activities also result in water pollution, due to discharge of heavy metals and release of fine particles causing high turbidity with disastrous effects on aquatic life and the ecological system in general. Mining also causes destruction of riparian vegetation and disruption of the river morphology.

Increase of livestock numbers, changes in herding behavior/grazing patterns and breaking down of wells has resulted in an overuse of pasture land and an expansion of grazing grounds into formerly unused areas, including protected areas. Besides, the traditional herd composition has shifted and the number of goats, having a destructive grazing habit, almost doubled. These factors combined lead to an almost irreversible degradation of pastures and a reduction of the vegetation cover, thereby reducing the moisture storage in the soil, and leading to accelerated desertification processes.

In the forestry sector estimated harvesting levels are four times the sustainable annual allowable cut. A large proportion of the harvest is illegal. Frequent forest fires and pest outbreaks put further pressure on the resource.

Construction of dams and the creation of storage reservoirs affect the natural flows of the rivers, disrupt the connectivity and destroy spawning habitats. As a result fish stocks will decline and specific species might disappear from that basin.

On the long term, climate change might have a significant effect on temperature, precipitation and evaporation. For most parts of Mongolia the annual run-off is estimated to increase, but at the same time the seasonal and annual distribution of water resources are expected to become more erratic. The foreseen increase of the potential evaporation will lower soil moisture levels that will have a detrimental effect on the vegetation, accelerating the land degradation. Lake sizes and lake levels are expected to reduce and rivers and springs dry out more frequently during parts of the year.

Millennium Development Goal 7, Ensure environmental sustainability, and more in particular target 15: ‘Reduce the shrinking process of rivers and streams by protecting and rehabilitating their sources’, will be supported by the NMWP.

6.4.5. Green growth

Of late the concept of ‘green growth’ is rapidly gaining prominence in the development discussions internationally. In the context of water management ‘green growth’ and IWRM are complementary and mutually reinforcing approaches. The concept of green growth brings together the crucial economic, social and environmental issues described in previous sections. Sustainability is the key driver

Box 7. Green growth

Fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyze investment and innovation which will underpin sustained growth and give rise to new economic opportunities.

OECD, 2011

behind green growth. It responds to the growing recognition that economic growth and environmental stewardship must be complementary.

Green growth has been the major theme of Rio+20, the big international conference on sustainability, to make sustainable development a reality that includes economic growth and respect the limits of the earth's natural resources. Economic growth is and will remain for quite some time the first priority for Mongolia. The various MDG's cannot be met without growth. But sooner or later growth based on unsustainable practices will take its toll and on the long term the costs to remedy the damages created are likely to be much higher than the benefits gained at the short term. Green growth requires economists, decision makers and many others to find realistic solutions that take account of future natural resource scarcity and include environmental values into the economic analyses to fully assess overall wealth and well-being. As such it complements the more traditional view on economic growth and does not replace it. Green growth, however, does provide additional opportunities. Green economy investments such as in renewable energy (wind, solar) have proven to be financial beneficial, to create employment and are beneficial for the environment.

Green growth has many components. An important component is finding ways to reduce CO_2-emissions. But an equally important component is how we develop and manage our water resources. Water is a key driver for growth and human well-being. Developing the resource requires an IWRM approach. IWRM is based on the same principles as green growth. Water management can contribute to green growth by prioritizing the protection of the resource, maintaining the eco-systems and taking care of sustainable water availability for our needs now as well as for future generations. This includes the sustainable management and use of ecosystems as the 'green infrastructure' for growth and food and water security, but also to protect us from floods and droughts. Recycling and reusing both domestic and industrial wastewater multiplies the volume of water available for human use, and treating waste can produce energy. Productivity gains in agriculture is another essential tool to achieve green growth.

Summarizing, opting for green growth does not mean that everything has to be done different now. The main objective of our activities remains economic growth and increased human welfare. Green growth emphasizes the sustainability dimensions involved and IWRM offers the best suited approach to achieve it. It does ask for a rethinking of our way forward and looking for innovative approaches to reduce our demand for water and protect the resource. As such it will help to create new water market opportunities (e.g. in waste water treatment and more efficient water use technologies) and related employment.

6.5. IWRM in Mongolia

6.5.1. Mission and strategic goals of IWRM in Mongolia

The main purpose of the Integrated Water Management Plan is to support the government to achieve the six national development goals formulated in the MDG-based Comprehensive National Development Strategy (see Chapter 6.3.1). This is summarized in the mission statement for the IWM Plan that is formulated as:

Strategic goals for the IWM Plan logically follow from this mission statement for each of the broad policy fields of the MDG-based Comprehensive National Development Strategy (see Table 33 and Figure 48.

Table 33. Strategic goals for the IWM Plan and their key actors

Policy field	Strategic goals for IWRM	Key actors *)
Policy on human and social development	Meet the needs for affordable safe drinking water, sanitation and recreation and protection against floods of all Mongolians in pursuit of their development aspirations.	Ministry of Construction and Urban Development (for urban areas) Ministry of Industry and Agriculture (for rural areas) Municipalities
Policies on economic growth and development	Provide sufficient water of adequate qualities at the locations of economic activity for achieving Mongolia's economic growth and development ambitions.	Ministry of Economic Development Ministry of Industry and Agriculture Ministry of Mineral Resources Ministry of Energy
Environmental policy	Ensure sufficient quantities of water of adequate quality in Mongolia's water bodies, including groundwater, at all times to maintain, protect and sustain healthy and balanced ecosystems and protect the environment that is the source of water.	Ministry of Environment and Green Development
Legislative and state structure development	Have in place an institutional framework including legislation, organizational structures, equipment and capable human resources that will effectively, efficiently and equitably manage the water sector.	Government of Mongolia
*) Note: Names of the ministries as per August 2012.		

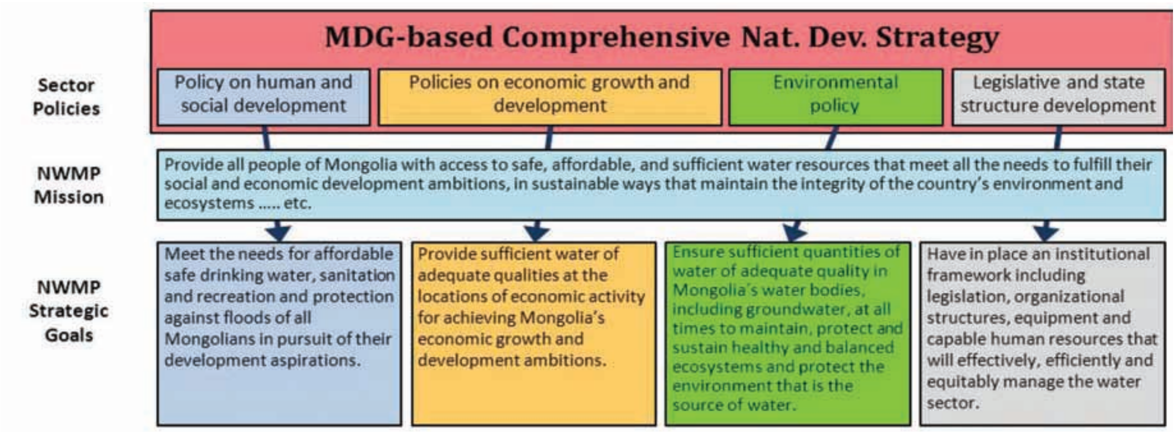


Figure 48. IWM Plan strategic goals and their link to the National Development Strategy

The strategic goals are interdependent and one sector's policy is likely to affect other policies. This, in combination with the (large) number of key actors demands effective coordination between the sectors. These are precisely the kind of issues where IWRM approaches focus on.

6.5.2. Aiming for a water secure Mongolia

The strategic goals mentioned in the previous chapter can be summarized as the aim to increase water security in Mongolia. Water security can be seen as the end goal of IWRM. Absolute water security will never be achieved. No matter how much is done, there will always remain a certain risk of droughts or floods, a breakdown of a water supply pipe or an accidental pollution to take place. These risks can

Box 8. Definition of water security

The availability of an acceptable quantity and quality of water for health, livelihoods, ecosystems and production, coupled with an acceptable level of water-related risks to people, environments and economies.

Grey and Sadoff, 2007

be minimized, but never completely eliminated. By investing in reliable infrastructure and taking care of an adequate management, water security can be increased to a socially acceptable level.

Water security is not only about having enough water. Water security includes all issues related to water. In simple terms, it addresses the ‘too little’, ‘too much’ and ‘too dirty’ issues in water management. These are the problems that people are facing and water management should solve, or at least, alleviate. At the same time, increasing the water security, considering the complexity of the concept can only be realized when all stakeholders act in a coordinated manner in a cooperative atmosphere without tensions between the stakeholders. In summary, water security should include:

- ensuring the availability of adequate and reliable water resources of acceptable quality;
- mitigating water related risks such as flood, drought and pollution;
- addressing the conflicts that may arise from disputes over shared water.

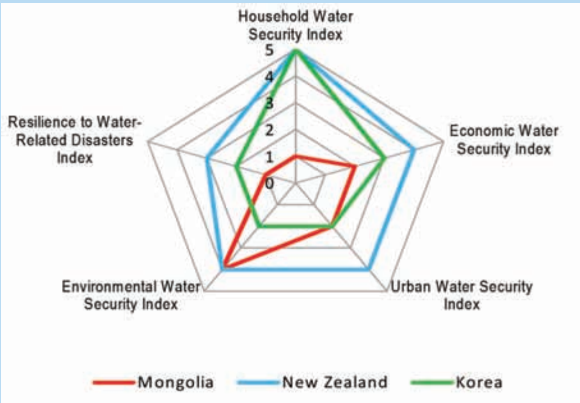
Water security as a concept is relatively new. There is no consensus yet on how to measure water security. The many dimensions involved in the concept make it impossible to express water security in just a single score or index, e.g. a number between 0 and 10. Moreover, the importance of the various dimensions will differ depending on the situation and the severity of the problems. What may be extremely important in water management in one country (e.g. coastal protection in Japan) does not even exist at all in another country (e.g. Mongolia). Similarly, water security at a national level will be different from water security at basin or community level. Nevertheless, it is possible to derive a structure that supports water managers and decision makers to describe what they mean with water security in their particular case and define indicators to quantify them.

Till now no universal structure has been developed that is generally accepted or applicable. The Asian Water Development Outlook (AWDO, 2012) uses 5 key dimensions and a scoring from 1 to 5 for each dimension. Scoring is done based on expert judgment taking into account specific points of attention. The resulting scores can be presented in a radar plot as in Box 4. The approach can be used to compare the water security of countries or of river basins. The AWDO (2012) describes the results of a comparison between all countries in the Asia-Pacific Region, including Mongolia. As shown in the box, the AWDO (2012) concludes that Mongolia is still far away from becoming a water secure country (New Zealand is one of the highest scoring counties

Box 9. Water security Indexes

Five key dimensions of Water Security for river basins

7. Satisfy **household** water and sanitation needs in all communities
8. Support productive **economies** in agriculture and industry
9. Develop vibrant, livable **cities** and towns
10. Restore healthy **rivers** and ecosystems
11. Build resilient **communities** that can adapt to change.



Asian Water Development Outlook, 2012 (*in print*) in the AWDO list; Korea is a country that is well known in Mongolia making it easier to compare). This IWM Plan describes the water management strategy that will improve the water security of Mongolia. It is a step in a continuous process to become a more water secure country.

Increasing water security calls for an adaptive management process. The social, economic and environmental context is bound to continuously change. IWRM provides the process to generate a virtual spiral of progress and adaptation as illustrated in Figure 50 (UNESCO, 2009). The spiral visualizes that through the collaborative and incremental approach of IWRM, the economic, social and environmental benefits can be increased of water resources in river basins and their groundwater aquifers. The incremental approach means that issues are tackled gradually, step-by-step, and that it is not necessary to try to solve all issues for 100% immediately. The same approach applies to this national plan. IWRM as a process of adaptive management – resulting in a spiral of progress

6.5.3. Water sub-sectors for IWRM

Water resource management is not an objective by itself. The objective of water resource management is to support other sectors to realize their aims, including the sector 'Environment'. For each of the sector development policies of the National Development Strategy a Water Sub-sector can be distinguished that focuses specifically on supporting that particular sector development policy.

Figure 49. Framework for IWRM

The internationally most common depiction of IWRM is shown in Figure 49 (GWP 2000). The same water sub-sectors shown here also logically follow from the sector development policies defined in the National Development Strategy (see Figure 51).

The most crucial aspect of IWRM is the integration of these water sub-sectors and integration starts with effective co-ordination. This requires considerable institutional adaptations ranging from establishing new or restructuring existing organizations and changing existing planning procedures. In IWRM terms this means setting up an 'enabling environment' that is geared to realizing the required cross-sectoral integration, and includes:

- clear policies, solid legislation and political commitment to implement these policies and legislation;
- an effective institutional framework comprised of capable, financial sound and adequately mandated institutions at national and regional level; and
- management instruments that enable these institutions to implement the needed activities
- This enabling environment can be

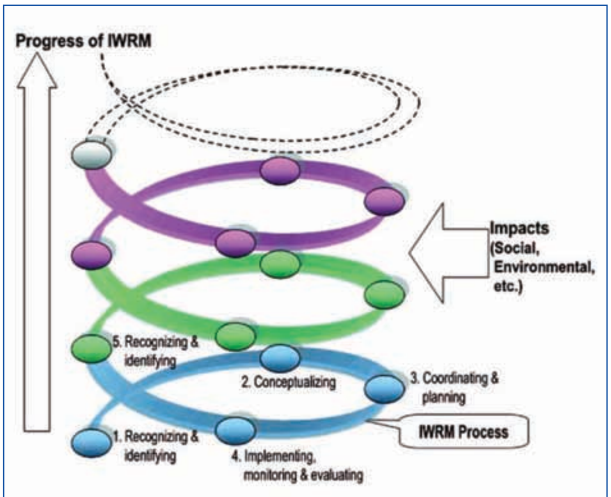


Figure 50. IWRM as a process of adaptive management– resulting in a spiral of progress

considered the fifth sub-sector of integrated water management, or better even the first sub-sector, as it forms an important boundary condition for effective and efficient coordination of the other four sub-sectors.

In the context of the National Development Strategy the institutional reforms needed to develop an enabling environment would fall under the 'Legislative and state structure development', with which the structure of this national Water Management Plan becomes a perfect fit for supporting the National Development Strategy (see Figure 51).

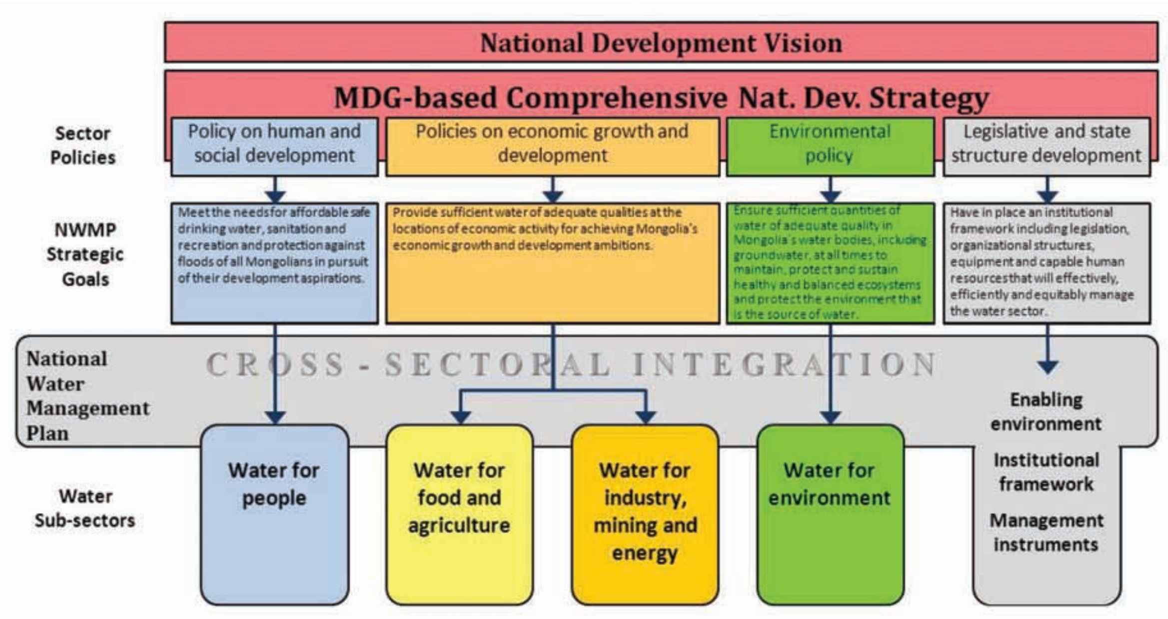


Figure 51. Water Sector Development and sub-sectors in relation to national development policies

6.5.4. Issues, measures and strategy components

The five sub-sectors form the basis on which the Integrated Water Management Plan has been developed. The next chapters provide the content of the IWM Plan. For each of the five sub-sectors an analysis was made. This includes an assessment of the performance of each sub-sector to support the socio-economic sectors, now and in the future. When that performance is less than required we can identify a number of challenges and these challenges comprise of a number of inter-related issues. Measures need to be taken to resolve those issues. A consistent set of measures makes a strategy.

Any measure that can be conceived to address water management issues would fall in any one of the following five categories:

1. Providing sufficient water of adequate quality	*2. Improving water use efficiency*	*3. Protecting the water resources*	*4. Improving the management of water*	*5. Preventing, and mitigating impacts of, water calamities*

1. *Providing sufficient water of adequate quality.*
   This category includes all kinds of measures that would bring (more) water or improve water quality to locations where specific water (quality) demands have been identified, such as constructing or repairing pipelines; drilling or regenerating boreholes; constructing or renovating treatment plants; building dams; etc. Most of these measures would be classified as 'Supply Management'.

2. *Improving water use efficiency.*
   This category includes all those measures that are designed to use less water or in other words to reduce the demand for water, such as reducing leakages; reuse of (waste) water; water metering; improving irrigation practices; etc. Most of these measures would be classified as 'Demand Management'

3. *Protecting the water resources.*
   This is a category for all those measures that are designed to preserve, improve or restore the quantity and quality of the water resources, such as protecting run-off forming areas; curtailing human and economic activities in specific areas; constructing or repairing waste water treatment plants; etc.

4. *Improving the management of water.*
   This category includes all measures that are designed to improve the management of the water and the water system and covers all sorts of monitoring activities; setting up effective management organizations that can avail over sufficient and capable staff, equipment and financial resources; training of water professionals; laws and regulations; etc.

5. *Preventing, and mitigating impacts of, water calamities.*
   This is the category that includes all the measures designed to prevent or deal with water calamities like floods, droughts or pollution accidents such as constructing flood protections or diversion channels; mobilizing rain generators; etc.

These five categories are not entirely new, but can be found in one form or the other in most water management plans ever made in one form or the other. For instance Mongolia's Water National Program (2010) formulated six strategic goals, which when analyzed closely comprise exactly these five categories. For this Integrated Water Management Plan these five categories form the five components of the water management strategy (see Figure 52).

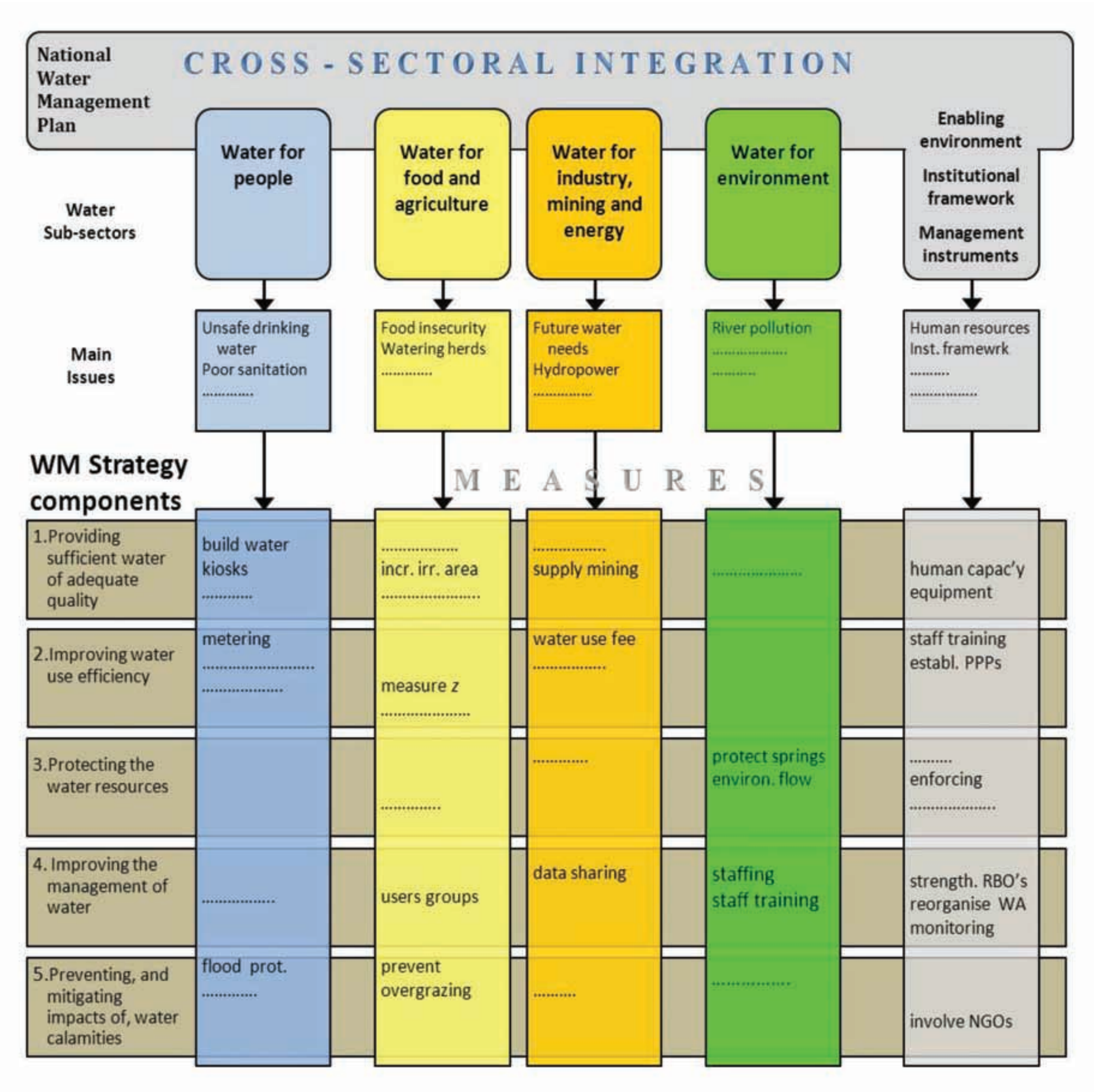


Figure 52. Structuring of issues and measures

To tackle a challenge several issues need to be solved and quite a number of measures may be required in combination; each measure will fall in one of the five strategy components. Each strategy component comprise a cluster of measures that address issues in different water sub-sectors. The strength of IWRM is to come up with single measures that address issues in several sub-sectors instead of each sub-sector designing measures to only address the issues in their own sector. A second strength of an IWRM approach is to timely recognize those measures that are designed to deal with issues in one sector but have a potential negative effect on another sector, e.g. constructing a diversion weir in a river to irrigate hayfields may change the downstream river ecology. When such potential threats are recognized early, many more (cheaper or effective) options are available to mitigate or even prevent such negative effects, then when the 'damage' has already been done.

The challenges, the issues and the possible measures to solve these issues are described in Chapter 7. The selected measures are combined into the strategies of the IWM Plan and are presented in Chapter 8.

PART E – THE ISSUES and how to address them

Water resource development aims to support the socio-economic sectors to achieve their goals: e.g. provide drinking water supply and sanitation for human well-being and development, hydropower development for energy, irrigation development for food security, etc. IWRM planning specifies the measures that have to be taken to ensure the sustainable development of these sectors and to resolve any issues related to the quantity and quality of the water and ecosystems. This should be done for the present situation as well as for the future, to make sure that Mongolia is prepared for any possible developments the country might face. In short: to enhance Mongolia's water security

The previous chapter ended in a description of the sub-sectors the government distinguishes in the field of water management: Water for People, Water for Food, Water for Industry, Mining and Energy and Water for Environment. To effectively solve the issues connected to these sub-sectors an enabling environment is required which comprises clear policies, laws, institutions and reliable and quantified information. Providing this enabling environment is the fifth sub-sector for the government.

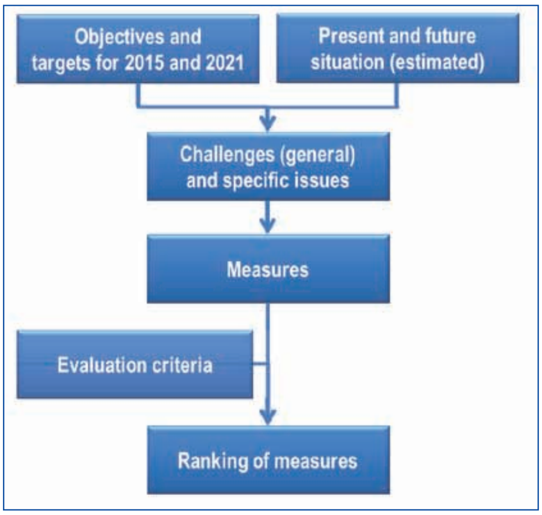


Figure 53 Flow diagram of the analysis

This chapter will look at each of the five sub-sectors analyzing the water situation as shown in Figure 53. Comparing the present situation and the objectives and targets for 2015 and 2021 determines the challenges for achieving those targets. To be prepared for the future we have to estimate how the future will look like. These estimates are called scenarios and are described in Chapter 7.1. The balance between demand and supply is given in Chapter 7.2. The challenges and issues of the sub-sectors are described in detail in Chapter 7.3. Once the issues that need to be resolved are clear measures can be defined. The measures that have to be taken to solve the issues are the subject of Chapter 7.4. Based on a set of evaluation criteria the measures are then screened to identify the most promising measures in Chapter 7.5.

7. Water sector issues

7.1. Scenario's – how to deal with an uncertain future

7.1.1. Why scenarios – definitions

The Integrated Water Management Plan addresses the future and this future is uncertain. The water sector has to support the socio-economic objectives of the government, e.g. to provide the people with access to sufficient drinking water of good quality, to provide water to herders to water their livestock and to farmers to irrigate their lands when there is insufficient rainfall. But how many people will there be in future and where will they live? How big will be the livestock and what will be its composition? How much area needs to be irrigated and which crops will be grown?

This determines the demand for water. At the other hand the supply of water may change because of climate change. Will there be more water available or less? All these uncertainties are beyond the control of the water resources planners and have to be captured in scenarios. By developing alternative scenarios different possible futures can be analyzed with the aim to find the best strategy to deal with these uncertain futures.

The IWM Plan has taken the year 2010 as the starting point of the analysis. This is the base year. For that year all required data is available. The planning horizons are 2015 for the short term and 2021 for the midterm. As outlook for the longer term the years 2040 and 2080 are used, in particular to test the strategies on robustness to climate change which effects will only become visible at such longer time scale. The years 2015 and 2021 are also the planning horizons used in the MDGs-Based Comprehensive National Development Strategy of Mongolia and the National Water Programme.

7.1.2. Scenario elements

Scenarios represent assumptions of developments that may happen in the future, beyond the control of water resource managers. These future developments influence both the demand and the supply and have to be taken into account when decisions are made on water resource development in Mongolia. For each of the water using socio-economic sectors and for the supply three possible future outlooks (scenarios) have been developed:

- *Medium scenario:* follows the trend and expectations of responsible organizations;
- *Low scenario:* provides a low estimate of relevant developments; and
- *High scenario:* provides a high estimate of relevant developments.

Demand related scenario elements

Mongolia is developing rapidly. The fast-growing economy is fuelled by the development of the mining and industrial sector. The economic growth also affects the degree of urbanization, in particular at Ulaanbaatar. The most important socio-economic scenario variables and key factors for determining the water demands within the context of the IWM Plan are:

- Population:
  - population numbers divided in urban and rural population;
  - water supply coverage (private connections, kiosks, natural water sources)
  - domestic water consumption norms; and
  - the need for sanitation facilities and waste water treatment;
- Municipal services:
  - type of service, number of water users and water consumption norms;
- Industries, mines and energy production:
  - type of industries, numbers, production size and water consumption norms;
  - type of mines, exploitation size and water consumption norms;
  - type of energy production, production size and water consumption norms;
  - the need for waste water treatment; and
  - introduction of improved technologies, water reuse and water loss reduction;
- Agriculture:
  - total livestock numbers, composition of the stock and water consumption norms;
  - irrigation area, type of crops and crop water requirements;
- Tourism:
  - numbers and location
  - the need for sanitation facilities and waste water treatment;

- Environment:
  - area for tree-planting or reforestation and water consumption norms; and
  - required environmental flows to sustain ecological values.

Estimates are made on how these variables will develop and grow for three scenarios: medium, low and high on the basis of specific assumptions. These assumptions are listed in Table 24. The accordingly calculated water demand in each water basin in the years 2015 and 2021 is described in Chapter 7.2.1 and presented in Table 26 and Table 27.

Supply related scenario elements

The availability of surface water in Mongolia is mainly determined by rain- and snowfall and by evaporation. These elements are stochastic by nature and vary year by year. Global warming and related climate change influence these variables, both with respect to their absolute value as well as their variability over space and time. Changes in temperature also affect glaciers and permafrost conditions which have impacts on river discharges. The future impact of climate change in Mongolia is still very uncertain (see also Chapter 2.2.2) and will only become evident on the long term. For that reason additional time horizons of 2040 and 2080 are used to analyze the impacts of climate change. The analysis for 2015 and 2021 in the IWM Plan is based on the present climatic conditions.

For the effects of climate change on river runoff three scenarios have been developed as explained in Chapter 3.3.1: a Central Scenario, a Wet Scenario and a Dry Scenario. The words ‘Dry’ and ‘Wet’ refer to a condition relative to the Central Scenario and should not be mistaken to mean that under the ‘Dry’ the runoff will decrease and under the ‘Wet’ Scenario the runoff will increase compared to the present situation. Accordingly it is possible that calculations for the ‘Wet” Scenario result in runoff that is less than the present runoff when the Central Scenario predicts a considerable decrease of the runoff, and similarly it is possible that calculations for the ‘Dry’ Scenario result in runoff that is much higher than the present runoff when the Central Scenario predicts a considerable increase of the runoff.

The results in terms of runoff of the three climate scenarios for the time horizon 2080 have been described in Chapter 3.3.1 for three seasons: Spring (March-May), Summer (June-August) and Autumn (September-November). The Central Scenario suggests that for nearly all basins in spring the runoff is likely to increase. The increase is more in the basins in the western part of the country. Here the increase of the runoff can reach up to 40%. This can be explained by the expected increase of snowfall in winter, in combination with an increasing temperature in springtime. In spring the thicker snow cover will melt more rapidly. This combination leads to an increase in spring runoff, particularly in the higher mountain regions. Also the summer runoff shows a positive trend. In basins where significant runoff occurs, these increases tend to remain below 20%. It seems that the increase in rainfall is more than the increase in actual evaporation. This is remarkably as the rise of the potential evaporation, which is already much higher than the rainfall, is expected to outrun the increase in rainfall in the summer. This is discussed below. In the autumn the pattern is more or less similar to that of the summer, although the increase in runoff is slightly more than in summer. In respect of the winter runoff, the results suggest a slight decrease in some basins, but, considering that during the winter season the volume of the runoff is very low, these changes do not have a great impact on water management.

The availability of groundwater is not subject to the above three scenarios. Climate change affects the groundwater resources indirectly only by changing conditions of infiltration of surface water and precipitation to the groundwater. It is therefore safe to assume that the estimated potential exploitable groundwater resources do not change significantly in the near future.

The available surface water and groundwater resources are described in Chapter 7.2.2 and summarized by water basin in Table 34.

7.2. Demand and Supply – an integrated water balance for Mongolia

7.2.1. Developments in demand

With an increase in population, urbanization, welfare and economic activities the demand for water is likely to go up. Increased activities do not necessarily mean that more water will be needed. Improved technologies and reduction of losses could result in less water consumption per unit of activity. For example it is expected that the norm water use of apartments connected to the central system will go down to 200 and 160 l/day/person in 2015 and 2021 respectively.

In calculating a water balance it is possible to make a distinction between total use (withdrawal) and net use (withdrawal minus discharge). Many activities make use of the water for a specific purpose and after they have done that, discharge a major part of the water back to the water resource system, either directly to the river or to the groundwater. The net use is the part that is not returned to the system and can consist of water that is being lost in the water use process or is evaporated (e.g. in agriculture). The net use of drinking water systems is often in the range of 20-40%, for irrigated agriculture 60-80% and for industries applying water reuse 10-30%. For hydropower plants the net use of water is usually very small, less than 5%, as the actual water use consists of evaporation and other water losses from the reservoir only. The water use by hydropower plants therefore was not included in the water balance calculations.

The water balance presented in Chapter 7.2.3 compares for each water basin the total water demand and not the net water demand with the water resources. The often in comparison very small size of the water demand does not warrant a further analysis of the reduced quantity of the net water demand. And anyway at most locations the calculated water demand has to be retrieved from the water resources and any discharged volume of water will be available only for locations further downstream in the water basin.

Another important distinction for the water balance is between green water and blue water. Green water is the water that is directly used from rainfall. Green water can only be used at the spot where the rain falls, making use of the limited storage of unsaturated groundwater available in the root zone. Blue water is the water that is available in rivers, lakes and reservoirs and as saturated groundwater. This water can be used to supply a demand elsewhere. The distinction between green and blue water is especially important in agriculture as the agricultural water demand is supplied by green water (rainfed agriculture) and blue water (irrigated agriculture). The water balance presented in Chapter 7.2.3 only includes the blue water.

The water consumption and water use in 2010 and the water demand in 2015 and 2021 are presented in Chapter 5. The demands for 2015 and 2021 are based on the estimated growth rates as described in Table 24. Detailed information by water basin is summarized in Annex 2.

7.2.2. Developments in supply

Surface water

The availability of water in Mongolia and observed developments in the supply are described in detail in Chapter 3. A particular phenomenon of the supply is its variability, both within the year and between the years. Traditionally people have been able to adjust their lives to the variability within the year, e.g. by moving with the livestock to the rivers in the summer and to the mountains in the winter. The variability over the years is more difficult to cope with. Records show that Mongolia has experienced multi-year wet periods and multi-year dry periods. Recent years have been relatively dry. Figure 18 and Figure 54 illustrate this variability over the years and the relative dry periods in the 40s, the end 70s and since 1996.

Source: Davaa, 2011

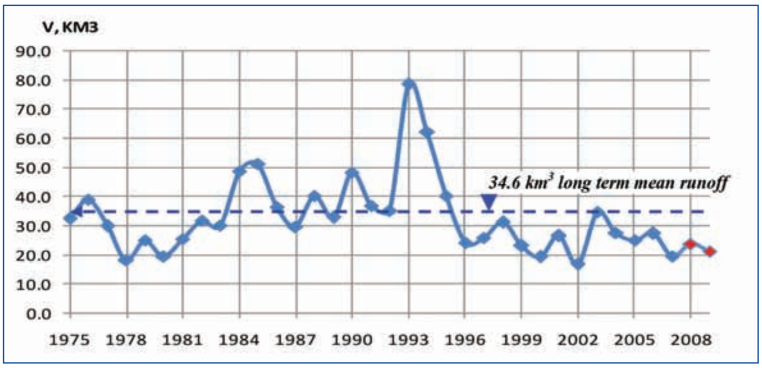


Figure 54 Long term variation of surface water runoff of Mongolia

This variability should be taken into account when assessing whether Mongolia has sufficient water to meet its needs. This means that not only the average availability (50%) should be considered but also the lower availabilities, e. g. 20% dry (the once in 5 years low runoff) or 10% dry (once in 10 years low runoff). The water balance presented in Chapter 7.2.3 includes the 50% and 10% availability of surface water.

Although the data presented in Figure 54 may seem to suggest so, there is no scientific evidence for changes in runoff due to climate change. The observed low runoff of the last 15 years still remains completely within the ranges of normal climate variability. On the contrary, actually most climate models, as mentioned in Chapter 2.2.2, predict a (slight) increase in rainfall resulting in an increase of the runoff. Even if climate change does result in changes in the runoff, these changes will be small compared to the normal variability and will only become evident on a much longer time scale than the time horizon of 2021. For this reason it has been assumed for the IWM Plan that by 2021 climate change will not have had a significant impact on the surface water resources situation and that the (expected) supply until 2021 will only be subject to the normal variability, without adding a climate change effect on top of that.

Besides varying in time, the supply also has a strong variability in space with most of the rainfall falling in the north of the country, while rainfall in the south (Gobi) is much smaller. This spatial variability should be taken into account, not only between basins but in many cases also within the basins.

Groundwater

The potential exploitable groundwater resources are described in Chapter 3.4.2. The groundwater constitutes a permanent source used all year around for water supply of people, livestock and industries. The potential exploitable groundwater resources indicate the groundwater volume which may be abstracted from a unit area. The actual exploitable groundwater resources depend on the area which may be developed for groundwater abstraction and the possible yields of boreholes and therefore are smaller than the potential exploitable groundwater resources. Local groundwater investigations are required to identify the actual exploitable groundwater resources. For the Integrated Water Management Plan it is assumed that the potential exploitable groundwater resources will not change significantly due to climate change and thus will remain the same as at present.

A distinction should be made between renewable and non-renewable groundwater. Renewable groundwater is recharged annually and the exploitable groundwater resources equal the potential infiltration of surface water or precipitation to the groundwater. Non-renewable or fossil groundwater is not recharged annually and the abstraction of this groundwater will lead to a depletion of the exploitable groundwater resources.

Although by definition the use of non-renewable groundwater is not sustainable, there are circumstances when the use could be justified. For example in a case where the water use is very small compared to the available source (e.g. small rural and urban domestic use in the Gobi) or in cases where it is used as a bridging measure while preparing a more permanent and sustainable supply (e.g. reservoir or trans-basin transfer). In all other cases the exploitation of non-renewable groundwater is like mining minerals – it can only be done once. This means that its abstraction can only be considered when the added value for its use is very high.

At present about 80% or more of the water use-consumption by people and industries in Mongolia is supplied from groundwater. Recently discussions are broadly focused on changing this situation and to increase the percentage of the surface water resources in the water supply. However in some areas groundwater resources are dominantly available to be used for mining and irrigation rather than surface water resources. It's clear that this is contradictory. The aim here is neither to prefer surface water to groundwater nor to cause any dispute, but to support the most appropriate measure to be taken in dealing with this issue.

In the National Security Concept of Mongolia (2010) it was stated that 'groundwater investigations, funded by the state budget, are to be carried out and hydrogeological maps are to be drafted to re-determine and formalize the groundwater resources and to improve databases, monitoring network and capacity of research institutes'. But the enforcement has been delayed and it is still unclear as the responsible organisation has not been assigned so far.

There are a number of groundwater investigations that were carried out by organisations and people interested in mining the natural resources. These investigations are obviously different from each other in terms of methods, equipment and time. And the quality of these investigations may vary. Therefore, groundwater resource investigations need to be started urgently in Mongolia using a systematic and integrated approach. In this approach the quality and the dynamics of the groundwater would be an important indicator.

In case in a certain area such groundwater investigations indicate that future demand can not be fully supplied from the groundwater resources, it should be allowed to use the groundwater resources within the accepted limit of the renewable groundwater resources. And to find and use other resources to supply the remaining demand. These other resources could be accumulated flood water in basins where surface water resources are relatively abundant and to transfer the water to the basin with a shortage in water resources.

7.2.3. Water balance for Mongolia as a whole and by basin

Water balances at the national and water basin level provide a first indication of the condition of the water resources of the country to support the water-using socio-economic activities in a sustainable way and of the potential to further develop the water resources. A positive water balance (more resources than demand) does not always mean that there are no issues because there is always a strong spatial and temporal variability of the supply and demand.

An overview of the current and future water demand of the years 2010, 2015 and 2021 in relation to the water availability (or water supply) by basin is given in Table 34. In the table the total basin demand from surface water and groundwater can be compared to the available total surface- and groundwater resources. The water balance of the water basins is presented with more detail in the water basin summaries in Annex 2.

The water resources include the annual surface water and groundwater resources with an important difference that surface water resources are abstracted from variable flow while groundwater resources are abstracted from storage. The surface water resources represent the annual river flow after subtracting the required environmental flow. The environmental flow is determined based on percentages provided for all river basins in the "Surface water Monograph" (Davaa, Myagmarjav, 1999). The groundwater resources represent the annual volume of the potential exploitable resources and the exploitable resources. The exploitable groundwater resources are used in the water balance.

The table shows that the total demand is smaller than the available potential groundwater and surface water resources in all basins. However one must realize that the demand is supplied from either surface water or groundwater resources and that often the demand is concentrated in one location while the available resources are distributed over the basin area. Therefore existing water demands need to be compared with the locally available surface water and exploitable groundwater resources. This should be done in each water basin water management plan.

When comparing the total of the available surface water resources in a dry year (the 10% surface water availability) and the exploitable groundwater resources with the future water demand in 2021 (see Table 34 last column) then it appears that the water demand is less than 50% of the total resources in 14 out of the 29 basins. In the other 15 water basins the demand is more than 50% of the total resources and in these water basins further exploration of the water resources should have priority to be ready to supply the demand in dry years.

To indicate the water balance by water basin a general classification was made dividing the basins in four classes based on available water resources and future water demand. The classification for the groundwater resources as based on the exploitable groundwater resources is shown in Figure 55. The classification for the surface water resources determined for the 50% and the 10% availability is shown in Figure 56.

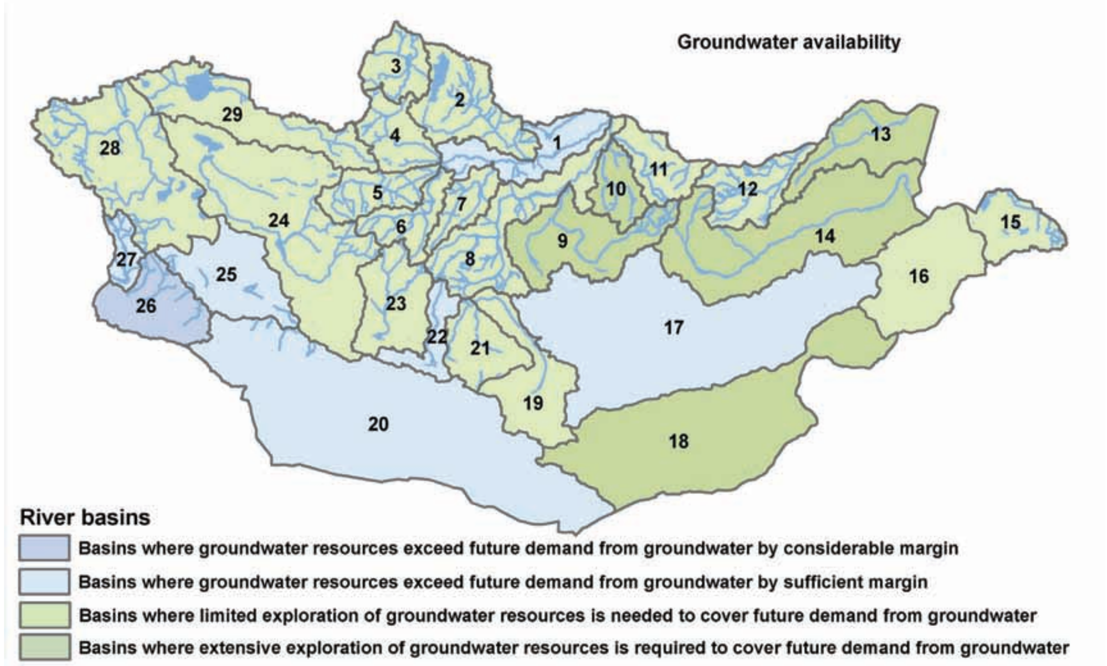


Figure 55 Classification of water basins according comparison of available groundwater resources and the demand from groundwater

The classification used for the groundwater resources is:

(1). exploitable groundwater resources exceed demand by considerable margin (future demand less than 10% of exploitable resources),

(2). exploitable groundwater resources exceed demand by sufficient margin (future demand less than 50% of exploitable resources),

(3). limited exploration of exploitable groundwater resources is required (future demand more than 50% of exploitable resources) and

(4). extensive exploration of exploitable groundwater resources is required (future demand more than 100% of exploitable resources).

The potential groundwater resources exceed the exploitable groundwater resources in all basins and it is expected that the future demand from groundwater can be supplied from the unexplored groundwater resources in water basins where the demand exceeds 50% of the groundwater resources. This is the case in 22 out of the 29 water basins with extensive exploration activities expected in 5 water basins.

Further exploration of groundwater should be organized in line with the government policy to limit the use of groundwater and stimulate the use of surface water as describe above. In areas without surface water, exploration of groundwater seems the best option however because the use of local groundwater resources is generally cheaper than transferring surface water to the area over large distances.

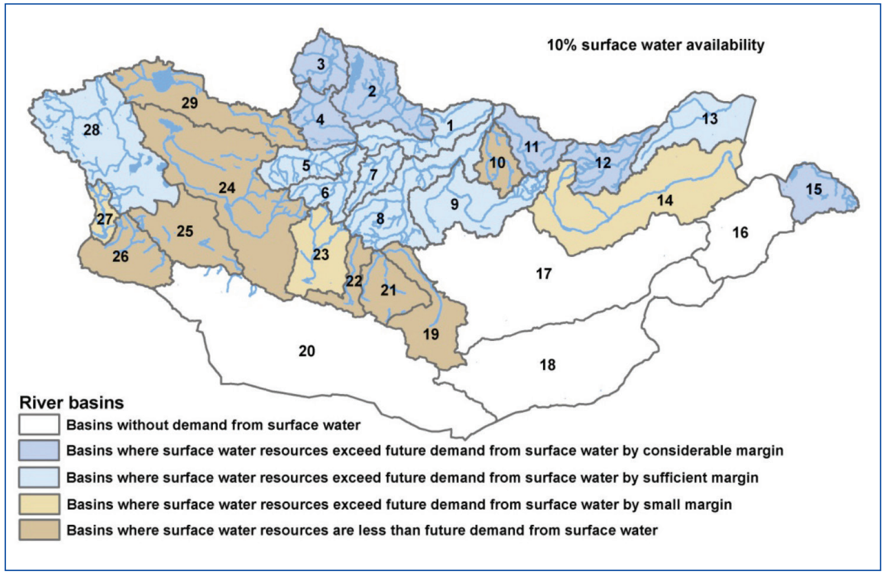
The classification used for the surface water resources is:

(1). surface water resources exceed demand by considerable margin (future demand less than 10% of exploitable resources),

(2). surface water resources exceed demand by sufficient margin (future demand less than 50% of exploitable resources), (3). surface water resources exceed demand by small margin (future demand more than 50% of exploitable resources) and

(4). surface water resources are less than future demand (future demand more than 100% of exploitable resources).

Water basins of class 3 and 4 with a future water demand which is more than 50% of the surface water resources are shown with a brown color to indicate that in these basins (locally) future demand may exceed the available water resources. This concerns 8 water basins for the 50% and 11 water basins for the 10% availability of the surface water resources.



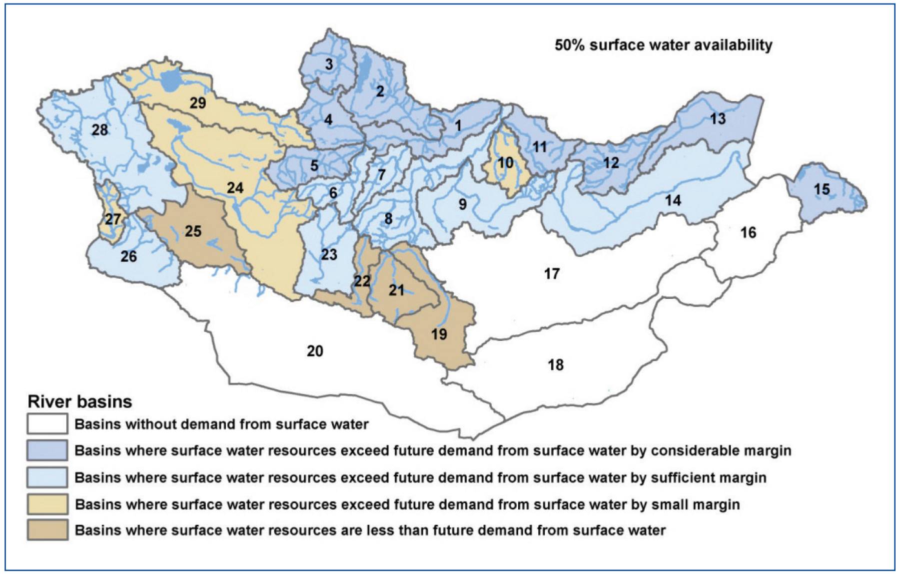


Figure 56. Classification of water basins according comparison of available surface water resources and the future demand from the surface water

Table 34. Water balance by water basin

Nr	Name	Demand (medium scenario, million m³/year)									Groundwater availability (million m³/year)		Surface water availability (million m³/year)		2021 total demand as % of total resources
		2010			2015			2021							
		SW	GW	Total	SW	GW	Total	SW	GW	Total	Potential	Exploitable	50%	10%	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	K / (M + O)
1	Selenge*	8.5	23.4	32.0	14.1	29.3	43.4	20.8	36.7	57.5	697.0	90.3	277.3	165.2	22.5
2	Khuvsgul Lake - Eg	1.5	1.0	2.5	2.1	1.4	3.5	2.8	2.0	4.8	432.0	0.2	401.1	276.2	1.7
3	Shishkhid	0.5	0.3	0.8	0.8	0.4	1.2	1.0	0.6	1.6	206.0	0.2	39.0	29.6	5.5
4	Delgermurun	1.4	1.7	3.1	1.8	2.4	4.1	2.0	2.9	4.9	229.0	2.7	81.0	47.6	9.8
5	Ider	1.7	0.8	2.5	2.5	1.1	3.6	3.3	1.3	4.6	129.0	0.5	53.3	29.7	15.2
6	Chuluut	1.3	0.9	2.2	1.9	1.3	3.2	2.4	1.7	4.1	86.0	0.1	13.9	6.2	65.5
7	Khanui	1.6	1.0	2.6	2.1	1.4	3.5	2.5	1.7	4.2	96.0	0.2	13.9	11.8	35.0
8	Orkhon*	16.9	12.1	29.1	27.6	17.4	45.0	40.3	21.2	61.5	838.3	26.7	221.6	99.7	48.7

Nr	Name	Demand (medium scenario, million m^3/year)									Groundwater availability (million m^3/year)		Surface water availability (million m^3/year)		2021 total demand as % of total resources
		2010			2015			2021							
		SW	GW	Total	SW	GW	Total	SW	GW	Total	Potential	Exploitable	50%	10%	
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	K / (M + O)
9	Tuul	7.9	82.3	90.2	10.4	110.5	120.9	10.5	133.5	144.0	637.7	142.8	63.1	30.5	83.1
10	Kharaa	7.3	19.8	27.1	11.9	26.0	37.9	17.4	37.0	54.5	182.0	52.6	25.9	12.8	83.1
11	Eroo	2.3	1.0	3.3	3.6	2.0	5.6	5.3	3.2	8.6	239.0	0.6	196.2	112.1	7.6
12	Onon	0.8	0.8	1.6	1.1	1.1	2.2	1.3	1.5	2.9	344.0	0.6	259.0	230.8	1.2
13	Ulz	0.7	4.2	4.9	1.0	12.0	13.0	1.3	16.0	17.2	320.0	26.4	22.7	3.8	57.0
14	Kherlen	8.8	14.8	23.6	12.2	20.0	32.1	16.9	26.1	43.0	721.0	43.9	59.5	28.4	59.5
15	Buir Lake - Khalkh	0.6	0.3	0.9	0.6	0.9	1.5	0.9	1.2	2.2	198.0	1.1	102.3	54.9	3.8
16	Menengiin Tal	0.0	2.4	2.4	0.0	2.6	2.6	0.0	2.9	2.9	168.0	0.1	0.0	0.0	2895.7
17	Umard Goviin Guveet - Khalkhiin Dundad Tal	0.0	12.0	12.0	0.0	15.9	15.9	0.0	18.2	18.2	433.0	46.7	0.0	0.0	39.0
18	Galba-Uush - Doloodiin Govi	0.0	5.2	5.2	0.0	26.6	26.6	0.0	42.6	42.6	352.0	59.0	0.0	0.0	72.2
19	Ongi	1.9	3.4	5.3	2.7	4.6	7.4	3.7	6.1	9.8	294.0	5.8	1.0	0.3	161.1
20	Altain Uvur Govi	0.0	6.2	6.2	0.0	10.4	10.4	0.0	15.1	15.1	337.0	65.5	0.0	0.0	23.0
21	Taats	0.8	1.0	1.7	1.0	1.3	2.3	1.3	1.5	2.8	61.0	0.5	0.9	0.3	353.5
22	Orog Lake - Tui	2.7	1.4	4.1	4.4	2.1	6.5	6.5	2.6	9.1	33.0	5.9	2.6	0.9	134.0
23	Buuntsagaan Lake – Baidrag	3.3	1.2	4.5	5.3	1.6	6.9	8.2	1.9	10.2	174.0	2.9	22.7	12.9	64.3
24	Khyargas Lake – Zavkhan	12.6	4.0	16.5	20.8	5.2	26.0	31.1	6.2	37.3	892.0	10.0	44.9	22.8	113.7
25	Khuisiin Govi - Tsetseg Lake**	5.9	1.7	7.6	10.2	2.2	12.4	15.6	2.5	18.1	493.0	8.1	0.0	0.0	224.0
26	Uench - Bodonch	0.6	0.6	1.1	0.9	0.7	1.6	1.3	0.8	2.2	237.0	11.3	2.7	1.1	17.4
27	Bulgan	1.9	0.2	2.1	3.1	0.3	3.4	4.6	0.4	5.0	86.0	0.0	8.3	5.7	87.9
28	Khar Lake - Khovd	12.8	3.8	16.6	20.6	5.3	25.9	30.2	6.4	36.6	684.0	12.7	115.8	80.8	39.1
29	Uvs Lake - Tes	13.2	2.2	15.4	22.0	3.0	25.0	33.0	3.8	36.8	405.0	6.1	63.1	29.8	102.5
	Mongolia total	117.5	209.6	327.1	184.5	308.9	493.4	264.5	397.7	662.2	10,004.0	623.4	2,091.7	1,294.1	

Explanation: Groundwater availability: Potential resources based on aquifer properties and renewable resources;
Exploitable resources based on approved groundwater deposits.
Surface water availability: Available resources after subtracting environmental flow: 50% means available in an average year, 10% means available in a dry year with probability of once in 10 years; the surface water resources include the surface water which is generated within the river basin only; inflow from other upstream river basins is not included.
2021 total demand as % of total resources: total resources based on sum of exploitable groundwater resources and 10% surface water resources

Remarks: * Demand of Erdenet mine is located in Orkhon river basin but is supplied by transfer from groundwater resources in Selenge river basin and therefore is added to total water demand of the Selenge Basin: 15.118 million m^3/year in 2010, 15.5 million m^3/year in 2015 and 16 million m^3/year in 2021.
** Khuisiin Govi - Tsetseg Lake basin has demand from surface water for irrigation but surface water resource was not estimated

The overall conclusion from the water balance is that in almost all water basins further exploration of the water resources is needed to meet the future demand during average years and during dry years. Especially in many water basins groundwater resources need to be explored further to supply the demand from groundwater. The potential groundwater availability is large and sufficient groundwater resources are expected to be available. However locally it may be difficult to find the required volumes, e.g. at Ulaanbaatar or near large mines in the South. In such situations the solution may be to reduce the water demand by promoting more efficient use of water or to increase the water availability by storing water in reservoirs or by transferring water from other basins with abundant water resources.

7.2.4. Virtual water; water footprint of Mongolia

Box 10. Volume of water needed to produce:

1 sheet of A4 paper:	10 liters
1 slice of bread:	40 liters
1 egg:	140 liters
1 pair of leather shoes	8,000 liters
1 pair of blue jeans:	11,000 liters
1 kg of beef:	15,400 liters
1 car:	150,000 liters

Quite a different way of looking at a county's water balance is to analyze its water footprint as a country and of its people as individuals. For nearly all products used in daily life water is utilized to make that product. Some products require much water others less. The water that is used is more or less embodied in the product. This is referred to as 'virtual water'. The source of that virtual water can be 'blue' water or 'green' water (Table 35). The water footprint approach also includes 'grey' water. Grey water takes into account a side effect of producing goods, which is pollution. A very large proportion of domestic water supplied is returned to the system as sewage water. Agricultural and industrial production also causes pollution. The grey water demand can be seen as the volume of fresh water that would be needed to lower the concentration of these pollutants to the standard levels of contamination. For example on average the production of a pair of jeans takes about 6000 liters of 'green' water, 3600 liter of 'blue' water and to reduce the concentration of pollutants from the production process to below standard levels another 1400 liter of fresh water is required, called the 'grey' water. It should be noted that the term 'grey' water in the virtual water terminology is not the same as what is meant with 'grey' water in terms of waste water (Table 35).

Table 35. Definitions of colour classifications for water

Definition of:	in wastewater terminology	in virtual water terminology
White water	fresh, potable water	
Black water	sewage water that contains human waste	
Grey water *)	recyclable household waste water not containing human waste	the volume of fresh water that would be needed to dilute pollution to agreed water quality standards
Blue water		the water in freshwater lakes, rivers and aquifers.
Green water		the soil water from precipitation that is available for plant growth
*) **Note:** *'grey water' has two different meanings in water management!!*		

The concept of 'grey' water is a theoretical one that provides an understanding in quantitative terms how pollution affects water availability. 'Grey' water is a volume of fresh and clean water that would be needed to dilute the concentration of pollutants to within standard levels. A major part of the water resources are thus claimed for this purpose. Obviously treatment of waste water would reduce the 'grey' water demands leaving more water available for other purposes. Depending on local conditions this grey water can be much higher than the blue water demand (well up to 10 times).

The leading organization on water footprint and virtual water trade is the Water Footprint Network[1]. Water footprints and virtual water trade have been calculated for all countries and regions of the world and are published on the internet. The data sets used are from the period 1996-2005, which is quite acceptable for most countries as the variables for water footprint and virtual trade are not changing very fast for most countries. For Mongolia however major changes have taken place since then and the data on Mongolia in the global database are not accurately reflecting the present situation.

In this Chapter Mongolia's water footprint and virtual water trade is discussed. Because the available data do not really reflect the present situation, the main purpose is to introduce a new and different way to look at a national water balance. The water footprint approach provides additional insights that help to strengthen policy decision-making on water management. Of course that is only useful when current data are used to calculate the water footprints for national consumption, national production etc. and the calculation of virtual water flows. Since such data are presently not available, this provides opportunities for relevant national universities on the updating of Mongolia's water footprint and virtual water trade calculations. This would be excellent subjects for an MSc or PhD thesis.

The water footprint of national production

The water footprint of national production for Mongolia is determined by multiplying the production of the Mongolian economy (in terms of tons of meat, liters of alcohol, tons of coal, etc.) by their 'standard' water consumption per unit. Literature provides these standard water consumption rates[2]. These standards are general global estimates. Depending on the local conditions the actual rates could deviate considerably. The results are presented in Table 36. The water footprint of the national production in Mongolia during 1996-2005 was calculated to be 8,227 million m^3/year in total. The water footprint of agricultural production accounts for about 98% of the total while that of industrial and domestic supply accounts for only 1.5% and 1%, respectively. The table also shows also that most of the water footprint is from grazing, using 'green' water, i.e. rainfall. Figure 57 shows the spatial distribution of the national water footprint of production.

Table 36. Water footprint of national production within Mongolia, period 1996-2005.

Water footprint	Water footprint of crop production (Mm³/year)	Water footprint of grazing (Mm³/year)	Water footprint of animal water supply (Mm³/year)	Water footprint of industrial production (Mm³/year)	Water footprint of domestic water supply (Mm³/year)	Total water footprint (Mm³/year)
Green water	274	7513				7787
Blue water	32		160	6	9	207
Grey water	38			114	81	233
Total	345	7513	160	120	90	8227

If only the 'blue' water is taken into account then the share of agriculture is 93%, while that of industrial and domestic supply accounts for only 3% and 4%, respectively. The total amount of 207 million m^3/year of blue water for the period 1996-2005 compares reasonable well with the demand presented in Table 23, given the uncertainties in the data used.

1 See http://www.waterfootprint.org

2 All tables and figures in this paragraph are derived from: Mekonnen, M.M. and Hoekstra, A.Y. (2011) National water footprint accounts: the green, blue and grey water footprint of production and consumption, Value of Water Research Report Series No. 50, UNESCO-IHE, Delft, the Netherlands

The grey water footprint for industrial production and domestic water supply accounts for 90-95% of the total water footprint of these sectors. It represents the volume of fresh water that can be 'saved' through proper wastewater treatment of industrial and municipal wastewater.

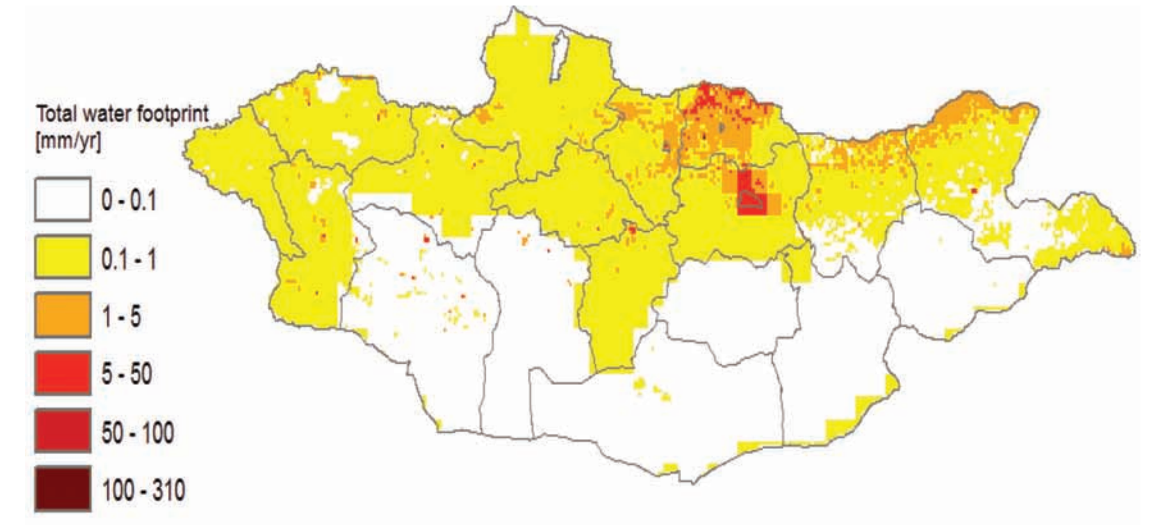


Figure 57. Water footprint of national production within Mongolia, period 1996-2005

The water footprint of national consumption

A similar approach can be used to determine the water footprint of the national consumption. The results are given in Table 37. The table shows the internal footprint (the consumption of products that are made in Mongolia) and the external footprint (consumption in Mongolia of products that are imported). The total water footprint of national consumption for Mongolia during 1996-2005 was calculated at 9,094 million m^3/year. Agriculture dominates the water footprint of national consumption accounting for about 98% while industrial and domestic water consumption account for only 1% each. About 8% of the water footprint of Mongolian consumption is 'externalized' by means of the imports of products and food from abroad.

Table 37. Water footprint of Mongolia's consumption, period 1996-2005.

Water footprint	Internal (Mm³/year)			External (Mm³/year)			Total (Mm³/year)				Ratio (%) external / total water footprint
	Green	Blue	Grey	Green	Blue	Grey	Green	Blue	Grey	Total	
Related to consumption of agricultural products	8017	172	73	474	43	127	8491	215	200	8905	
Related to consumption of industrial products	0	3.5	56	0	2.6	37	0	6.0	93	99	
Related to domestic water supply	0	9	81	0	0	0	0	9	81	90	
Total water footprint of national consumption	**8017**	**184**	**210**	**474**	**132**	**164**	**8491**	**230**	**374**	**9094**	**8**

Virtual water trade

Virtual water imports into Mongolia and virtual water exports from the country are shown in Table 38. The table shows that Mongolia is exporting more virtual water than it imports. Furthermore, a large part (almost 70%) of Mongolia's virtual water export is from green water.

Table 38. Mongolia's virtual-water flows related to trade in crop, animal and industrial products, period 1996-2005.

Virtual water flow	Gross virtual water import (Mm^3/year)			Gross virtual water export (Mm^3/year)			Net virtual water import (Mm^3/year)		
	Green	Blue	Grey	Green	Blue	Grey	Green	Blue	Grey
Related to trade in crop products	435.5	44.8	65.5	128.7	68.7	24.7	306.8	-23.9	40.8
Related to trade in animal products	24.8	3.0	1.5	575.8	18.1	7.8	-551.0	-15.1	-6.3
Related to trade in industrial products	0.0	4.5	76.0	0.0	4.4	97.0	0.0	0.0	-21.0
Total	460.3	52.3	143.0	704.6	91.3	129.5	-244.3	-39.0	13.5

The water footprint of national consumption per capita

For the period 1996-2005 the average water footprint per person for Mongolia was calculated at 3,775 m^3/year (see Table 39). By far the main part (99%) of this water footprint is due to consumption of goods and products purchased from markets while only 1% of that is due to the direct water use at home. Figure 58 shows the contribution of various consumption categories to the national water footprint of consumption for Mongolia. The country's water footprint per capita ranks highest in the world. This is due to relative large meat and dairy product consumption, but is also contributed to by the low water productivities (or low water use efficiency), i.e. large water footprints per ton of product consumed. Again, the main source used is green water (93%). The blue water consumption per capita is only 95 m^3/year, which is relative low. The values given are indicative only as they are based on rather weak basic data on consumption and water productivities of the county.

Table 39. The water footprint of Mongolia's consumption per capita, shown by major consumption category and by internal and external component, period 1996-2005

Water footprint	Internal (m^3/year/capita)			External (m^3/year/capita)			Total (m^3/year/capita)			
	Green	Blue	Grey	Green	Blue	Grey	Green	Blue	Grey	Total
Related to consumption of agricultural products	3327	71	30	197	18	53	3524	89	83	3696
Related to consumption of industrial products	0	1.4	23	0	1.1	15	0	2.5	39	41
Related to domestic water supply	0	3.7	34	0	0	0	0	3.7	34	37
Total water footprint of national consumption	3327	76	87	197	19	68	3524	95	155	3775

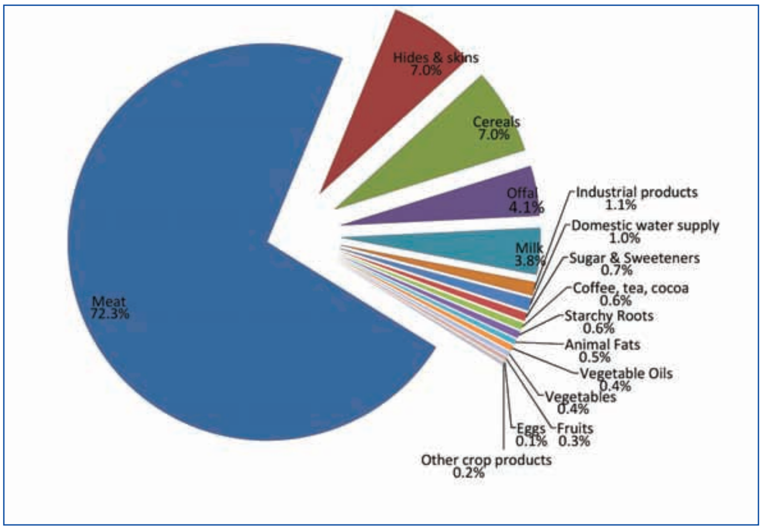


Figure 58. Contribution of different consumption categories towards the national water footprint of consumption for Mongolia, period 1996-2005

What can be learned from the analysis of the water footprint?

The first lesson to be learned is, as mentioned above, that Mongolia has a very high water footprint per capita. This is due to the relatively high meat consumption and the low efficiency of the production processes in the country. On the other hand, by far most of this consumption is from green water (rainfall) based agricultural products. The water used this way would, if not used by agriculture, otherwise be lost anyway due to evapotranspiration. The use of blue water in Mongolia is small, in absolute terms but also per capita, certainly compared to the available average exploitable surface water and groundwater resources (in total about 2,700 million m^3/year, see Table 2). Another conclusion is that the impact of the virtual water trade of Mongolia is limited. The amount of virtual water that Mongolia is exporting comes mainly from green water and the amount of exported blue water (91 million m^3/year) is very small compared to the available resources. Also the virtual import of water is mainly from green water while the low blue water import is not expected to raise concerns about the impacts on the water resources in the basins in other countries where the water is actually used. The volume of grey water is of the same order of magnitude as blue water. A considerable portion of the internally generated grey water can be 'recovered' through wastewater treatment. With better and more recent data this picture can be approved much.

7.3. Challenges and issues

The five water sub-sectors (Water for People, Water for Food, Water for Industry, Mining and Energy, Water for Environment and Enabling setting / water governance) and the related issues are described by linking the issues to twenty identified challenges.

7.3.1. Sub-sector 1: Water for people

Growing population and increasing welfare result in more demand for safe drinking water and in higher water demands for human wellbeing and development. At the same time an increase in capacity and efficiency is needed for waste water treatment.

General issues related to safe drinking water

- Lack of access to safe drinking water and sanitation contributes to poverty; in 2010 39% of the population lived below the poverty line;
- Growing population and increasing per capita domestic water use will require development of additional water sources to meet (future) water demand;
- Water supply to ger districts and rural herders is inadequate; water consumption per capita does not meet sanitary requirements and is below international standards; and
- Water quality standards are not met locally due to natural water quality problems (high mineralization, high fluoride and arsenic) or man-induced pollution; this is a threat to human health.

In meeting the future requirements and demands the sub-sector faces the following three challenges related to drinking water supply and waste water treatment.

Challenge 1.1: Safe drinking water and optimal waste water treatment in urban areas

Per capita water consumption in Mongolia is very high in apartments and very low in ger areas. The daily water consumption of ger area residents is not enough to meet sanitary requirements and below the minimum consumption as recommended by the WHO. In 2010, 41.4 thousand occurrences of infection diseases were reported, 30% of which were water related diseases (hepatitis and diarrhea). These infections stem from a lack of access to safe water and poor sanitation.

To improve the water supply in urban areas repairs and expansion of the facilities are needed including both private and communal (kiosks) connections. Treatment of waste water is lacking or inefficient requiring improved or new treatment plants in both Ulaanbaatar and other urban centers. Sanitation in ger areas needs to be improved to reduce health risks and diseases.

Main issues related to safe drinking water in urban areas

- Water use by inhabitants of apartments is inefficient and extremely high;
- Water supply infrastructure has to keep pace with the urbanisation;
- Water sources need better protection to avoid pollution; and
- Existing water supply systems are poorly maintained and need renovation.

Main issues related to treatment of waste water and sanitation in urban areas

- Sanitation infrastructure does not keep pace with the urbanisation, sewage systems in the urban areas need expansion and the capacity of waste water treatment facilities is insufficient and inefficient; and
- There is a general lack of improved sanitation facilities in ger areas.

Main issues related to water supply and waste water treatment at army camps and border posts

- Army camps and border posts are often located in remote areas and water supply and sanitation do not always meet the required standards.

Challenge 1.2: Safe drinking water and optimal waste water treatment in rural areas

In 2010 less than 50% of the rural population had access to improved water sources. Part of the rural population uses drinking water which does not meet the quality standards. Health problems related to hardness and high concentrations of fluoride and arsenic of the drinking water are reported. Inadequate sanitation is prevalent in rural areas (69%), where 48% of poor people have no access to improved sanitation, compared to 25% of the more affluent people.

Main issues related to safe drinking water in rural areas

- Lack of protected water points for rural population increases the incidence of water born diseases and affects human well-being; and
- Improvement of the water supply and sanitation infrastructure requires major investments and sustainable organization of operation and management of the systems.

Main issues related to treatment of waste water and sanitation in rural areas

- Waste water treatment facilities are lacking in soum centers; and
- There is a general lack of improved sanitation facilities in soum centers.

Challenge 1.3: Water for tourism and sanatorium

Tourism facilities are often located in remote areas and water supply and sanitation should meet the required standard. Mineral springs are used for recreation and health requiring expansion to cover the increasing demand for sanatoriums.

The tourism sector is developing as an important economic sector, its direct contribution was 350 bln MNT or 3.9% of GDP in 2010, but including wider effects from investments, supply chain and induced income impacts, the total amount reached 890 bln MNT or 8.9% of GDP. By 2021 the sector is estimated to grow, directly generating 670 bln MNT or 2.4% of GDP and including wider impacts 1,720 bln MNT or 6.1% of GDP[3]. To remain attractive for tourists it is important to preserve a clean and healthy environment and to provide sufficient and clean water, good sanitation and modern sanatorium facilities.

Main issues related to water for tourism and sanatorium

- The number of tourists both local and foreign is expected to grow. The number of reliable and high quality water supplies and waste water treatments need to be increased for the sector to meet the growing demand; and
- Mongolia's good potential for development of mineral springs for recreation and health is underutilized. Additional springs should be developed for use in sanatoriums.

7.3.2. Sub-sector 2: Water for food

Agriculture is an important economic sector in terms of employment, export revenues and contribution to GDP. In 2010 the sector accounted for 15.9% of the country's GDP and 33.5% of the population was engaged in agriculture. Extensive livestock farming contributes more to the GDP than crop cultivation. For its future development the sub-sector faces two major challenges.

Challenge 2.1: Water for livestock

Over history, livestock herding has been the traditional way of life, well adapted to the climatic conditions and able to deal with natural disasters and water deficiencies. Increasing numbers of livestock, changes in composition of the stock, on-going changes in the traditional nomadic lifestyle and the effects of climate change have resulted in pastureland degradation. The water supply for pasture lands is in serious disrepair and urgently needs to be improved. Traditionally, individual water points were constructed for livestock watering comprising both deep, high yielding tube wells as well as shallow herder-made wells. Due to a lack of maintenance and unresolved ownership engineering type wells in particular have degraded and the number of operational wells has sharply declined in the last 20 years.

3 World travel & Tourism Council; Travel & Tourism Economic Impact 2012 Mongolia

Main issues related to water for livestock

- Grazing areas cannot be used due to a lack of sufficient operating water points;
- Grazing pressure is unacceptably high near urban and rural centers and isolated water points;
- Problems with operation and maintenance of boreholes and ponds has resulted in a decline of operating water points; and
- Shortcomings in the livestock water supply system, both in terms of water quantity and water quality, are a threat to the health of livestock and have a negative influence on social welfare and agricultural production. As such it limits the economic revenue of the sector.

Challenge 2.2: Water for irrigation

Although Mongolia has always been a country of pastureland and nomadic herders, (irrigated) crop production has been practiced throughout history. The Mongolian climate and uneven distribution of rainfall (geographically and over time) are not favorable for rain fed crop production and irrigation is an option to increase crop production. In most cases irrigation is supplementary, when precipitation is insufficient to sustain the crop. After 1990 the irrigated area declined sharply to only increase again in recent years. Irrigation infrastructure is generally poorly maintained. In 2010 37 thousand ha agricultural land was irrigated out of a total sown area of 315 thousand ha.

Main issues related to water for irrigation

- Government plans to set-up adequate crop irrigation infrastructure and to increase the area of irrigated crops, as a result the irrigation water demand will increase considerably;
- Since 1990 the irrigation infrastructure deteriorated due to lack of maintenance and unresolved ownership issues. Water use in crop irrigation is inefficient due to old techniques and equipment; and
- Limited financing capabilities of the farmers and high risks, hamper development of irrigated agriculture.

7.3.3. Sub-sector 3: Water for industry, mining and energy

In 2010 the industrial sector contributed 35.6% to the national GDP, of which 63.8% by the mining sector. The mining sector is rapidly developing as the backbone of the country's economy; it accounts for 81% of the export value and employs 34 thousand people. The growing population, economic development and ongoing industrialization/ mining activities result in an increase in the energy demand. Three distinct challenges are facing the sub-sector.

Challenge 3.1: Water for industries

While mining is the largest industry in Mongolia, traditional manufacturing industries, such as wool, leather and food processing, also use considerable amounts of water. The rapid development of industries puts a strain on the available water supply and waste water systems. Most industries receive water from the centralized water supply system. In addition, groundwater abstracted from private wells is used. Due to a lack of adequate environmental precautions, industries cause serious soil and water pollution and affect ecosystems.

Main issues related to water for industry

- Water demand by industries is expected to increase significant in the coming years;
- Water use by industries is highly inefficient; and
- Industrial waste water increases the waste loads on central waste water treatment plants beyond acceptable levels. Waste water treatment at industries has to be stimulated to reduce waste loads on central WWTPs and prevent pollution of water resources.

Challenge 3.2: Water for mines

The mining industry needs water for its operations and for the new cities that grow near the mines. Mining also has the potential to severely impact the environment: landscapes may change, too much water may have to be extracted and the water that is discharged may be polluted.

Main issues related to water for industry and mining

- Water demand by mining activities is expected to increase significant in the coming years;
- Water use in mining operations is highly inefficient and water reuse not sufficiently developed;
- Waste water is often discharged without treatment;
- Lack of water resources near mineral deposits is a constraint for potential mining activities, water may have to be transported over long distances, sometimes from other basins; and
- Decision making by government and private companies, concerning the establishment of new mining operations is sometimes hampered by a lack of information on available water resources and required infrastructure.

Challenge 3.3: Water for energy

Mongolia has the world's most typical continental climate with extreme ranges of temperature. Average temperature in most of the country is below zero from November to March and close to it in April and October, making energy for heat generation crucial for survival. The large geographical area of the country and its low population density make the provision of energy a difficult task. At present 3 aimag and 150 soum centers are not yet connected to the main electricity grid. The energy demand is expected to grow fast due to urbanizations, increased welfare and a steep economic growth. At present most of the electricity is generated by coal-fired power plants, 6.5% of the needs is imported from abroad and a minor part (< 4%) is hydropower.

Mongolia has an estimated potential hydropower production capacity of 1280 to 3840 MW, and 81 potential dam sites have been identified. Whereas coal-fired plants are a major source of pollution, hydropower is a clean source of energy. A disadvantage of hydropower is that suitable locations for hydropower dams are often far from the industrial and population centers, requiring long transmission lines that are costly and are a source of energy losses.

Main issues related to water for energy

- The energy production capacity in Mongolia, both heat and electricity, needs to increase to keep pace with the increasing demand and to replace current imports;
- Hydropower development is restricted by climate conditions (freezing of the rivers in wintertime) and has to compete with other energy sources such as coal fired plants, and wind and solar energy;
- Hydropower development is restricted by the fact that potential sites for hydropower plants are at a considerable distance of the places where there is a demand for power (mines, urban centers), requiring large investments in transmission lines and causing transmission losses; and
- Hydropower reservoirs change the regimes of the rivers in which they are built, and may have a negative impact on ecology and downstream water availability for other users.

7.3.4. Sub-sector 4: Water for the environment

The natural environment should be regarded as a water consumer as well as a water resource. The environment with its biodiversity provides valuable services to the nation and its people and is the basis for Mongolia's thriving tourist industry. Besides that, a healthy environment is the key to regulating runoff, storage of rainwater, percolation to recharge groundwater aquifers, prevention of erosion and soil degradation, etc. A deteriorating natural environment over large areas would eventually affect the weather and rainfall patterns.

Depriving it of adequate and quality water would lead to a rapid deterioration of the natural environment and its environmental services to the nation will be lost. Allocating good quality water to prevent this makes the natural environment a water consumer. But a deteriorating natural environment also loses its capacity to store water and to regulate runoff, which in turn will adversely affect percolation and recharge of aquifers. This way the natural environment as a water resource is affected negatively when too much water is withdrawn or when water qualities are permitted to deteriorate. Once this process has started it quickly turns into a downward spiral that is almost impossible to reverse.

These are powerful reasons to ensure that adequate water of good quality remains available for the natural environment at all times. The environmental sub-sector faces five challenges.

Challenge 4.1: Conservation of water resources

Growing population, urbanization and industrialization, combined with an increase in mining activities and irrigated agriculture increase the demand on the water resources system. Inefficient use of water resources and possibly climate change cause a decline in the resource availability. At the same time the water balance at the national level shows that Mongolia has enough water to meet its demand and that large amounts of water are leaving the country unused. The following main issues are considered:

Main issues related to conservation of water resources

- The hydrological regime of rivers is deteriorating due to, deforestation, changing soil and vegetation cover, mining activities, hydropower generation, urbanization and on the long term probably climate change;
- The protection of watersheds and water bodies is insufficient to preserve water retaining properties and water quality;
- Large amounts of water leave the country unused. More of these resources should be preserved within Mongolia; and
- Water is used inefficiently in urban areas and by industries.

Challenge 4.2: Pollution of water resources

Ongoing industrialization, mining activities, inefficient waste water treatment and increasing agricultural activities may significantly pollute surface and ground water resources. Locally pollution of surface water is already a major issue.

Main issues related to pollution of water resources

- Untreated or badly treated water is released directly to rivers or infiltrates into the soil, so polluting the surface- and groundwater with organic material, pathogens, heavy metals and other dangerous substances;
- Not maintaining hygienic protection zones around water bodies and water points results in pollution of water sources and threatens human health;
- Increase of irrigated agriculture, combined with an intensification of the use of fertilizers and pesticides is a potential threat to water quality of lakes and rivers;
- Discharge of untreated water from mining operations often pollutes the receiving water bodies, e.g. with heavy metals, and increased total suspended solid loads;
- Discharge of industrial effluents to the sewer system ends up in domestic waste water treatment plants, where it upsets the treatment processes rendering the plant inefficient; and
- Ineffective regulations to make polluters pay (Polluter Pay Principle) inhibit waste water treatment (and water reuse) by industrial water users.

Challenge 4.3: Sufficient and clean water for the environment

Increased demands on the water resources resulting in changing flows, combined with increased water pollution is impacting aquatic and riparian ecosystems. Knowledge is lacking on the environmental flow in rivers which is required to maintain healthy ecological conditions in surface water. Many lakes are drying out due to human interventions or climate change without means to reverse this trend. Increased groundwater abstraction leads to lower groundwater levels which may affect vegetation depending on shallow groundwater tables.

Main issues related to sufficient and clean water for the environment

- As a result of human interventions and possibly climate change ecological conditions are deteriorating; the numbers and composition of flora and fauna in water bodies is changing, some species are already extinct, others have become rare or are endangered;
- Deterioration of Mongolia's unique biodiversity and landscape, including its clean rivers, is a threat for the tourism sector development potential;
- Hydropower reservoirs change the regimes of the rivers in which they are built, and may have a negative impact on river ecology. Fish migration routes may be blocked by dams;
- Knowledge is lacking on the required environmental flow in rivers to maintain healthy ecological conditions;
- Dewatering of mines and extraction of groundwater lead to lowering of groundwater tables;
- Increasing livestock numbers leads to deterioration of the pasture land. The composition of the vegetation becomes less favorable for grazing and the pasture biomass decreases;
- Lake levels drop or lakes completely dry up due to increased evaporation and/or reduced river inflow;
- Measures to protect lakes and wetlands are insufficient to preserve important habitats.

Challenge 4.4: Restoration of water resources

The improvement of water resources after damage caused by overuse or neglect is not an easy task. Stringent measures are needed e.g. to restore river valleys damaged by mining activities or to clean river beds polluted by waste water discharges.

Main issues related to restoration of water resources

- Mining activities, especially gold mining and open pit mining, have significant adverse environmental impacts: changes in landscape which are not restored after closing the mine, re-direction of rivers, establishment of new settlements, etc.; and
- Polluted river sediments will require a cleanup after reduction of waste water discharges to rivers.

Challenge 4.5: Hazards due to floods, droughts, dzuds and other disasters

Floods may occur during and after periods of heavy rain. When located in flood-prone areas gers, houses, industries, schools or offices are at risk. Droughts, especially occurring in the desert-steppe zone of the country have a big impact on the agriculture sector. In periods of drought, livestock is affected by food and water shortages and crop cultivation requires supplementary irrigation. A special risk is the dzud, when a harsh and cold winter follows a dry summer and food availability for livestock becomes precarious. Large numbers of livestock do not survive these conditions.

Main issues related to hazards due to floods, droughts, dzuds and other disasters

- The environment and the water resources are vulnerable to small changes in climate. Warmer and dryer conditions may lead to an increase of number of dust storm days and a higher frequency of droughts and dzuds, but also more frequent and higher intensity rain storms;
- The flood protection systems in place at various sites are in poor condition due to a lack of maintenance and the illegal dumping of solid waste in flood channels; and
- Flood prevention measures are not organized and there are no operational early warning systems for floods. There is a lack of public awareness on the subject.

7.3.5. Sub-sector 5: Enabling setting/water governance

Effectively addressing the water management issues mentioned in the previous sections requires an enabling setting and water governance that includes effective legislation, capable and efficient institutions and organizations, adequate financial resources and a socio-political climate supporting sustainable development in general and sustainable use of water resources in particular. Under this sub-sector seven different challenges have been identified.

Challenge 5.1: Legislation for water management

The existing legislation on water needs improvement to better support water management, in particular with respect to coordination, which constitutes the basis for IWRM (see Chapter 6.2.4). Existing laws and regulations need to be made consistent in terminology, be re-focused on responsibilities and accountability, rather than on mandates, and punitive measures need regular updating to remain effective as a deterrent. RBO's are still in an early stage of development and legislation will require adjustments in future while RBO's further evolve.

Main issues related to legislation for water management

- Inconsistencies and ambiguity in water-related laws, regulations, procedures, definitions, terminologies, norms and standards inhibit their effectiveness;
- Compliance with international treaties, conventions and trans boundary agreements is incomplete;
- Omissions are observed in existing legislation regarding, regulations on water use, powers and responsibilities in water management organizations, allocation and dispute resolution, calamity safeguards, wetland management, water pricing and water management financing; and
- Enforcement by responsible agencies is weak due to inadequacies in technical expertise and ineffective penalties.

Challenge 5.2: Institutions for water management

The water sector in Mongolia is institutionally complex and highly dispersed, especially at national level. Mandates and responsibilities are not always clear, subject to interpretation, and overlapping on several issues, while at the same time some necessary water management functions have not been assigned at all. A recent UNDP project document (2009) characterized the institutional organization of the water sector as "... *one of the most disorganized to be found...*".

In August 2012 a government restructuring considerably changed the institutional landscape and in particular affected two national apex bodies that were established earlier as key coordinating bodies in the water sector: the National Water Committee and the Water Authority. Some of the at least six ministries with responsibilities in water management were split up or reorganized.

Water management in Mongolia is dominated by a handful of strong ministries each of which is in a position to pursue its own agenda and priorities, without any horizontal accountability. Organizations charged to coordinate the water sector have neither the capacity nor the authority to function effectively.

Main issues related to institutional framework for water management at the national level

- The all overriding issue is the almost total lack of effective coordination. Several institutions have been assigned responsibilities to coordinate, but none has the capacity or the authority to effectively coordinate any major aspect of water management;
- The recent legal embedding of the NWC and its elevation to a higher hierarchical level is a major step forward, but it remains uncertain whether it wields sufficient authority to effectively coordinate the water sector;
- The Water Authority having recently been disbanded leaves a gap in the institutional landscape; there is need for a National Water Authority to independently support the water management decision-making with thoroughly researched technical advice;
- Water management suffers from a considerable degree of overlapping without coordination, resulting in duplication, contradiction and competition, and eventually to wasting of valuable human and financial resources;
- The performance of water management functions is seriously hampered by shortages of adequately capable staff, budget constraints and the lack of proper means and equipment;
- Water management data and information is highly dispersed and very difficult to access. Organizations treat data they possess as assets and are uncooperative in sharing. An overview of existing data and its location is absent and the quality of data and information cannot be verified.

The Law on Water (2004) introduced and facilitates the establishment of Water Basin Councils (WBCs) for water basin water management. The revised Law on Water (2012) further clarified the status of the WBCs and introduced the Water Basin Authorities. Starting 2006 about 15 (sub-) WBCs have been established. These organizations are still young, institutionally immature and need to further develop their capabilities. At present the Water Basin Councils and the Water Basin Authorities resort under the new River Basin Management Division in the Ministry of Environment and Green Development.

Main issues related to the institutional framework for water management at the basin level

- The formal status of WBCs is still not clear and seems contradictory: on the one hand WBCs are presented as the vehicle for public participation, but on the other hand the councils are almost exclusively composed of civil servants.
- The establishment of Water Basin Authorities as technical offices for water management at the basin level is a major improvement, but tasking the WBAs to establish Water Basin Councils will reinforce the WBA's superiority over the WBC and demotes the WBC to a mere consultative role.
- The recent establishment of a River Basin Management Division in the Ministry of Environment and Green Development is definitely a step forward, but placing the WBAs and the WBCs under this Division is contrary to the IWRM principles of subsidiarity, state disengagement and public participation.
- A vision and planning is missing for a controlled evolution of RBOs towards self-contained and authoritative entities with in parallel a gradual but systematic transfer of water management functions to these basin organizations

Challenge 5.3: Financing the water sector

Financing of the water sector comprises construction costs for infrastructure, O&M costs for water infrastructure and recurrent costs for water management institutions including staff training. The Water National Program estimates the investments in the water sector till 2015 to exceed 3 trillion MNT (about equal to 1/3 of Mongolia's GDP in 2010), which only includes the operating costs of the new to be constructed infrastructure, but not of existing infrastructure. More than half of this amount would need to be financed from national sources.

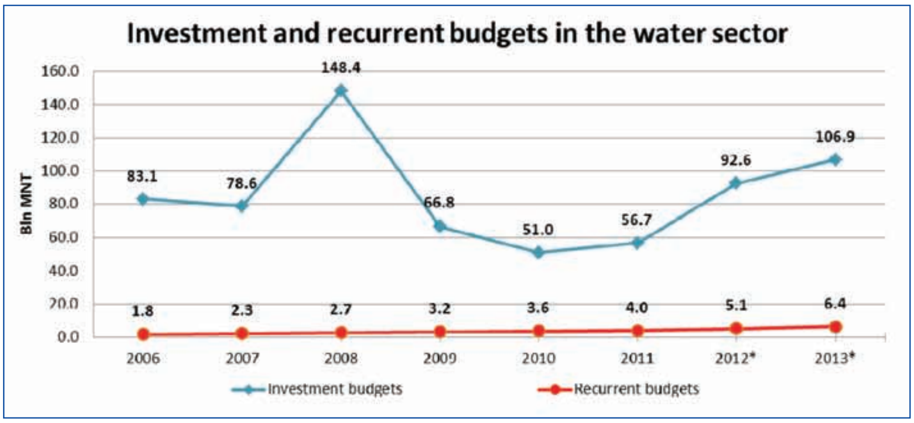


Figure 59. Investment and recurrent budgets in the water sector

Expenditures on recurrent costs for water management institutions used to amount to 2-4% of the investment budgets. During the period 2009-2012 the percentage was about double that, but this was mainly caused by a considerable drop in investments in the water sector and not by an increase of recurrent budgets (see Figure 59). About 75% of the recurrent costs are comprised of personnel costs. In about 25% of all cases financial constraints are reported to be the cause for sub-optimal performance of water management functions.

Main issues related to financing the water sector
- Funding of the planned investments in the water sector weighs heavily on the state's financial resources;
- Cost recovery is developed insufficiently to support the O&M and recurrent costs in the water sector let alone finance investments;
- Existing legal provisions to channel revenue to the water sector are not used.
- About 45% of the planned investments are expected to be financed through Foreign Aid, but Mongolia is rapidly rising to the status of middle income country, depriving it from accessing soft loans from development banks and thus increasing its lending costs.
- Private sector (co-)financing through PPP-like concepts is still in a very early stage of development, making it unlikely to become a significant source of financing before 2020.

Challenge 5.4: Capacity building for water management

The organizations responsible for water management in Mongolia require skilled staff to plan, monitor and supervise the activities in the water sector, but also a large number of craftsman and skilled laborers are needed for the construction of all planned infrastructure. A recent survey revealed that at present already in more than 20% of the cases insufficient competences of the human resources causes underperformance of functions in the water sector. Upgrading or replacing staff is complicated and time consuming, assuming that sufficient competent staff is actually available on the labor market. But already there are reports of shortages of staff (reported in almost 10% of the cases). Solving that could be a simple matter of increasing the budgets, but might also have to do with competition from the private sector, in which case higher remuneration should need to be considered. It becomes even more complicated when properly qualified staff is not sufficiently available on the market. If that is the case new staff would need to be trained or in the worst case the whole education and training system would need a overhauling to produce the properly qualified graduates for the water sector.

Main issues related to capacity building for water management
- Institutional human resource capacity of organizations in the water sector inadequate in number and in quality to face the challenges of integrated water resources management;
- Water management curricula at Mongolian universities and Technical Schools are not sufficiently responsive to the needs of the sector;
- The pool of skilled labor and artisans is insufficient to meet the demands from the expected construction boom that is not limited to the water sector alone but competes with similar growing demands from the mining, transport and housing sectors.

Challenge 5.5: Monitoring and research for water management

To be able to manage the water resources in an environmental friendly and sustainable way, a good understanding of the nature and functioning of the natural resources system is needed. This requires monitoring of the state of the system and research and technology development to better understand and manage the resource. At the same time, a better understanding and knowledge of the various water using activities is needed, this to be able to make a better estimate of the water demands on the natural system by the various socio-economic sectors, both in terms of quantity and quality.

Science continues to develop and better approaches for water management become available like the innovative 'environmental flow' approach for water management planning. In Mongolia research and data collection through monitoring would need to be adapted to facilitate adoption of such new approaches.

Main issues related to monitoring and research for water management

- The quality and accessibility of meteorological, surface water, groundwater and water quality data are insufficient to allow a good understanding of the (changes in) surface water resources;
- Monitoring of surface water and groundwater resources is technologically underdeveloped
- The absence of a comprehensive monitoring system for groundwater that covers the most relevant parts of the country hinders the analysis of the (changes in) groundwater resources;
- Water quality data suffer from inadequate sampling and analysis techniques;
- Water use data is not well monitored complicating assessment of appropriate water demand projections (including rational water use norms);
- Insufficient data is available regarding return flows and re-use of water in domestic water supply, industry, irrigated agriculture, power production and mining;
- Insufficient data is available on the quality of water discharged to the sewer system or surface water by industries, mines and waste water treatment plants;
- The quantities and quality of surface water and groundwater required for ecological functions have not yet been estimated or analyzed;
- Data on frequency and extent of, and damage caused by, flooding are very scare and do not allow an analysis of changes in occurrence or assessment of average annual damage due to flooding;
- Research in water resources misses the necessary integration of expertise in surface water, groundwater and ecology.

Challenge 5.6: Data and information management

Accessibility and exchange of basic socio-economic, water resources and ecological data is very important to be able to manage the water resources in an integrated way. Various databases exist at water related government organizations and research institutes but access and exchange of data are poorly organized. It is very difficult for researchers and for the general public to get access to the data or to information derived from this. Planning the water sector is severely hampered by the inaccessibility of data and information and the lack of transparency regarding the quality of the data and information

Main issues related to data and information management

- Existing databases at water related government organizations and research institutes are not linked and do not allow for easy exchange of data and information;
- Rules and regulations for organizations to allow access to data while safeguarding the protection and quality of such data are not in place or not enforced adequately
- Regular (annual) reporting and systematic publication of detailed results by water sector organizations to inform researchers and the general public is lacking.

Challenge 5.7: Public awareness of water management and public participation

Private citizens and industries are not the only water users, but also more abstract entities such as the environment and recreation (e.g. water sports) are to be counted among the water users. The management of the quantity and quality of the water resources affects all of these. The sustainable use of water resources is the combined responsibility of the government and the users. It is impossible for the government to police every user and punish every offender. Users themselves need to start acting more responsible. Such a desired change of attitude can only be expected when the users fully understand the issues at stake and the (long term) consequences of particular actions or activities. Therefore awareness of the importance of water management issues needs to be reinforced among all levels of the society.

Campaigns to raise public awareness too often take the form of lecturing the general public. This is not very effective as people in general dislike being patronized. A more effective way to change attitudes is by providing regular (accurate) updates on specific information in layman's terms using mass media. Governments are not the best agents to carry out awareness campaigns as they generally suffer from a negative image of distorting the truth and pursuing hidden agendas. In that regard NGOs generally have more credit with the general public, but when becoming too closely associated with the government, they also lose their credibility. Awareness campaigns therefore require very careful planning, preparation and execution

Main issues related to public awareness of water management and public participation

- The general public, industrial water users and also government officials are not sufficiently informed about the importance of water management and the role they themselves are expected to play in it;
- The value of traditional methods to protect and take care of water resources to reinforce water management methods and activities are not fully appreciated;
- The current centralized and government dominated system of water management does not provide incentives for users to participate.

7.4. Measures and targets

In Chapter 5 the basic information for quantifying the issues is presented. The situation in 2010, the base year is considered the base situation, the expected situation in 2015 and 2021, according to the medium scenario, sets the targets for the water resources strategy. An overview of the present situation, the selected indicators and the targets for 2015 and 2021 are described here.

7.4.1. Sub-sector 1: Water for people

Challenge 1.1: Safe drinking water and optimal waste water treatment in urban areas

Many people in Ulaanbaatar, aimag centres and other urban areas have access to safe drinking water. Safe drinking water is defined as water that is supplied from an improved drinking water source and that meets the drinking water quality standards. Water quality standards in urban drinking water supply are generally met. The few exceptions, mainly in Choibalsan, Dornod aimag and Altai, Govi Altai aimag pertain to too high hardness of the water, which has an effect on the taste of the water, but does not directly affect human health.

Supply from protected water source: In the base year 2010, 86.7% of the urban population received water from a protected source, which is already above the MDG target for 2015 (70%)[4]. New targets of 90% and 95% of the urban population receiving water from a protected source were set for the years 2015 and 2021.

Private water supply connections: In the base year 2010, the percentage of private connections in urban areas was 32.9%. The construction of new apartments and the planned introduction of private connections in ger areas (the 40,000 connections program in Ulaanbaatar) will increase the percentage and targets of 45% and 50% are set for 2015 and 2021.

Sanitation: The MDG target is to increase the proportion of population with adequate sanitation facilities to 40% by 2015 (or 50% of the urban population) and to increase the number of apartment households that are connected to the central sanitation system to 30% of the total population (or 44% of the urban population) by 2015.

Waste water treatment plants: The number of waste water treatment plants in normal operation in urban areas was 17 in 2010. This number is planned to increase to 32 in 2015 and 40 in 2021. With this increase in operational WWTPs the percentage of treated waste water in urban areas will be near 100% in 2021.

Unaccounted water: Although important to be reduced there are no targets set for the

4 MDG-based comprehensive development strategy 2008

quantity of unaccounted drinking water and waste water. Nevertheless the installation of water meters both at the water consumers and at the producers of waste water (industries) is expected to improve the accountability. In Ulaanbaatar the percentages of unaccounted drinking water and waste water were 17.2% and 22.1% in 2010.

Reuse of water: There is no reuse of treated waste water practiced as yet. Reuse of waste water is promoted but the quantities of treated waste water to be reused are not defined in policy documents. No targets are set in this plan for treated domestic waste water as implementation of reuse depends on results of studies and aspects like costs and applicability of the treated waste water. Reuse of water is mainly connected to industrial activities.

Army camps and border posts: Most army camps and border posts are located in remote areas and require an improved water supply source. The number of army camps and border posts is unknown. The targets only include the number of army camps and border posts where water supply and waste water treatment is to be improved. There are no targets set for the extent of the improvement.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 40. Details of the measures are presented in Chapter 9.

Table 40. Summary of issues and measures for Challenge 1.1

<table>
<tr><td colspan="2">Sub-sector 1: Water for people</td></tr>
<tr><td colspan="2">Challenge 1.1: Safe drinking water and optimal waste water treatment in urban areas</td></tr>
<tr><th>Issues</th><th>Measures</th></tr>
<tr><td rowspan="8">▪ Lack of access to safe drinking water and sanitation;
▪ Growing demand requires additional water sources;
▪ Water supply to ger districts is inadequate;
▪ Water quality standards are not met;
▪ Water use in apartments is inefficient and extremely high;
▪ Water supply infrastructure to keep pace with the urbanization;
▪ Water sources need better protection;
▪ Existing water supply systems are poorly maintained;
▪ Sanitation infrastructure does not keep pace with the urbanization;
▪ Lack of improved sanitation facilities in ger areas.
▪ Water supply and sanitation at army camps and border posts do not meet required standards.</td><td>1. Establish and enforce sanitation and protection zones around water supply sources</td></tr>
<tr><td>2. Local surveys and exploration studies to identify new or verify existing water resources</td></tr>
<tr><td>3. Construction and renovation of water supply sources</td></tr>
<tr><td>4. Renovation and expansion of water supply network and increase of number of connected water supply kiosks</td></tr>
<tr><td>5. Construction and renovation of waste water treatment plants</td></tr>
<tr><td>6. Renovation and expansion of sewerage network</td></tr>
<tr><td>7. Reuse of domestic and treated waste water</td></tr>
<tr><td>8. Improve water supply and waste water treatment at army camps and border posts</td></tr>
</table>

Challenge 1.2: Safe drinking water and optimal waste water treatment in rural areas

Access to safe drinking water in rural areas, especially outside soum centers, is limited. At present many people depend on wells and springs or rivers, lakes and ponds for their water supply.

Water quality in rural areas is often problematic. Many water sources are used for both domestic use and livestock watering and lack separate water outlets to avoid pollution. In some areas the natural groundwater quality does not meet the water quality standards, especially in southern Mongolia. Treatment is sometimes needed to provide safe drinking water in these areas.

Supply from protected water source: In the base year 2010 an estimated 43.4% of the rural population was provided with water from an improved source. The MDG target for 2015 is 60%. A target of 80% is set for 2021.

Sanitation: The current proportion of the rural population with adequate sanitation facilities is unknown but is probably very small: <5%. A target of 20% for the proportion of population with adequate sanitation facilities in rural areas by 2015 may be derived from the national MDG target of 40%. The target for 2021 is set at 40% as many projects are planned and implemented to improve sanitation facilities in soum centers.

Waste water treatment plants: The number of waste water treatment plants in normal operation in soum centers was 8 in 2010. This number is planned to increase to 25 in 2015 and 60 in 2021.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 41. Details of the measures are presented in Chapter 9.

Table 41. Summary of issues and measures for Challenge 1.2

Sub-sector 1: Water for people	
Challenge 1.2: Safe drinking water and optimal waste water treatment in rural areas	
Issues	Measures
▪ Water supply to rural herders is inadequate; ▪ Lack of protected water points for rural population; ▪ Improvement of the water supply and sanitation infrastructure required; ▪ Waste water treatment facilities are lacking in soum centers; ▪ Lack of improved sanitation facilities in soum centers.	1. Establish and enforce protection zones around water sources. 2. Local surveys and exploration studies to identify new or verify existing water resources at soum centers 3. Construct water supplies in soum centers and in rural areas for herders and farmers 4. Construct small waste water treatment plants in soum centers and organize reuse of treated waste water 5. Improve drinking water quality by implementing sustainable water treatment facilities

Challenge 1.3: Water for tourism and sanatorium

For the further development of tourism in Mongolia it is important to provide sufficient, clean water to tourist facilities and to implement high-tech waste water treatment to achieve international standards. The MDG goal is to receive 1 million tourists in 2015 and a total number of tourists equal to the population number in 2021. The number of tourist camps in Mongolia was about 300 in 2010. In general the size of the camps varies between 5-25 gers with about 10-100 beds.

The total number of sanatoriums in Mongolia is about 100 of which about 27 are certified. The target is to increase the certified sanatoriums to 35 in 2015 and to 40 in 2021.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 42. Details of the measures are presented in Chapter 9.

Table 42. Summary of issues and measures for Challenge 1.3

Sub-sector 1: Water for people	
Challenge 1.3: Water for tourism and sanatorium	
Issues	Measures
▪ Reliable and high quality water supplies and waste water treatments needed for growing tourist sector; ▪ Additional springs needed for use in sanatoriums.	1. Improve and expand water supply infrastructure for tourism and sanatorium 2. Improve water supply infrastructure and utilization of high-tech WWTP in tourist camps 3. Develop mineral springs for the purpose of spa resorts and sanatoriums

The indicators and targets for Sub-sector 1 are summarized in Table 43.

Table 43. Performance indicators and targets for Sub-sector 1: Water for people

Performance indicator		Actual	Targets		Remarks
		2010	2015	2021	
1.1	**Safe drinking water and optimal waste water treatment in urban areas**				
	% of urban people supplied from protected water source	86.7%	90%	95%	Targets based on 2010 percentage
	% of urban people having private water supply connection	32.9%	45%	50%	Includes connections in ger areas
	% of urban people having adequate sanitation	37.7%	50%	70%	Target 2015 based on MDG
	% of urban people with private connection to central sewerage system	30.2%	44%	50%	Target 2015 based on MDG
	Number of normally working domestic WWTPs in urban areas	17 (4)	32 (5)	40 (6)	Number of WWTP in Ulaanbaatar city between brackets
	Number of army camps/border posts supplied with safe water	?	30 added	30 added	Actual number not known
1.2	**Safe drinking water and optimal waste water treatment in rural areas**				
	% of rural people supplied from protected water source	43.4%	60%	80%	Target 2015 based on MDG
	% of rural people having adequate sanitation	< 5%	20%	40%	Target 2015 based on MDG
	Number of normally working domestic WWTPs in soum centers	8	25	60	Target based on NWP
1.3	**Water for tourism and sanatoria**				
	Number of tourists	456,300	1,000,000	> 3,000,000	Equal to population in 2021
	Number of certified sanatoriums	27	35	40	

7.4.2. Sub-sector 2: Water for food

Challenge 2.1: Water for livestock

The "Mongolian Livestock" National program of 2010 aims to develop a livestock sector that is adaptable to climate change and social conditions, aims to create an environment where the sector is economically viable and competitive in the market economy, aims to provide a safe and healthy food supply to the population, aims to deliver quality raw materials to processing industries, and aims to increase exports.

Wells and boreholes: Related to water, the program aims to construct or repair water wells and boreholes based on herders' ideas and initiatives, applying cost sharing for the construction, transferring responsibility for use, protection and maintenance of new and repaired wells to the herders to increase their ownership. The program plans to construct new wells and rehabilitate existing wells reaching a total of about 2500 in 2015 and 5050 in 2021. As a comparison the National Water Program aims to construct 800-1000 wells per year.

Ponds: The number of new ponds to be constructed is planned at 54 in 2015 and 125 in 2021 which seems ambitious if compared with the actual number of ponds constructed in recent years.

Herder groups: The operation and maintenance is more and more organized through local herder groups which take responsibility and ownership of the water points. The number of herder groups which have signed water use and pasture management agreements is increasing.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 44. Details of the measures are presented in Chapter 9.

Table 44. Summary of issues and measures for Challenge 2.1

Sub-sector 2: Water for food	
Challenge 2.1: Water for livestock	
Issues	**Measures**
▪ Lack of operational water points; ▪ Grazing pressure is locally unacceptably high ▪ Number of operating water points is declining; ▪ Livestock water supply system, both provide inadequate water quantity and water quality	1. Local surveys and exploration studies to identify water resources for new boreholes, ponds and reservoirs in rural areas
	2. Construction of new and renovation of existing water sources (boreholes, ponds) based on grazing capacity and desertification condition
	3. Improve the operation and maintenance of livestock water supply points
	4. Support to improve water supply of intensive livestock breeding

Challenge 2.2: Water for irrigation

The "Government policy on Food and Agriculture" and the "National food security programme" aim to increase the area under irrigation to increase the production of cereal, fodder, sea buckthorn and other crops. The total irrigated area needed to produce the planned production in 2015 is 60,000 ha and in 2021 92,000 ha (medium scenario). The areas per crop are indicated in Table 46.

The required infrastructure to supply water to the irrigated areas includes dams, ponds, weirs, boreholes, canals, pipelines, diversion works, etc. No specific targets are set for the construction of these structures. New ponds planned for livestock water supply may be used for irrigation also, but the number is not fixed.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 45. Details of the measures are presented in Chapter 9.

Table 45. Summary of issues and measures for Challenge 2.2

Sub-sector 2: Water for food	
Challenge 2.2: Water for irrigation	
Issues	**Measures**
▪ irrigation water demand will increase considerably; ▪ Water use in crop irrigation is inefficient; ▪ Limited financing capabilities hamper development of irrigated agriculture.	1. Surveys and exploration studies to identify water resources for irrigation and haymaking areas
	2. Construction and renovation of dams and reservoirs for irrigation
	3. Construction and renovation of headworks, main conveyance channel and irrigation systems
	4. Improve irrigation management
	5. Improvement of agro technology of irrigated crops and conduct water saving technology

The indicators and targets for Sub-sector 2 are summarized in Table 46.

Table 46. Performance indicators and targets for Sub-sector 2: Water for food

Performance indicator		Actual	Targets		Remarks
		2010	2015	2021	
2.1	Water for livestock				
	Number of new boreholes in rural areas	2635	2466	5050	Numbers vary in different policy documents
	Number of new ponds in rural areas	5	59	132	Includes rehabilitated ponds
	Number of herder groups for O&M of boreholes	685	900	1800	ADB (Ovorkhangai) 60 groups, IFAD (Arkhangai, Khuvsgul, Bulgan, Gobi-Altai, Khentii) 625 groups

Performance indicator		Actual 2010	Targets 2015	Targets 2021	Remarks
2.2	**Water for irrigation**				
	Irrigated area for cereal (ha)	9,400	16,950	33,000	Target based on MFALI policy
	Irrigated area for fodder (ha)	3,800	13,450	15,500	Target based on MFALI policy
	Irrigated area for potatoes (ha)	9,900	11,100	12,500	Target based on MFALI policy
	Irrigated area for vegetables (ha)	6,100	10,800	17,300	Target based on MFALI policy
	Irrigated area for fruit - sea buckthorn (ha)	600	6,900	12,500	Target based on MFALI policy
	Irrigated area for other crops (haymaking)	7,700	800	1,200	
	Total irrigated area	37,500	60,000	92,000	Target based on MFALI policy

7.4.3. Sub-sector 3: Water for industry, mining and energy

Challenge 3.1: Water for industries

Several industrialization programs have been approved by the government to increase processing capacity and to create jobs, both in urban and rural areas. Increasingly industries are expected to be supplied from supply systems separate from drinking water, are expected to increase the use of recycled water to reduce total water use and are expected to treat waste water. However there are no specific targets set in policy documents.

It is advised to undertake studies in industrial water supplies and waste water treatment to determine realistic targets for water use, water reuse and waste water treatment. Preliminary targets are used in this plan based on expert judgment which should be revised when the results of such studies become available.

The preliminary targets are:

- **For separate water supplies:** most industries in urban areas receive water from the central water supply system; a small number estimated at 10% in 2015 and 20% in 2021 will have a separate water supply possibly connected to a water reuse system.
- **For waste water treatment:** industries are required to have their own waste water treatment from which water is discharged to a central waste water treatment facility or discharged to the environment or from which water is reused; the percentage of industries with own waste water treatment is estimated preliminarily at 25% in 2015 and 50% in 2021.
- **For water reuse:** options for reuse of water need to be investigated but conditions are probably best at the industry premises; a limited preliminary target is set at 10% in 2015 and 20% in 2021.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 47. Details of the measures are presented in Chapter 9.

Table 47. Summary of issues and measures for Challenge 3.1

Sub-sector 3:	Water for industry, mining and energy
Challenge 3.1:	Water for industries
Issues	Measures
▪ Water demand by industries is expected to increase ▪ Water use by industries is highly inefficient; ▪ Industrial waste water increases beyond acceptable levels	1. Surveys and exploration studies to investigate water supply sources for big industries
	2. Implementation of water supplies for new industrial parks
	3. Implement water supplies to industries separate from drinking water supplies
	4. Implement separate waste water treatment plants for industries
	5. Reuse of industrial water

Challenge 3.2: Water for mining

The Government of Mongolia puts the highest priority on exploiting mineral deposits of strategic importance. In total 15 strategic mines were selected by the government. Most mining activities require water for their operations but are insensitive to water quality, which generally makes reuse possible. The general norm is that 70% of the discharged water is to be re-used. Water sources used are groundwater and surface water.

Most mines are likely to be established in the South Gobi area and at initial stage water for the mines will be supplied from the groundwater in the same area. In the future water demand will be increasing and it needs to be supplied from basins in which surface water resources are abundant by collecting the flood water and by transferring the water within the accepted level for the ecology (by not using the environmental runoff).

As for industries no specific targets are set in policy documents regarding water supply, water reuse or waste water treatment. It is also advised for mines to undertake studies in water supplies and waste water treatment to determine realistic targets for water use, water reuse and waste water treatment. Preliminary targets are used in this plan based on expert judgment which should be revised when the results of such studies become available.

The preliminary targets are:

- For water supplies: all mines organize their own water supply; assessment studies to determine the (additional) water resources should be completed of 8 mines before 2015 and of 11 mines before 2021; the number of water supplies to be constructed is 7 before 2015 and 19 before 2021.
- For waste water treatment: mines are required to have their own waste water treatment from which water is discharged to the environment or from which water is reused; the percentage of mines with own waste water treatment is estimated preliminarily at 25% in 2015 and 50% in 2021.
- For water reuse: options for reuse of water need to be investigated but conditions are probably good at most mines as reuse of water is implemented at many already; a high preliminary target is possible at 50% in 2015 and 90% in 2021.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 48. Details of the measures are presented in Chapter 9.

Table 48. Summary of issues and measures for Challenge 3.2

Sub-sector 3: Water for industry, mining and energy	
Challenge 3.2: Water for mines	
Issues	Measures
▪ Water demand by mining activities is expected to increase; ▪ Water use in mining operations is highly inefficient; ▪ Waste water discharged without treatment; ▪ Lack of water resources near mineral deposits constrains mining activities; ▪ Decision making on new mining operations is hampered by a lack of information on water resources.	1. Surveys and exploration studies to investigate mining water supply sources 2. Implementation of water supplies for new mining areas 3. Reuse of water used by mines 4. Treat mine waste water and dispose to the environment

Challenge 3.3: Water for energy

The energy demand in Mongolia is rising rapidly due to population and economic growth and increasing demand by the industry and mining sector. The installed capacity of hydropower plants in 2010 was 27.9 MW.

The installed capacity of thermo-power plants in 2010 was 835.7 MW. New thermo-power plants are planned for 2015 in Ulaanbaatar (450 MW), Moron and Ukhaa Hudag (600 MW). Other planned thermo-power plants are at Chandgana (600 MW), Tavan Tolgoi (300 MW) and Shivee Ovoo (3600 MW).

The targets for the energy sector are derived from the above quoted capacity. The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 49. Details of the measures are presented in Chapter 9.

Table 49. Summary of issues and measures for Challenge 3.3

Sub-sector 3: Water for industry, mining and energy	
Challenge 3.3: Water for energy	
Issues	Measures
▪ The energy production capacity needs to increase ▪ Hydropower development is restricted; ▪ Reservoirs change the regimes of the rivers and have a negative impact on ecology and water availability.	1. Research and design of hydropower plants 2. Construction of hydropower plants 3. Monitoring of water regime of hydropower plants 4. Water supply to thermal power plants new and operating 5. Investigations into geothermal potential

The indicators and targets for Sub-sector 3 are summarized in Table 50.

Table 50. Performance indicators and targets for Sub-sector 3: Water for industry, mining and energy

Performance indicator		Actual	Targets		Remarks
		2010	2015	2021	
3.1	**Water for industry**				
	% of separate industrial water supplies	-	10%*	20%*	Preliminary target
	% of industries with own waste water treatment facility	-	25%*	50%*	Preliminary target
	% of industrial waste water reused	-	10%*	20%*	Preliminary target
3.2	**Water for mining**				
	Approved assessment study of water resources at 15 strategic mineral deposits	….	8	11	
	Number of water supplies constructed by mines	….	7	19	
	% of mines with waste water treatment facility		25%*	50%*	Preliminary target
	% of mining water reused by mines		50%*	90%*	Preliminary target
3.3	**Water for energy**				
	Thermo power plants capacity (MW)	835.7	1885	6385	Target based on planned plants
	Hydropower capacity (MW)	27.9	151	471	Target based on planned hydropower stations
** The target presented here is preliminary and needs to be verified in a detailed study*					

7.4.4. Sub-sector 4: Water for the environment

Challenge 4.1: Conservation of water resources

The forested upper parts of the basins are important as runoff forming areas but these areas are not well protected. Only 30.5 % of the runoff forming areas is located inside registered national or local protected areas. An increase in runoff forming areas inside the protected areas together with an improved enforcement of the protection measures will improve the conservation of water resources. A preliminary target is set of runoff forming areas located inside registered protected areas at 50% in 2015 and 80% in 2021.

Few reservoirs exist in the upper parts of the watersheds to store surface water. Construction of additional reservoirs may augment the water storage capacity and hydropower potential. Detailed surveys are needed to investigate the potential of such reservoirs. A preliminary target is set to increase the storage capacity by 1 million m^3 in 2015 and by 2 million m^3 in 2021.

The protection of water bodies (rivers, lakes) is specified in the law and sanitation zones have been identified along the rivers in all aimags. The immediate target is to improve the enforcement of the protection.

Conservation of water resources may also be achieved by reducing the water consumption. The installation of water meters is ongoing in all urban centers. This measure is already part of issue 1.1.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 51. Details of the measures are presented in Chapter 9.

Table 51. Summary of issues and measures for Challenge 4.1

Sub-sector 4:	Water for the Environment
Challenge 4.1:	Conservation of water resources
Issues	Measures
▪ The hydrological regime of rivers is deteriorating; ▪ The protection of watersheds and water bodies is insufficient; ▪ Large amounts of water leave the country unused; preservation of water in the catchments needs to improve; and ▪ Water is used inefficiently.	1. Establish and enforce protection of runoff forming part of watershed areas
	2. Establish and enforce protection zones around water bodies
	3. Exploration to assess usable surface water and groundwater resource reserves taking into account recharge and future trends, and enforce water use within the limit which was set
	4. Installation of water meters at water users
	5. Establish recreational area on river side in cities
	6. Establish reservoirs to regulate river runoff and create water storage

Challenge 4.2: Pollution of water resources

The protection against pollution of the water resources concerns both surface water and groundwater. The protection of surface water is combined with the protection measures described in issue 4.1. The rivers with known pollution are Tuul, Kharaa, Orkhon and Khatgal. The target for polluted rivers is zero although to achieve this major efforts are required regarding waste water treatment (issues 1.1, 1.2 and 3.1) and clean up measures (issue 4.4).

The protection of groundwater is relevant at locations where groundwater is exploited or where exploitation is planned. The well fields at Ulaanbaatar and major urban areas are generally well protected. But well fields and boreholes in small urban areas often lack a physical protection. Pollution of groundwater deposits is not known to exist at present. The target for the future is to maintain this situation.

The responsibility of water users to prevent pollution of water resources is related to the polluter pays principle (PPP) which requires polluters to pay for pollution caused by their activities. The introduction of PPP is ongoing and needs enforcement.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 52. Details of the measures are presented in Chapter 9.

Table 52. Summary of issues and measures for Challenge 4.2

Sub-sector 4: Water for the Environment	
Challenge 4.2: Pollution of water resources	
Issues	Measures
▪ Untreated water is released directly to rivers or infiltrates into the soil; ▪ Failure to maintain hygienic protection zones around water bodies and water points; ▪ Increase of irrigated agriculture, combined with the use of fertilizers and pesticides threatens water quality; ▪ Discharge of untreated water from mining operations pollutes the water bodies; ▪ Discharge of industrial effluents to the sewer system renders the WWTP inefficient; ▪ Regulations to make polluters pay are ineffective	1. Protection of water resources from pollution 2. Implementation of polluter pay principle 3. Improve sanitation facilities and waste water disposal in ger areas

Challenge 4.3: Sufficient and clean water for the environment

The requirement to maintain healthy ecological conditions in rivers is often translated as environmental flow. Percentages specifying the allowable water use from upper, middle and lower parts of rivers were published in 1999. These percentages are used in this plan as new environmental flow requirements have not been determined as yet. Research to determine environmental flow requirements in Mongolian rivers is highly needed. Targets are set to carry out such research studies in 5 rivers before 2015 and 10 rivers before 2021.

The change of climate and the changing land and water use affect the ecological conditions of all wetlands and lakes in Mongolia. Measures are to be researched and defined to reduce the impact of these changes. To support these measures the number of lakes and wetlands registered under the Ramsar convention is to be increased from 11 at present to 15 in 2015 and 20 in 2021.

An increase in groundwater abstraction may lead to lower groundwater levels, affecting existing shallow wells and vegetation depending on the groundwater. Currently such reduction in groundwater levels is not yet known to happen but in future it may become a problem for people and nature.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 53. Details of the measures are presented in Chapter 9.

Table 53. Summary of issues and measures for Challenge 4.3

Sub-sector 4: Water for the Environment	
Challenge 4.3: Sufficient and clean water for the environment	
Issues	Measures
▪ Ecological conditions are deteriorating; ▪ Deterioration of biodiversity and landscape, including its clean rivers threatens tourism sector; ▪ Hydropower reservoirs have a negative impact on river ecology; ▪ Knowledge is lacking on environmental flow; ▪ Lowering groundwater tables; ▪ Deteriorating pasture land; ▪ Lake levels dropping; ▪ Measures to protect lakes and wetlands are insufficient.	1. Research to determine environmental flow in rivers 2. Improve implementation of Ramsar convention and increase number of lakes and wetlands registered in Ramsar Convention 3. Conservation of good and sustainable ecological conditions wetlands and lakes by preserving water to maintain biodiversity. 4. Improve irrigation technology of green areas in cities and enforce water supply norms 5. Prevention of negative effects due to lower groundwater levels by human activities

Challenge 4.4: Restoration of water resources

Pollution of rivers usually is caused by mining activities or urban waste water discharge. Well known cases are the Tuul River downstream of Ulaanbaatar, the Kharaa River downstream of Boroo mine and the Khatgal River downstream of Erdenet. Restoration of the water resources requires cleaning of the river sediments and termination of the pollution source. No activities have been started as yet but it is advised to start with an inventory of the existing pollution and the options for cleaning. It is advised to designate two rivers for restoration before 2015 and at least two more before 2021.

The protection of water bodies against mining activities is specified in the Law on Prohibition of Mineral Prospecting Exploration in Water Basin Areas and Forest Areas. Zones around water bodies have been defined within which the law is applicable. All zones should be defined before 2015.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 54. Details of the measures are presented in Chapter 9.

Table 54. Summary of issues and measures for Challenge 4.4

Sub-sector 4: Water for the Environment	
Challenge 4.4: Restoration of water resources	
Issues	Measures
▪ Mining activities adversely impact environment; ▪ Polluted river sediments require cleanup.	1. Make inventory, clean and reconstruct damaged and polluted river valleys
	2. Create special protected areas to protect and restore rivers and lakes with changing ecological conditions

Challenge 4.5: Hazards due to floods, droughts and dzuds and other disasters

Urban areas near rivers are prone to floods during and after periods of heavy rain. In the last decade at Ulaanbaatar two major floods occurred (2003 and 2009) in which 33 people were killed and 2275 families (about 10,000 people) were affected. Estimations of the total damage range between 400,000 and 3 million US$. The current number of people protected by flood protection structures is unknown but ongoing flood protection works are estimated to protect 122,000 people in 2015. A preliminary target of 150,000 people is set for 2021.

Drainage systems for precipitation are lacking in many urban areas. The area covered by drainage is not known while existing drainage pipes are often in a bad condition. Improvement and extension of drainage systems is required but targets are unknown. A preliminary target is used of 20% of the urban area in 2015 and of 40% of the urban area in 2021.

Rain generators are used for cloud seeding to stimulate rainfall. They are used mainly for agricultural purposes but may be used as well for firefighting or other purposes. The number of generators used is small and these belong to one company which is related to MEGD. It is planned to install an additional 10 generators each year.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 55. Details of the measures are presented in Chapter 9.

Table 55. Summary of issues and measures for Challenge 4.5

Sub-sector 4: Water for the Environment	
Challenge 4.5: Hazards due to floods, droughts, dzuds and other disasters	
Issues	Measures
▪ The environment and the water resources are vulnerable to small changes in climate; ▪ Flood protection systems are in poor condition; ▪ Flood prevention measures are not organized and no early warning systems.	1. Construction and maintenance of flood protection structures 2. Construct drainage systems in urban areas 3. Define ownership and improve maintenance and management of drainage systems in urban areas 4. Establish and enforce water management methodology and rules for drought and desertification conditions 5. Installation of rain generators to implement cloud seeding

The indicators and targets for Sub-sector 4 are summarized in Table 56.

Table 56. Performance indicators and targets for Sub-sector 4: Water for the environment

Performance indicator		Actual	Targets		Remarks
		2010	2015	2021	
4.1	Conservation of water resources				
	% of runoff forming area within protected areas	30.5%	50%*	80%*	Preliminary target
	Surface water storage volume (McM)	1	2	4	Actual storage based on volume of Taishir Dam (0.93 McM)
	Water use per capita of connected users (l/day)	200-400	200	160	
4.2	Pollution of water resources				
	Polluter pays principle is active	not	active	active	Not active at present
	Number of rivers with pollution	4	0	0	Major rivers with pollution
	Number of groundwater deposits with pollution	0	0	0	No pollution at present
4.3	Sufficient and clean water for the environment				
	Number of rivers for which environmental flow is determined	0	5	15	
	Number of lakes registered under Ramsar	11	15*	20*	Preliminary target
4.4	Restoration of water resources				
	Number of rivers designated for restoration	0	2	4	Number depends on study of river bed pollution
	% of area defined as protection zone	80%	100%	100%	
4.5	Hazards due to floods, droughts, dzuds and other disasters				
	Number of urban people protected against flooding	unknown	122000	150000*	
	% of urban area with drainage system	unknown	20%*	40%*	
	Number of rain generators in use	21	30	60	10 additional rain generators / year
* *The target presented here is preliminary and needs to be verified in a detailed study*					

7.4.5. Sub-sector 5: Enabling setting/water governance

Challenge 5.1 Legislation for water management

Inconsistencies within and contradictions between laws and regulations render such legislation powerless and ineffective, and forms a hindrance for the implementation of IWRM. Of the 50 laws in Mongolia that regulate protection of the environment, the proper use of natural resources and the restoration of available resources (see **Error!**

Reference source not found.) the 3 environment related laws, the 7 water related laws, and the Law on Household and Industrial Waste should be reviewed and made consistent as a single package of core water legislation by 2015. The remaining laws that facilitate the package of core water laws should follow and be completed by 2021. At the same time all ineffective penalties need to be adjusted to have a deterring effect.

Alternative financing options to attract private capital for financing investments in the water sector need to be investigated and the legal frameworks for promising options be prepared by 2015.

Mongolia has ratified several international treaties and conventions and has entered into trans-boundary agreements with its neighbors Russia and China. National legislation needed to implement these is lagging behind and completion is not forthcoming. These are issues with a strong political nature that make it impossible to set targets for full compliance.

Although more complete than in many other countries, Mongolia's water legislation still needs updating to address some crucial omissions as mentioned in chapter 7.3.5 (Challenge 5.1). All the issues need to be included in the legislation by 2015 and regularly be reviewed and updated thereafter.

The insufficiency in technical expertise among the enforcing agencies (the State Special Inspection Agency and its local offices) needs to be addressed urgently. Possible options are to integrate the SSIA's aimag and soum offices with their counterparts from the Ministry of Environment and Green Development; increase the staff of the SSIA with subject specialists; delegate most of the tasks to the Water Basin Organizations or a mixture of these measures. A study to select the best option and its implementation should be completed by 2015.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 57. Details of the measures are presented in Chapter 9.

Table 57. Summary of issues and measures for Challenge 5.1

Sub-sector 5: Enabling setting / water governance	
Challenge 5.1: Legislation for water management	
Issues	**Measures**
▪ Inconsistencies and ambiguity in water-related laws; ▪ Non-compliance with international treaties, conventions and agreements; ▪ Omissions in existing legislation; ▪ Enforcement is weak.	1. Coordinate, make consistent and update water related laws and combine them in a "Package Law on Water"
	2. Improve compliance with international treaties, conventions and trans-boundary agreements
	3. Update and improve rules, procedures, norms, normatives and standards
	4. Improve enforcement capacity and capabilities

Challenge 5.2 Institutional framework for water management

Major steps towards a more rational organization of water management in Mongolia already have been set recently. By 2016 the institutional framework as depicted in Figure 60 should be in place. The essence of this institutional framework is to clearly distinguish the line tasks and the coordination responsibilities.

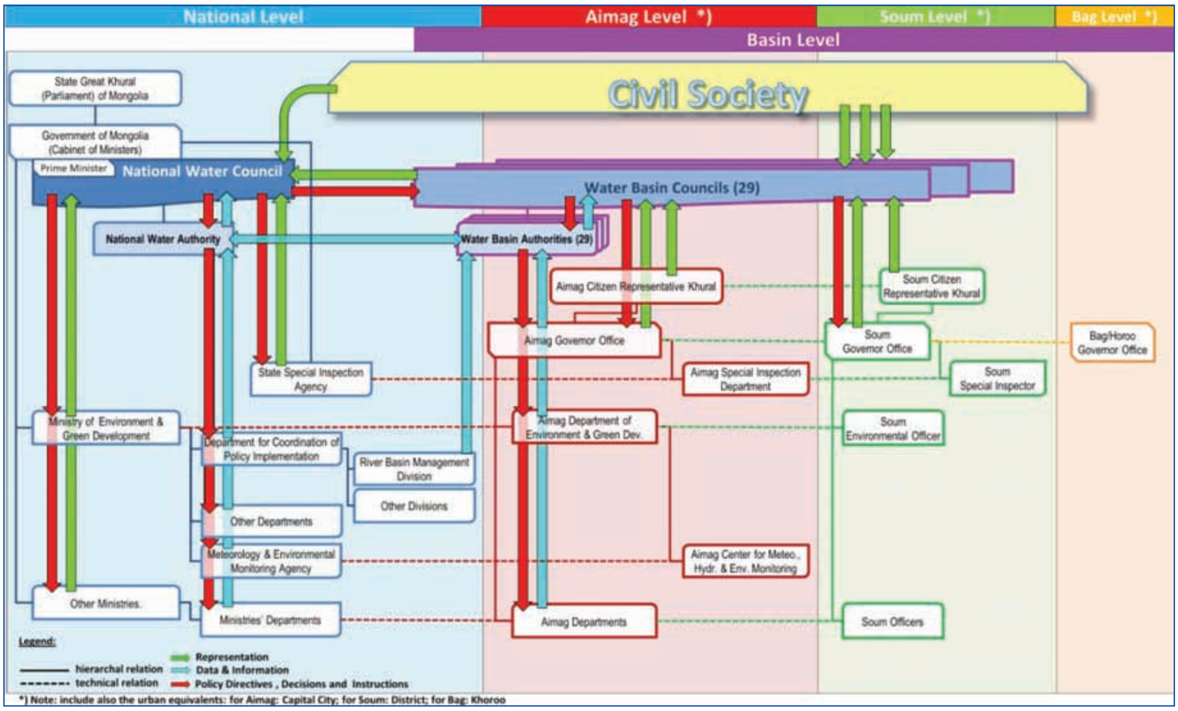


Figure 60. Proposed institutional framework for the water sector by 2015

The National Water Council at the national level and the Water Basin Councils at the basin level are composed of senior representatives of the stakeholder ministries or their departments and representatives from the civil society from the national and the local level respectively. The ratio between representatives from the public service and civil society shall be 50%-50%.

Authority of the Councils is ensured by their chairmanship: the National Water Council is chaired by the Prime Minister and reports directly to the Cabinet. Water Basin Councils should have a similar authoritative chairperson; for instance the governors of the aimags located in the basin chair the Council in turn or alternatively the Water Basin Council is chaired by a council of all Aimag Governors in the basin.

The National Water Authority and the Water Basin Authorities share a common database of all data to ensure that all authorities are completely up to date at any moment in time.

With the establishment of the National Water Council and its National Water Authority and their respective mandates and responsibilities, the total of mandates, responsibilities and tasks of all actors in water management needs to be reviewed and rationalized to remove overlaps.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 58. Details of the measures are presented in Chapter 9.

Table 58. Summary of issues and measures for Challenge 5.2

<table>
<tr><td colspan="2">Sub-sector 5: Enabling setting / water governance</td></tr>
<tr><td colspan="2">Challenge 5.2: Institutions for water management</td></tr>
<tr><th>Issues</th><th>Measures</th></tr>
<tr><td rowspan="6">At the national level
▪ Lack of effective coordination.
▪ New NWC's authority to effectively coordinate uncertain;
▪ Disbanded Water Authority leaves a gap in the institutional landscape;
▪ Overlapping in functions
▪ Shortages of adequately capable staff, budget and equipment;
▪ Data and information is dispersed and difficult to access.
At the river basin level
▪ The formal status of WBCs unclear;
▪ The establishment of Water Basin Authorities demotes the WBC to a mere consultative role.
▪ Placing the WBA's and the WBC's under this RB Management Division is contrary to the IWRM principles.
▪ A vision and planning is missing for a controlled evolution of RBO's.</td><td>1. Update status and mandate of responsible government authorities and basin organizations responsible for coordinating water issues</td></tr>
<tr><td>2. Improve the mechanisms for coordination and cooperation between sectors involved in water issues</td></tr>
<tr><td>3. Improve the operations and relations between authorities in charge of water issues at national and basin level</td></tr>
<tr><td>4. Strengthen the role of scientific research, professional water related organizations, NGOs and civil society in water management</td></tr>
<tr><td>5. Improve exchange, storage, quality control and access to water management data at national and basin levels</td></tr>
<tr><td>6. Develop a clear vision and prepare a work plan for the development of RBO's and their role in water management</td></tr>
</table>

Challenge 5.3 Financing water management

Financing for Mongolia's water sector includes financing of the planned capital investments and for operation and maintenance of the existing and new infrastructure as well as the water management institutions. The planned investments for water management are expected to peak during the years 2013-2015 with an estimated 1 trillion MNT annually on average. This is about equal to the 2011 budget allocation for capital investments for all the sectors together. This places a disproportional heavy burden on the state budget for the coming years. It is proposed to prioritize the planned works on the basis of a thorough economic analysis and spread the required investments over a longer period of time. At the same time alternative sources of financing need to be investigated and developed including the necessary legal frameworks (of the estimated 3.2 trillion MNT investment till 2015 only 0.4% is expected to come from the private sector).

Budgets for recurrent costs for water management already are insufficient and with new investments planned these will further increase. Till 2012 the increases in recurrent budgets were only reflecting the annual salary increases (see Figure 61). To address the existing budget shortages an estimated increase in real terms is required in the order of 25% by 2015 and an additional 35% by 2021. Budgets and financing sources to cover the recurrent costs need to be made available while cost reductions may be found in rationalizing water management and water management institutions by elimination duplications, inefficiencies, introducing automation and sharing of resources and data. When the projected increase in recurrent budgets in support of the establishment of additional River Basin Authorities till 2015 is actually being implemented, a major step towards realizing the target will have been set.

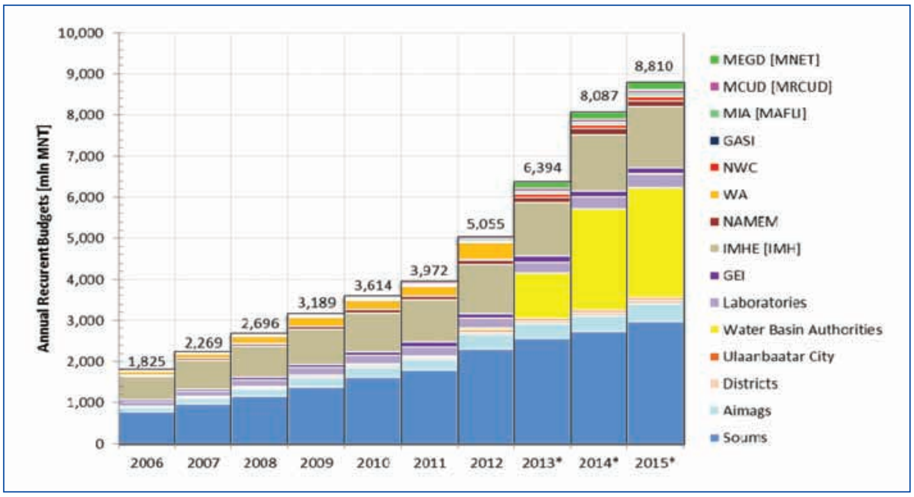


Figure 61 Development of recurrent costs in the water sector

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 59. Details of the measures are presented in Chapter 9.

Table 59. Summary of issues and measures for Challenge 5.3

Sub-sector 5: Enabling setting / water governance	
Challenge 5.3: Financing water management	
Issues	**Measures**
▪ Funding of the planned investments weighs heavily on the state's financial resources; ▪ Cost recovery is developed insufficiently; ▪ Existing legal provisions to channel revenue to the water sector are not used. ▪ Mongolia is rapidly rising to the status of middle income country, depriving it from accessing soft loans; ▪ Private sector (co-)financing cannot become source of financing soon.	1. Renew water pricing policy and improve cost recovery 2. Develop additional and alternative financial sources to finance the planned investments in the water sector 3. Improve efficiency of water sector to reduce recurrent costs

Challenge 5.4 Capacity building for water management

Adequate staffing in terms of numbers as well as qualifications for the water sector needs to be improved through: (1) offering employment conditions (in respect of salary, career options, etc.) at par with what is offered in the private sector, (2) make education centers more responsive to the sector's needs, (3) increase enrollment for vocational training among young people by promoting craftsmanship and (4) universities to design and offer refresher courses for mid-career staff in the water sector familiarizing them with the latest developments in the sector.

A thorough study needs to be completed and implemented by 2015 to recommend the most effective measures that will ensure an adequate supply of water managers, water engineers and specialists as well as technicians in a highly competitive market. This could possibly include an overhaul of Mongolia's education system.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 60. Details of the measures are presented in Chapter 9.

Table 60. Summary of issues and measures for Challenge 5.4

Sub-sector 5: Enabling setting / water governance	
Challenge 5.4: Capacity building for water management	
Issues	**Measures**
▪ Institutional human resource capacity of organizations in the water sector inadequate; ▪ Water management curricula do not meet the needs of the sector; ▪ The pool of skilled labor and artisans is insufficient.	1. Improve human resources (HR) capacity in water sector
	2. Carry out study how to improve education and training of water professionals of all levels
	3. Implement recommendations of study to improve education and training of water professionals of all levels

Challenge 5.5 Monitoring and research for water management

Monitoring data of water related variables need to be improved through improving the quality of the monitoring as well as the number of monitoring points. Improving the quality of monitoring (data) would be achieved by upgrading the current monitoring technologies, including sampling and analysis techniques, to more modern and technologically advanced methods. This would eliminate several sources of error and allow for more frequent sampling at hardly any additional costs.

Taking into account that groundwater monitoring data only become useful when prolonged time series are available, Mongolia urgently needs to establish a comprehensive groundwater monitoring network covering all relevant parts of the country. This should be a high priority and a basic grid of observation wells for groundwater levels and ground water quality monitoring should be in place by 2015 to be extended and completed by 2021. In parallel the institutional structure to carry out the monitoring and process the data should be put in place including the training of technicians and systems for storage and dissemination of data and information.

For better planning the water sector the monitoring of water use needs to be improved as well as return flows and reuse of water in the various sub-sectors. Another aspect of water management is flood protection and monitoring data on flooding and flood damage need to drastically improve to properly plan for flood protection.

For the protection of the environment and sustainable use of resources studies need to be carried out to establish the quantities and qualities of water required for ecological functions.

To effectively implement any form of "polluter-pays" concept, the monitoring system to establish the water qualities of the waste water discharged to the sewer systems and the effluents discharged on the surface water or groundwater systems by industries, mines and waste water treatment plants requires major improvements.

Research in water resources requires integrated approaches where of expertise in surface water, groundwater and ecology are included and possibly economics and social sciences as well.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 61. Details of the measures are presented in Chapter 9.

Table 61. Summary of issues and measures for Challenge 5.5

Sub-sector 5: Enabling setting / water governance	
Challenge 5.5: Monitoring and Research for water management	
Issues	Measures
▪ The quality and accessibility of data are insufficient; ▪ Monitoring of water resources is underdeveloped ▪ Comprehensive monitoring system for groundwater absent; ▪ Sampling and analysis techniques for water quality are inadequate; ▪ Water use data is not well monitored; ▪ Insufficient data on return flows and re-use of water; ▪ Insufficient data on quality of water discharged to the sewer system or surface water; ▪ Surface water and groundwater requirements for ecological functions unknown; ▪ Data on flooding are very scarce; ▪ Research in water resources misses integration of disciplines.	1. Improve and expand monitoring of quality and quantity of water resources 2. Improve sampling equipment and laboratory facilities. 3. Rationalize monitoring programs and formalize frequencies of sampling for water resources and water quality. 4. Expand and integrate water sector research and studies

Challenge 5.6 Data and information management

Poor data and information management proves to be one of the main bottlenecks for effective planning in the water sector. Rules and regulations need to be put in place and enforced immediately to make all data and information obtained with financing from public funding freely available. At the same time rules and regulations need to be put in place and enforced to safeguard and protect the quality of such data.

A central database for water sector data needs to be established where all water related government organizations and research institutes place their data to be accessible for any interested party, possibly against a nominal fee when downloading such data. Such a system shall be up and running by 2015.

Annual reporting and systematic detailed publication of results shall be made obligatory for all government organizations, institutes and projects, to be published on the internet for viewing and downloading by any interested party by 2015.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 62. Details of the measures are presented in Chapter 9.

Table 62. Summary of issues and measures for Challenge 5.6

Sub-sector 5: Enabling setting / water governance	
Challenge 5.6: Data and information management	
Issues	Measures
▪ Existing databases are not linked; ▪ Regulations for safeguarding the protection and quality of data inadequate; ▪ Regular reporting of detailed results is lacking.	1. Improve national databases, data quality control and data exchange 2. Create water database systems at basin level 3. Institutionalize regular detailed publication of results

Challenge 5.7 Public awareness of water management and public participation

Too often awareness raising campaigns, in particular campaigns initiated by governments and government agencies are quite patronizing and are perceived as 'indoctrination' campaigns. Such campaigns are counterproductive and more likely to alienate than to mobilize the general public. The way to gain the general public's trust starts with becoming transparent regarding the information being provided. NGOs are generally better agents for awareness raising than governments.

Not to underestimate the complexity of designing and executing effective awareness raising campaigns a study will be commissioned to a specialized and reputed firm having knowledge of mass psychology, communication and mass media to design a detailed awareness raising and public mobilization plan. Additional programs need to be designed focusing special target groups like industries and government officials. Implementation of an awareness raising campaign is a long term effort (possibly up to 10 years), which may include a number of one-off events, but in principle would have a continuous (or gradually evolving) theme repeated in many forms and many manifestations (as the saying goes: '*the strength of advertising is in the repetition*').

For implementation of the awareness raising strategy NGOs will be engaged both at the national and the local levels. NGOs will be given access to all relevant data, which would be most effective in the context of a broader public sector transparency and accountability program. The NGOs require a considerable degree of freedom, including criticizing the government or otherwise risk to be seen as a government agent and lose all credibility. At the national level at least two NGOs or NGO umbrella organizations will be engaged and in each river basin a minimum of two unrelated NGOs will be engaged on a long term assignment. NGOs would be compensated financially for executing the awareness raising campaigns, with arrangements in place to guarantee their continued independence.

The measures that need to be taken to address the issues and achieve the targets of this challenge are summarized in Table 63. Details of the measures are presented in Chapter 9.

Table 63. Summary of issues and measures for Challenge 5.7

Sub-sector 5: Enabling setting / water governance	
Challenge 5.7: Public awareness of water management	
Issues	Measures
▪ Importance of water management and the role of users not well known; ▪ The value of traditional methods to protect and take care of water resources not appreciated; ▪ No incentives for users to participate.	1. Design, using specialized professionals, comprehensive information and awareness raising strategies for specific target groups
	2. Implement the recommended information and awareness raising strategies
	3. Provide easy access for the public to all relevant information and data related to water resources and their use
	4. Promote and reintroduce traditional protection methods
	5. Enhance the role of NGOs as vehicles for public participation in water management at all levels

The indicators and targets for Sub-sector 5 are summarized in Table 64.

Table 64. Performance indicators and targets for Sub-sector 5: Enabling setting/ water governance

Performance indicator		Actual	Targets		Remarks
		2010	2015	2021	
5.1	Legislation for water management				
	Number of water and environmental laws reviewed and updated		11 core laws	all laws	Review focuses on making laws consistent and penalties effective
	Study options to improve enforcement agencies		study complete	implemented	
5.2	**Institutions for water management**				
	Institutional framework for IWRM (see Figure 60)		in place	Evaluated and updated	IWRM inst. framework includes full mandates with NWC and WBCs
	Number of WBC's and WBA's established	3	12	29	
5.3	**Financing the water sector**				
	Operational budgets of Water Management organisations	3,600 mMNT	+ 25%	+ 35%	Targets are increases in real terms

Performance indicator		Actual	Targets		Remarks
		2010	2015	2021	
5.4	Capacity building for water management				
	Study options to improve sustained supply water professionals		study complete	implemented	Study covers formal education, vocational training and incentive structures
5.5	Monitoring and research for water management				
	Number of groundwater monitoring wells	?	basic grid in place	Grid completed	
	Number of surface water monitoring points	?	??	??	
5.6	Data and Information management				
	Central water sector database		in place	open to public	All organisations are obliged to provide their data.
5.7	Public awareness of water management and public participation				
	At least 2 NGOs engaged long-term for awareness raising		in 10 river basins	in 29 river basins	
	Ratio public service and civil society members in NWC and WBCs	?	<75% - >25%	50% - 50%	

7.5. Inventory and evaluation of measures

Based on analyses of the 20 challenges with a total of 96 issues as described in the previous section, a full inventory was made of the measures that can be implemented to solve the issues or contribute to reaching the policy objectives. This inventory yielded a list of 88 measures with potential (see Table 65). A summary overview of the measures is presented in Table 84.

Table 65. Number of Challenges, Issues and Measures

Water Sub-sectors	Challenges	Issues	Measures
Water for people	3	11+4+2	8+5+3
Water for food and agriculture	2	4+3	4+5
Water for industry, mining and energy	3	3+5+3	5+4+5
Water for the environment	5	4+6+8+2+3	6+3+5+2+5
Enabling setting / water governance	7	4+10+5+3+10+3+3	4+6+3+3+4+3+5
TOTAL	20	96	88

The measures included in the list of measures with potential are drawn from measures already proposed in existing policy documents and from measures suggested during discussions with stakeholders, and have been complemented with measures formulated by the project team on the basis of analyses of the issues. The most important sources have been the Water National Programme, the Ulaanbaatar Master Plan (in Mongolian) and policy documents of the stakeholder ministries. Some of the measures translate into a single activity; others are combinations of several activities. Further detailing of the measures such as locations, sizes or capacities, timing, costs and financing are presented in Chapter 9.

The Water National Programme, published in 2010, proposes 67 measures to be implemented in the period 2011-2015. Another 29 measures are identified for implementation in the years 2016-2021. The measures are sub-divided in 6 broad categories according to the strategic goals of the Water National Programme. The categories commonly applied in water resources planning are covered: ‘development of the resources’ (making more water available), reduction of the demand’ (e.g. by reduction of losses or re-use of the water), ‘protection of the resource’ (e.g. by treatment of waste water, decrease of pollution loads), ‘water governance’ (institutional, organizational and legal aspects) and ‘research and development’ (e.g. by monitoring, capacity building).

7.5.1. Screening criteria and classifying measures

When planning the implementation of the proposed measures choices will need to be made. This IWM Plan covers the period till 2021 and not all issues are equally urgent. Moreover the available implementation capacity is not sufficient to implement all measures at once and the necessary financial resources cannot all be made available at once. To assist in making such choices the measures have been screened on their performance with respect to the policy objectives and issues that they are supposed to address. The aim of this screening is to provide an insight on how promising each measure is in solving present and expected water related issues. The screening is based on expert judgment and not on quantitative data, but has sufficient safeguards build in to avoid personal bias to distort the outcome.

The criteria used in the screening have been defined in a way making them mutually independent (to avoid double counting) while each refers to a single aspect only (to avoid ambiguity). The five criteria used in the screening are the following:

- **Effectiveness** (assesses the problem solving capacity of the measure):
- Effective measures are those which solve the most serious problems and have the highest impact on the objectives.
- **Efficiency** (assesses the economic soundness of the measure):
- Efficient measures are those that generate an immediate and lasting increase in economic returns.
- For investment (‘hard’) measures the benefit-cost ratio (BCR) at the national level is an indicator to represent efficiency. For regulatory (‘soft’) measures the effect on profitability of economic activities is an indicator.
- **Legality** (assesses the institutional and legal suitability of the measure):
- Legal measures can be completely implemented within the existing institutional framework and do not rely on uncertain legal or institutional amendments.
- **Legitimacy** (assesses the social acceptability and sustainability of the measure):
- Legitimate measures are those that are supported by the general public and directly improve the socio-economic conditions of as many stakeholders as possible.
- **Sustainability** (assesses the environmental sustainability of the measure):
- Sustainable measures are those which improve (or at least maintain) the present environmental conditions for the next generations.

The screening was made by scoring each measure on each of the five criteria according to the scoring matrix presented in Table 66. Any personal bias or preference of the evaluators is eliminated as much as possible by strictly defining the criteria and scoring basis and using the same criteria and the same scoring base for screening all the measures.

It is not very likely that any measure will score high on all criteria as measures designed to solve a particular issue in most cases have some negative side effects with regard to one or several other criteria, e.g. environmental conservation measures usually have a very low financial return; water abstraction measures in general will serve economic or social developments but often have a negative impact on the environment. This is normal and cannot be avoided and often such measures are combined with other measures to mitigate the negative side effects.

Adding the scores on these five criteria for each measure makes it possible to categorize the measures and rank them. Measures that score plusses on most criteria and only few or no minuses are preferred over those whose positive scores on a few criteria are negated by negative scores on other criteria. Measures are ranked in 4 categories on the basis of a total score that is derived by adding the plusses and deducting the minuses (the maximum score would be 10 when a measure scores (+ +) on all criteria and the lowest score would be -10 when a measure scores (- -) on all criteria):

Rank 1: very promising; total score >7; (high) positive scores on (almost) all criteria and hardly any negative effects on other criteria.

Rank 2: fair; total score > 4; positive scores on most categories and some negative effects on others or low positive scores combined with some neutral scores.

Rank 3: uncertain; total score > 1; positive scores still dominate but negative scores are considerable giving reason for concern.

Rank 4: poor; total score ≤ 1; positive scores on some criteria are (almost) completely negated by the negative effects on others.

Table 66. Scoring matrix for measure screening

Scores: Criteria	++	+	o	-	- -
Effectiveness (problem solving capacity)	preventing a major cause of the issue	solving a major cause of the issue	keeping a major cause of the issue under control	failing to address a major cause of the issue	failing to address the issue at all
Efficiency (economic soundness) for 'hard' measures	BCR >>1; economic benefits by far exceeding the costs	BCR>1; economic benefits exceeding the costs	BCR~1; economic benefits about balancing the costs	BCR <1; economic costs exceeding the benefits	BCR <<1; economic costs by far exceeding the benefits
for 'soft' measures	multiplying economic profitability	supporting economic profitability	not affecting economic profitability	constraining economic profitability	diminishing economic profitability
Legality (institutional and legal suitability)	not requiring any legal or institutional amendment	requiring a minor legal or institutional amendment	requiring a legal or institutional amendment	requiring a major legal or institutional amendment	requiring several major legal or institutional amendments
Legitimacy (social sustainability)	having broad public support; improving socio-economic conditions of many stakeholders	having public support; improving socio-economic conditions of some stakeholders	having little public support; improving socio-economic conditions of only few stakeholders	having no public support; not improving socio-economic conditions of stakeholders	being opposed by public; worsening socio-economic conditions of stakeholders
Sustainability (environmental sustainability)	causing a lasting improvement of the environmental conditions	improving the environmental conditions	maintaining the current environmental conditions	temporary having a negative impact on the environmental conditions	having a lasting negative impact on the environmental conditions

Effect of cost of measures

The total cost of a measure is also a criterion to be taken into account, although it is not a criterion of the same caliber as the five discussed above. In particular when financing is a constraining factor, very costly measures would be less attractive than cheaper measures of the same rank as for the cost of one expensive measure several cheaper measures could be implemented. By classifying measures as expensive, medium and cheap, the total scores on the performance criteria can be somewhat adjusted upwards or downwards, which in some cases elevates a measure to a higher rank and in other cases lowers it ranking. A considerable number of measures do not require any significant investments or O&M financing at all, like most of the 'soft' measures that include the formulation or modification of laws, rules and regulations. There are no financial constraints to implement such measures at all. The following four cost classes are distinguished:

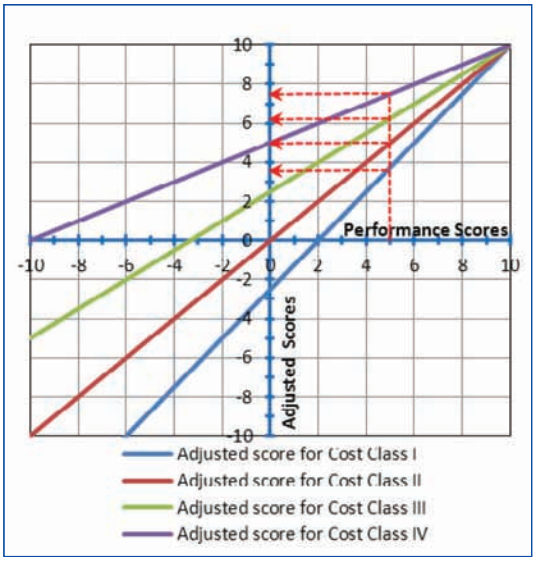


Figure 62 Adjustment of performance score

Cost Class I:	Expensive: Total investment > 200,000 mln MNT (> € 100 mln)
Cost Class II:	Medium costly: Total investment > 20,000 mln MNT (> € 10 mln)
Cost Class III:	Cheap: Total investment < 20,000 mln MNT (< € 10 mln)
Cost Class IV:	No significant investment required < 200 mln MNT (< € 0.1 mln)

Adjustment of performance scores as a result of the cost of the measure is made on the basis of Figure 62. The adjustment is downward for cost class I and upward for classes III and IV. Cost class II is not corrected for costs. The adjusted score can be found by connecting the performance score on the X-axis with the adjusted score on the Y-axis using the appropriate adjustment line. The outcomes of the screening of the measures are presented in Table 67.

7.5.2. Screening results of the measures

The evaluation of the measures was carried out by a group of nine national and international water sector experts, each of whom has a good and detailed understanding of Mongolia's water sector and its issues. The final scores for the measures on the evaluation criteria reflect the dominant opinion of the group of experts. Not surprisingly only very few measures jump out for being very promising. This is due to the fact that almost every measure scores good one some criteria and poorly on others. For the same reason hardly any measure scores poor overall, simply because it was selected in the first place for being promising on at least one aspect. As a result most measures end up scoring in the middle rankings of 2 or 3. This may seem a disappointing and not very useful outcome, but its value will become evident when these results are used to evaluate different strategies in the next chapter.

Table 67. Ranking and screening results of the measures

No	Measure description	Location	Evaluation					Ranking	Cost Class
			Effectiveness	Efficiency	Legality	Legitimacy	Sustainability		
Ranking:	1 Very promising; 2 fair; 3 uncertain; 4 poor								
Sub-sector 1. Water for people									
Challenge 1.1 Safe drinking water and optimal waste water treatment in urban areas									
1.1.1	Establish and enforce sanitation and protection zones	UB City	+ +	o	+ +	+	+ +	1	III
		21 Aimag Centers	+ +	o	+ +	+	+ +	1	III
		9 urban centers	+ +	o	+ +	+	+ +	1	IV
1.1.2	Local surveys and exploration studies at new or existing resources	UB City	+ +	o	+ +	+	o	2	III
		8 Aimag Centers	+ +	o	+ +	+	o	2	III
		1 urban center	+ +	o	+ +	+	o	1	IV
1.1.3	Construction and renovation of water supply sources	UB groundwater	+ +	o	+ +	+ +	o	2	II
		UB Tuul dam	+ +	-	+ +	o	-	4	I
		20 Aimag Centers	+ +	o	+ +	+ +	o	2	III
		Altai/Gobi-Altai	+ +	o	+ +	+ +	o	2	II
		12 urban centers	+ +	o	+ +	+ +	o	2	III
1.1.4	Renovation and expansion of water supply network	UB City	+ +	o	+ +	+ +	o	2	I
		Aimag Centers	+ +	o	+ +	+ +	o	2	I
		8 urban centers	+ +	o	+ +	+ +	o	2	II
1.1.5	Construction and renovation of WWTPs	UB City	+ +	-	+ +	+	+ +	2	I
		21 Aimag Centers	+ +	-	+ +	+	+ +	2	II
		14 urban centers	+ +	-	+ +	+	+ +	2	II
1.1.6	Renovation and expansion of sewerage network	UB City	+ +	-	+ +	+ +	+ +	2	I
		21 Aimag Centers	+ +	-	+ +	+ +	+ +	2	I
		11 urban centers	+ +	-	+ +	+ +	+ +	2	II
1.1.7	Reuse of domestic and treated waste water	UB City	- -	-	-	o	+	4	II
		Aimag Centers	- -	-	-	o	+	4	III
		Urban centers	- -	-	-	o	+	4	III
1.1.8	Water supply / waste water treatment at army camps & border posts	9 Army camps	-	-	+ +	+	o	3	III
		20 Border posts	-	-	+ +	+	o	3	III
Challenge 1.2 Safe drinking water and optimal waste water treatment in rural areas									
1.2.1	Establish and enforce protection zones around water sources.	Soum centers	+ +	-	+	+	+ +	2	III
1.2.2	Surveys of new / existing water resources at soum centers	Soum centers	+ +	-	+ +	+	o	2	III
1.2.3	Construct water supplies in soum centers and in rural areas	Soum centers	+	o	+ +	+ +	o	2	II
		Rural areas	+	o	+ +	+ +	o	1	IV
1.2.4	Construct small WWTPs in soum centers and organize reuse of water	Soum centers	+	-	+ +	+	+ +	2	II
1.2.5	Implementing sustainable water treatment facilities	65 Soum centers	+	-	+ +	+	o	2	III
Challenge 1.3 Water for tourism and sanatorium									
1.3.1	Improve water supply infrastructure for tourism and sanatorium	National	+	+	+ +	o	o	2	III
1.3.2	Improve water supply and utilization of high-tech WWTP in tourist camps	National	+	-	+ +	o	+	3	II
1.3.3	Develop mineral springs for spa resorts and sanatoriums	National	+	+	+ +	o	o	2	III
Sub-sector 2. Water for food and agriculture									
Challenge 2.1 Water for livestock									
2.1.1	Surveys to identify water resources in rural areas	Rural areas	+ +	o	+ +	+	o	2	III
2.1.2	Construction of new and renovation of existing water sources	Rural areas	+ +	o	+ +	+ +	+	2	II
2.1.3	Improve O&M of livestock water supply points	Rural areas	+ +	+	+ +	+ +	+	1	III
2.1.4	Support to improve water supply of intensive livestock breeding		+	o	+ +	o	o	2	III
Challenge 2.2 Water for irrigation									
2.2.1	Surveys to identify water resources for irrigation and haymaking	Rural areas	+ +	o	+ +	+	o	2	III
2.2.2	Construction and renovation of dams and reservoirs for irrigation	Rural areas	+	o	+ +	o	-	3	III
2.2.3	Headworks, main conveyance channel and irrigation systems	Rural areas	+	o	+ +	o	-	4	I
2.2.4	Improve irrigation management	Rural areas	+	+	+ +	+	+	2	III
2.2.5	Agro technology of irrigated crops and water saving technology	Rural areas	+	+	+ +	o	+	2	III
Sub-sector 3. Water for industry, mining and energy									
Challenge 3.1 Water for industries									
3.1.1	Surveys to investigate water supply sources for big industries	3 cities	+ +	+	+ +	o	o	2	III
3.1.2	Implementation of water supplies for new industrial parks	3 cities	+ +	+ +	+	+	o	2	II
		Soum centers	+ +	+ +	+	+	o	2	II
3.1.3	Water supplies to industries separate from drinking water supplies	UB City	-	o	o	o	+	3	III
		12 urban centers	-	o	o	o	+	3	III
3.1.4	Implement separate WWTPs for industries	UB City	+ +	-	o	-	+ +	3	II
		Urban centers	+ +	-	o	-	+ +	3	II
		Soum centers	o	- -	o	-	+ +	4	II
3.1.5	Reuse of industrial water	National	-	o	o	-	+	3	III

No	Measure description	Location	Evaluation					Ranking	Cost Class
			Effectiveness	Efficiency	Legality	Legitimacy	Sustainability		
Ranking:	1 Very promising	2 fair	3 uncertain	4 poor					
	Challenge 3.2 Water for mines								
3.2.1	Surveys to investigate mining water supply sources	15 mines	+ +	+ +	+ +	o	o	2	III
3.2.2	Implementation of water supplies for new mining areas	21 mines	+ +	+ +	+	+	o	2	I
		Orkhon-Gobi transfer	+	-	+	+	-	4	I
3.2.3	Reuse of water used by mines	15 mines	+ +	+	o	+	+	2	II
3.2.4	Treat mine waste water and dispose to the environment	21 mines	+ +	- -	o	+	+ +	3	I
	Challenge 3.3 Water for energy								
3.3.1	Research and design of hydropower plants	Various rivers	+	-	+ +	+	+	3	II
3.3.2	Construction of hydropower plants	Shuren	+ +	+	+	+	-	3	I
3.3.3	Monitoring of water regime of hydropower plants	Hydro dams	+	-	+ +	-	+	3	III
3.3.4	Water supply to thermal power plants new and operating	UB City + 2	+	+	+ +	+	o	2	III
3.3.5	Investigations into geothermal potential	Khangai moutains	+	o	+ +	o	o	2	III
	Sub-sector 4. Water for the environment								
	Challenge 4.1 Conservation of water resources								
4.1.1	Establish / enforce protection of runoff forming part of watershed areas	23 watersheds	+ +	-	+	- -	+ +	3	III
4.1.2	Establish and enforce protection zones around water bodies	Main rivers	+ +	-	+ +	-	+ +	2	III
4.1.3	Assess water resource reserves and enforce water use within the limit	All river basins	o	-	o	-	+	3	III
4.1.4	Installation of water meters at water users	UB City	+	+	+ +	-	+	2	III
		Urban areas	+	+	+ +	-	+	2	III
4.1.5	Establish recreational area on river side in cities	UB + other cities	-	-	o	+	-	4	III
4.1.6	Establish reservoirs to regulate river runoff and create water storage	Altai and Khangai	o	- -	o	-	- -	4	III
	Challenge 4.2 Pollution of water resources								
4.2.1	Protection of water resources from pollution	All river basins	+ +	o	+	+	+ +	2	II
4.2.2	Implementation of polluter pay principle	All river basins	+ +	+	+	o	+ +	2	III
4.2.3	Improve sanitation facilities and waste water disposal in ger areas	Ger areas	+	-	+ +	+ +	+ +	2	II
	Challenge 4.3 Sufficient and clean water for the environment								
4.3.1	Research to determine environmental flow in rivers	22 main rivers	+ +	o	+ +	o	+	2	III
4.3.2	Implementation of Ramsar convention and increase nr of registered lakes	National	+	-	+	o	+ +	2	IV
4.3.3	Conservation of sustainable ecological conditions wetlands and lakes	National	+ +	o	+	o	+ +	2	III
4.3.4	Improve irrigation green areas in cities and enforce water supply norms	UB + other cities	-	-	+ +	o	o	3	III
4.3.5	Prevention of negative effects due to lower groundwater levels	Near cities/mines	+	-	o	+	+	3	III
	Challenge 4.4 Restoration of water resources								
4.4.1	Make inventory, clean / reconstruct damaged and polluted river valleys	Damaged valleys	+ +	-	+ +	+	+ +	2	II
4.4.2	Create special protected areas to protect and restore rivers and lakes	Forest/wetlands	+ +	-	+	+	+ +	2	III
	Challenge 4.5 Hazards due to floods, droughts, dzuds and other disasters								
4.5.1	Construction and maintenance of flood protection structures	UB City	+ +	o	+	+ +	+	2	II
		Urban areas	+ +	o	+	+ +	+	2	II
4.5.2	Construct drainage systems in urban areas	UB + other cities	+ +	o	+	+ +	+	2	II
4.5.3	Define ownership and improve O&M of drainage systems in urban area	UB + other cities	+	o	o	+	o	2	IV
4.5.4	Establish / enforce water management for drought and desertification	National	o	-	o	+	o	2	IV
4.5.5	Installation of rain generators to implement cloud seeding	Upper watersheds	+	o	+ +	o	o	2	III
	Sub-sector 5. Enabling setting / water governance								
	Challenge 5.1 Legislation for water management								
5.1.1	Coordinate water related laws and make consistent		+ +	o	-	-	+	2	IV
5.1.2	Improve compliance with international treaties and conventions		+	o	-	-	+	2	IV
5.1.3	Update and improve rules, procedures, norms and standards		+ +	o	+	+	+	1	IV
5.1.4	Improve enforcement capacity and capability		+ +	-	o	o	+ +	2	IV
	Challenge 5.2 Institutions for water management								
5.2.1	Update status and mandate of authorities in charge of water		+ +	o	- -	-	+	2	IV
5.2.2	Improve coordination and cooperation mechanisms		+ +	+	-	-	+	2	IV
5.2.3	Improve operations of water authorities at national and basin levels		+ +	+	-	o	+	2	IV
5.2.4	Strengthen the role of sciencech, professionals, NGOs and civil society		+	o	o	o	+	2	IV
5.2.5	Improve exchange, storage, quality control and access to data		+ +	+	-	o	+ +	2	IV
5.2.6	Develop vision and prepare a work plan for the development of RBOs		+ +	o	o	-	o	2	IV

No	Measure description	Location	Evaluation					Ranking	Cost Class
			Effectiveness	Efficiency	Legality	Legitimacy	Sustainability		
Ranking: 1 Very promising; 2 fair; 3 uncertain; 4 poor									
Challenge 5.3 Financing the water sector									
5.3.1	Renew water pricing policy and improve cost recovery		+	+	-	- -	o	2	IV
5.3.2	Develop alternative financial sources to finance water sector		+ +	+	-	o	-	2	IV
5.3.3	Improve efficiency of water sector to reduce recurrent costs		+	+	o	o	o	3	III
Challenge 5.4 Capacity building for water management									
5.4.1	Improve human resources capacity in water sector		+ +	+	+	o	+	1	IV
5.4.2	Study to improve education and training of water professionals		+ +	o	+ +	o	o	2	III
5.4.3	Implement recommendations of study (5.4.2)		+	o	o	o	o	3	III
Challenge 5.5 Monitoring and research for water management									
5.5.1	Improve and expand monitoring of water resources		+ +	o	+	+	+	2	III
5.5.2	Improve sampling equipment and laboratory facilities.		+ +	o	+ +	o	o	2	III
5.5.3	Rationalize monitoring programs and formalize		+ +	-	+	o	+	2	IV
5.5.4	Expand and integrate water sector research and studies		+	o	+	o	+	2	IV
Challenge 5.6 Data and Information management									
5.6.1	Improve national databases, data quality control and data exchange		+	o	-	-	+	3	III
5.6.2	Create water database systems at basin level		+	o	+ +	o	+	3	II
5.6.3	Institutionalize regular detailed publication of results		+	o	o	o	+	2	IV
Challenge 5.7 Public awareness of water management and public participation									
5.7.1	Design comprehensive information and awareness raising strategies		+	o	+ +	-	o	3	III
5.7.2	Implement recommended information strategies		+	o	+	o	+	2	IV
5.7.3	Provide easy access for the public to relevant information and data		+	o	+	+	+	2	IV
5.7.4	Promote and reintroduce traditional protection methods		o	o	+ +	+	+	2	IV
5.7.5	Enhance the role of NGOs in water management at all levels		+	o	+	+	+	2	III

PART F – STRATEGIES TO ADDRESS THE ISSUES

8. Strategies for the Integrated Water Management Plan

This chapter describes strategies for achieving the objectives of the Integrated Water Management Plan for the period up to 2021. The strategies fit within the policy contexts as mentioned in Chapter 6 and address the present and anticipated issues described in the previous Chapter 7 (see Figure 63). The first strategies being discussed are those based on policy preferences with regard to the 3 key development objectives (Economic development, Social improvement and Environmental conservation). By applying weighing factors to the evaluating criteria used for ranking the measures in Chapter 7 four policy-based strategies are developed. Then strategies are developed for what to do when the required financing for the implementation of the IWM Plan is not forthcoming as planned. The measures as defined in Chapter 7 are ranked to determine the suitability of a measure for each of the strategies.

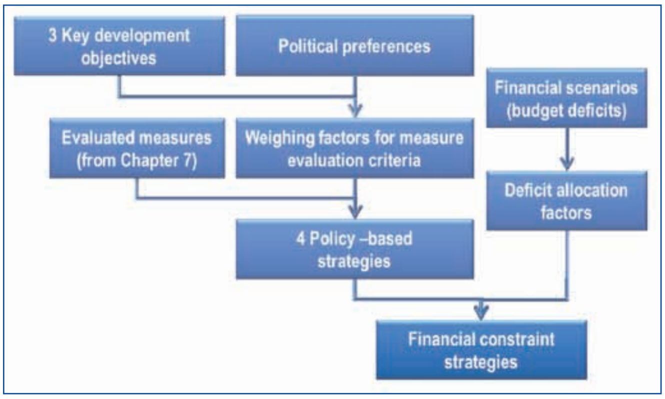


Figure 63 Flow diagram of the analysis

The objectives of IWM Plan that may be summarized by the modern concepts of 'Water security' and 'Green Growth' are best achieved through an IWRM approach. Lately, in international discussions on the subject, the three concepts 'Water Security', 'Green Growth" and 'IWRM' are presented more and more often as an inseparable trinity. The IWRM approach for this IWM Plan is structured according to the five strategy components as introduced in Chapter 6. The strategy components with the respective measures are described in detail in Chapter 9.

For the preparation of this IWM Plan assumptions on future developments have been made. Surely the future will not develop exactly as assumed and therefore high and low scenarios have been defined in a way that it is most likely that the future will develop somewhere between these high and low scenarios. Nevertheless, events may take place beyond the control of the planners affecting, and posing a risk to the plans presented in this IWM Plan. At the end of this chapter a number of possible risks are discussed.

8.1. Strategies based on political preferences

In the introduction of the MDG-based Comprehensive National Development Strategy the State Great Khural makes clear that Mongolia's advance towards a sustainable and prosperous future will be built on three pillars or key objectives:

- Economic development
- Social improvement
- Environmental conservation

Box 11

"...The objective of the MDG-based Comprehensive National Development Strategy of Mongolia is to protect and strengthen Mongolia's sovereignty, and develop it into a middle income country through achieving its Millennium Development Goals attaching high priority to promoting private sector-led dynamic economic growth, human development in Mongolia including education, healthcare, as well as sustainable development of science, technology and environment, strengthening intellectual development and human capacity; creating a knowledge-based economy sustained by high technology, which respects environmentally friendly production and services; fostering a democratic system of governance, which serves its citizens, protects human rights and freedoms, and is free from corruption and red tape..."

State Great Khural of Mongolia

Resolution No. 12, 31 January 2008

Setting out to achieve either of these key objectives separately would be quite well possible. However, combining the three in a single development policy will considerably complicate matters as any activity designed to achieve one particular objective will, in almost all cases, be detrimental to achieving one or both of these other key objectives. For example developing large scale mining for economic development is often posing a serious threat to the environment; or converting vast areas of land into protected areas for environmental conservation limits the freedom of citizens to utilize such lands or prohibits exploitation of mineral resources in such areas. As a consequence, measures designed to pursue one of these objectives would most probably require additional measures again to mitigate the negative effects on the other objectives, making it much more costly. Another option is to curtail such a measure to reduce adverse effects on other objectives, which means accepting sub-optimal solutions. In short this implies that implementation of the MDG-based National Development Strategy will become a continuous process of balancing and compromising between its three key objectives.

'*Politics is the art of compromising*', and although all national policy makers would agree on these three key objectives for development, they are likely to differ on which is the most important one. Policy makers will be biased towards either one of these three objectives and so will successive governments as these three key objectives represent the three mainstream political visions or orientations: liberalism, socialism and environmentalism. Policy makers as individuals and governments as a whole would have an inclination towards either of these political visions, which in turn would decide on how they look upon the advantages versus the disadvantages of proposed measures.

This IWM Plan has been prepared to assist policy makers to take decisions on water management, in particular when choices need to be made between different measures for instance in cases when human or financial resources are constrained. To facilitate such decision-making the measures proposed in this IWM Plan are analyzed from three different angles that could be labeled as three *policy strategies* as follows:

- **Economic development strategy**: This strategy has a liberal bias and gives preference to facilitating economic activities considering a fast growing GDP the engine of national development. Any damage to the environment or social inequity is considered an acceptable price to pay that can be rectified later from the wealth generated by the same economic development.
- **Social improvement strategy**: This strategy has a socialist bias and gives preference to social equity and making immaterial social improvements such as education and health accessible to all, even when that makes such activities loss-making.
- **Environmental conservation strategy**: This strategy has an environmentalist bias and gives preference to environmental conservation, protection and restoration. Under this strategy economic development and human activities are curtailed

when it poses a threat to the environment and a reduction of GDP-growth and human freedom is considered acceptable in the light of environmental sustainability.

Proponents of each of these policy orientations have different priorities and would rank the measures proposed in this IWM Plan differently.

8.1.1. Weighing factors for screening criteria

For the screening presented in the previous chapter the five criteria (Effectiveness, Efficiency, Legality, Legitimacy and Sustainability) have all been considered equally important, in other words all have been given the same weight. This would make it a fourth strategy: the *neutral strategy*. The criteria used for the screening of the measures have been defined in such a way that the various strategies can be characterized by varying the weight attached to each of the criteria as illustrated in Figure 64.

To facilitate a fair comparison of the outcomes of the different strategies the weights allocated to each of the five criteria should sum up to the same total for each of the strategies - the difference is in the distribution of this total of weights among the five criteria. In the neutral strategy, for which all criteria were considered equally important, each of the criteria would be given a weight equal to 1.0; this would bring the total of the weights for the five criteria to 5.0.

The economic development strategy places economic growth at the highest priority and considers measures that constrain economic growth and profitability as undesirable. Obviously the strategy prefers efficient and effective measures and some environmental damage or social inequity caused by pursuing the objective of economic growth is considered acceptable, as it will be more than compensated by the increase in wealth. Under this strategy any necessary amendments in laws or restructuring of institutions are not considered as constraints as these are meant to optimally serve economic development as well.

The social improvement strategy gives high importance to the criterion of legitimacy (= social sustainability). The strategy primarily aims to achieve improvements of the social conditions of the population in general. It is therefore also important that the measures are effective. Whether the measure requires institutional adjustments or whether the measure is costing the state is not considered an issue. The social strategy is not really concerned about the economic profitability of the measure. The social improvement strategy does have some concern for the environment, but environmental measures that result in an increase in cost of living for the ordinary person are not supported.

The environmental strategy evolved from the perception that we borrow the world as we know it from future generations and that we are obliged to hand over this world to future generations in the same if not better condition as we received it. The strategy considers any activity that threatens the (environmental) sustainability as highly undesirable and places the highest priority on measures that improve (or at least maintain) the environment. Even if that goes at the cost of profitability or personal freedom to exploit natural resources. When necessary, laws and institutions have to be adapted.

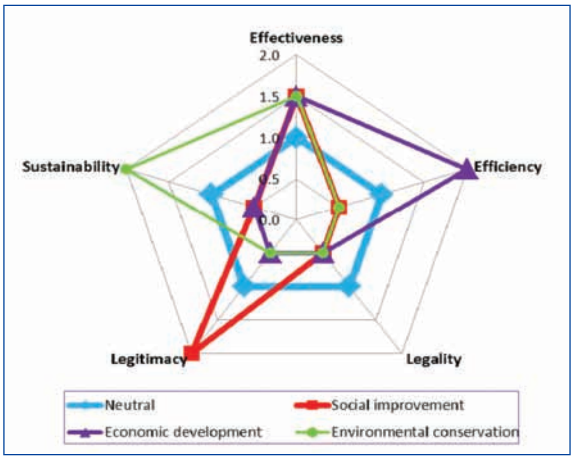


Figure 64. Weighing factors defining different strategies

Figure 64 gives a good impression on how these strategies as described above translate into weights (=importance) for different criteria depending on the particular emphasis of the different strategies. As for a fair comparison of the strategies the sum of the weights should always add up to a total of 5, it implies that increasing the weight on one criterion requires lowering the weight of other criteria. Hence, all these strategies balance an increased weight for a preferred criterion with lowering the emphasis on other criteria. This is best illustrated by comparing each of the strategies with the neutral strategy.

As was the case with scoring the screening criteria, the selection of the weights is not entirely objective and could be debated. However, the final rankings proved not very sensitive to small variations in the weighing factors. Therefore the selection of weights to express the preferences (and consequent concessions) for the various strategies has been limited to doubling or halving the weights compared to the neutral strategy. Any further detailing by introducing fractions would suggest an accuracy that has no actual scientific basis. The weighing factors as applied to the criteria when ranking the measures for the various strategies are as presented in Table 68.

Table 68. Weighing factors for the strategies

Weighing factors	Criteria				
Strategies	Effectiveness	Efficiency	Legality	Legitimacy	Sustainability
Neutral	1.0	1.0	1.0	1.0	1.0
Social improvement	1.5	0.5	0.5	2.0	0.5
Economic development	1.5	2.0	0.5	0.5	0.5
Environmental conservation	1.5	0.5	0.5	0.5	2.0

When applying the weighing factors and recalculating the scores the measures received for each of the five screening criteria (presented in Table 67), a different picture of the ranking emerges that represents the preferences and priorities from the three political strategies (when including the neutral strategy it makes four strategies). This is illustrated in Table 69 - Table 73. The considerations regarding adjustment of the scores of the measures on the basis of the effect of costs have been kept the same for each strategy. Looking at the results it is obvious that different political strategies with different policy orientations yield different assessments of how promising particular measures are.

8.1.2. Explanation and interpretation of the ranking

Addressing the preferences of different policy strategies.

This IWM Plan covers the period till 2021 and even after 2021 the plan will not suddenly become invalid overnight. This period will cover the tenure of several successive governments in Mongolia. It cannot be predicted how each of these governments would wish to approach the future, but it is safe to assume that their views are likely to change over time. By presenting this IWM Plan from different policy strategies makes it possible for governments with different political inclinations to use this IWM Plan.

A government will primarily look at the high ranking measures of the strategy that matches with their political orientation. The ranking of the measures for that policy strategy would represent the priority ranking for that government when it comes to making choices. A ‘socialist’ government would look at the social improvement strategy; a ‘liberal’ government would find the economic development strategy to best represent its preferences and a ‘green’ government would prefer the environmental conservation strategy.

However, governments are seldom exclusively socialist, liberal or green. Governments usually try to address all the issues, but only when they are forced to choose, they may make different choices, based on their political bias. In the ideal case when the required resources (human resources, financial resources, time, etc.) are ***not*** a limiting factor, all the measures could be implemented and all needs and preferences would be met. However, the reality is that there are always constraining factors – if not financing or human resources, time will always be a constraint. Measures simply cannot be implemented all in a day. Hence, there are always choices to be made on what to do first and what can wait.

Implications of measures on the key development objectives

The three key objectives, on which the MDG-based Comprehensive National Development Strategy of Mongolia is built, correspond with the three political orientations or policy strategies used for weighing the ranking:

MDG-based CNDS key objectives		Policy strategies
Economic development objective	⇔	Economic development strategy
Social improvement objective	⇔	Social improvement strategy
Environmental conservation objective	⇔	Environmental conservation strategy

The rankings per policy strategy are arrived at by applying different weights to each of the five screening criteria and the social, economic and environmental strategy each have a different combination of weights being applied (see Table 68). The result is that when a particular criterion with a good score ('+' or '+ +') is given a high weighing factor, it will elevate the ranking of that measure, but the same high weighing factor applied to a criterion with a low score ('-' or '- -') will amplify that negative score and lower the ranking of that measure.

This means that when the ranking of a measure under a particular policy strategy is lower than the neutral ranking it can be concluded that this particular measure adversely affects the objectives of that policy strategy. Since the policy strategies correspond with the respective key objectives of the MDG-based National Development Strategy, the combination of the rankings of a particular measure provides a very good insight in the implications of that measure on each of the key development objectives. **The results in the columns under 'Ranking per policy strategy' can also be read as the 'implications of the measures with respect to each of the three key development objectives'**.

The ranking in the neutral strategy reflects to what extend a measure satisfies all the key objectives. Since most measures also have some undesired (side-)effects, the neutral strategy is basically an average of the plus and minus scores. Such an 'average' score is not likely resulting in a very high (a '1') or a very low rank (a '4'), but most probably a ranking somewhere in the middle (rank '2' or '3'). A measure can only achieve a rank '1' in the neutral strategy when the scores on all criteria are high and then automatically this measure will rank high (1s and 2s) for all strategies (e.g. measure # 1.1.1, 1.2.3b, 2.1.3). Similarly, a very low ranking ('4') in the neutral strategy implies low rankings (3s and 4s) for all the strategies (e.g. measure # 2.2.3, 3.1.4c, 4.1.5).

It becomes complicated for measures with a rank '2' or '3' in the neutral strategy. This could be the result of almost identical rankings in all the strategies (e.g. measures # 1.1.2, 1.1.7, 1.2.2). However, a rank '2' or '3' in the neutral strategy is more likely caused by that measure having a high rank in one strategy and a low rank in another strategy (e.g. measures # 1.1.4, 1.1.5, 3.2.4). Such combinations of rankings in different strategies provide us with much more information which is best explained by the following examples:

Example 1: Measure # 1.2.2.

No	Measure description	Location	Ranking per policy strategy: Neutral	Social	Economic dev.	Environmental	Cost Class
Sub-sector 1. Water for people							
Challenge 1.2 Safe drinking water and optimal waste water treatment in rural areas							
1.2.2	Surveys of new / existing water resources at soum centers	Soum centers	2	2	2	2	III

The neutral rank is 2, which makes it a fairly promising measure. The rankings for all the other strategies are also 2. This means that this measure does not have any undesirable side effects with respect to any of the key objectives. Moreover the measure is cheap (cost class III), which means there is no reason not to implement this measure.

Example 2: Measures # 1.1.5 and 1.1.6.

No	Measure description	Location	Ranking per policy strategy: Neutral	Social	Economic dev.	Environmental	Cost Class
Sub-sector 1. Water for people							
Challenge 1.1 Safe drinking water and optimal waste water treatment in urban areas							
1.1.5	Construction and renovation of WWTPs	UB City	2	2	3	1	I
		21 Aimag Centers	2	2	3	1	II
		14 urban centers	2	2	3	1	II
1.1.6	Renovation and expansion of sewerage network	UB City	2	1	3	1	I
		21 Aimag Centers	2	1	3	1	I
		11 urban centers	2	1	3	1	II

The neutral rank for all measures is 2, making them fairly promising. However they rank 3 on the economic development strategy. The fact that the ranking for the economic development strategy is lower than the neutral ranking indicates that this particular measure is having a negative effect on the economic development objective. Most likely this is due to the fact that these activities do not generate sufficient revenue to cover investments and probably recurrent costs. The consequence would be that these measures are unlikely to be financed through private investments and need to be subsidized by the government. Moreover both measures are very costly (cost class I). All these considerations justify a much more detailed analysis before deciding to (and how to) proceed with these measures. Because the measures # 1.1.6 better addresses the social improvement objective, this measure would probably get priority over the measures # 1.1.5.

Example 3: Measure # 3.3.2

No	Measure description	Location	Ranking per policy strategy: Neutral	Social	Economic dev.	Environmental	Cost Class
Sub-sector 3. Water for industry, mining and energy							
Challenge 3.3 Water for energy							
3.3.2	Construction of hydropower plants	Shuren	3	2	2	4	I

The neutral rank for this measure is 3, which indicates there are some uncertainties. The measure is ranked 2 both on the economic development and social improvement objectives, but for the environmental conservation objective the rank is a 4, which is what is causing the concern. This measure is having a negative impact on the environmental objective and when proceeding to implement this measure, additional measures would be required to mitigate the adverse effects on the environment. This would make this measure that is already very expensive (cost class I) even more expensive. A very thorough study would be justified to map out all the benefits and costs, including the harm to the environment before deciding whether and how to proceed with implementing this measure.

These three examples make clear that the different strategies do not only provide the most promising measures from the view point of a particular political orientation, but also provide insight in the impacts of each measure on the three key policy objectives of the MDG-based Comprehensive National Development Strategy.

8.1.3. Discussion of weighted ranking outcome

For each sub-sector the outcomes of the ranking of measures per policy strategy are discussed in this chapter. The methodology applied to rank the measures is very useful and provides much insight, but it still is a method with some limitations and the outcomes should not be accepted at face value, but be considered carefully.

The limitations of the methodology are in the fact that the measures are assessed on a limited number of criteria. These criteria are more than adequate to analyze the effects of the measures on the social, economic and environmental objectives, but in a few cases measures are vindicated by other than those three objectives. Examples of such other objectives are political objectives like state security or being self-supporting in food. Such political objectives are different in nature from the social, economic and environmental strategies. The analysis as carried out here is based on a balancing of the social, economic and environmental objectives. Political objectives however, are not balanced with the other three objectives, but can completely overrule the other objectives. In terms of the analysis the political objectives would be 'irrational', which is the reason it is not possible to include a '*political reasons*' strategy as an additional strategy in this analysis and makes it necessary to have a second look at the outcomes of the analysis.

Sub-sector 1. Water for people

Table 69. Ranking the measures for Sub-sector 1: Water for people

No	Measure description	Location	Ranking per policy strategy				Cost Class
			Neutral	Social	Economic dev.	Environmental	
Ranking: 1 Very promising; 2 fair; 3 uncertain; 4 poor							
Challenge 1.1 Safe drinking water and optimal waste water treatment in urban areas							
1.1.1	Establish and enforce sanitation and protection zones	UB City	1	1	2	1	III
		21 Aimag Centers	1	1	2	1	III
		9 urban centers	1	1	1	1	IV
1.1.2	Local surveys and exploration studies at new or existing resources	UB City	2	2	2	2	III
		8 Aimag Centers	2	2	2	2	III
		1 urban center	1	1	1	1	IV
1.1.3	Construction and renovation of water supply sources	UB groundwater	2	1	2	2	II
		UB Tuul dam	4	3	4	4	I
		20 Aimag Centers	2	1	2	2	III
		Altai/Gobi-Altai	2	1	2	2	II
		12 urban centers	2	1	2	2	III
1.1.4	Renovation and expansion of water supply network	UB City	2	1	3	3	I
		Aimag Centers	2	1	3	3	I
		8 urban centers	2	1	2	2	II
1.1.5	Construction and renovation of WWTPs	UB City	2	2	3	1	I
		21 Aimag Centers	2	2	3	1	II
		14 urban centers	2	2	3	1	II
1.1.6	Renovation and expansion of sewerage network	UB City	2	1	3	1	I
		21 Aimag Centers	2	1	3	1	I
		11 urban centers	2	1	3	1	II
1.1.7	Reuse of domestic and treated waste water	UB City	4	4	4	4	II
		Aimag Centers	4	4	4	4	III
		Urban centers	4	4	4	4	III
1.1.8	Water supply / waste water treatment at army camps & border posts	9 Army camps	3	3	4	3	III
		20 Border posts	3	3	4	3	III
Challenge 1.2 Safe drinking water and optimal waste water treatment in rural areas							
1.2.1	Establish and enforce protection zones around water sources.	Soum centers	2	2	2	1	III
1.2.2	Surveys of new / existing water resources at soum centers	Soum centers	2	2	2	2	III
1.2.3	Construct water supplies in soum centers and in rural areas	Soum centers	2	2	3	3	II
		Rural areas	1	1	2	2	IV
1.2.4	Construct small WWTPs in soum centers and organize reuse of water	Soum centers	2	2	3	2	II
1.2.5	Implementing sustainable water treatment facilities	65 Soum centers	2	2	3	2	III
Challenge 1.3 Water for tourism and sanatorium							
1.3.1	Improve water supply infrastructure for tourism and sanatorium	National	2	2	2	2	III
1.3.2	Improve water supply and utilization of high-tech WWTP in tourist camps	National	3	3	4	3	II
1.3.3	Develop mineral springs for spa resorts and sanatoriums	National	2	2	2	2	III

From Table 69 it can be concluded that the measures defined for the sub-sector 'Water for people' largely address the social improvement objective and to some extent the environmental conservation objective. Quite a number of the measures have a negative impact the economic development objective as they cost more than what than what they generated as economic benefits. This is a common issue with waste water treatment.

Three measures stand out for not really addressing any of the policy objectives. Measure # 1.1.7 scores low on all strategies. The explanation is that although it is important to treat waste water, it doesn't make a difference whether after treatment the water is returned to the water system or is being reused, so it doesn't add anything to any of the policy objectives.

Measure # 1.1.8 does not seem to address any specific policy objective. This however is a typical case of a politically justified measure, which is not captured by the limited scope of analysis we used here. Nobody would question the fact that the army camps and border posts are crucial for national security and the personnel based there require adequate facilities this. Moreover the issue is very small and localized. The rankings for the social and environmental strategies are the same as the neutral ranking which means that implementing this measure doesn't cause adverse effects in respect of those policy objectives. For the economic policy objective this ranking is lower than the neutral ranking, because the costs of the measure are higher than its expected economic returns.

Measure # 1.3.2 scores low as this issue is actually a private business' management matter, but also here the rankings for the social and environmental strategies are the same as the neutral ranking which means that implementing this measure doesn't cause adverse effects in respect of those policy objectives. For the economic policy objective this ranking is lower than the neutral ranking, again because the costs of the measure are higher than its expected economic returns.

Sub-sector 2. Water for food and agriculture

Table 70. Ranking the measures for Sub-sector 2: Water for food and agriculture

No	Measure description	Location	Ranking per policy strategy				Cost Class
			Neutral	Social	Economic dev.	Environmental	
Ranking: 1 Very promising; 2 fair; 3 uncertain; 4 poor							
Challenge 2.1 Water for livestock							
2.1.1	Surveys to identify water resources in rural areas	Rural areas	2	2	2	2	III
2.1.2	Construction of new and renovation of existing water sources	Rural areas	2	1	2	2	II
2.1.3	Improve O&M of livestock water supply points	Rural areas	1	1	1	1	III
2.1.4	Support to improve water supply of intensive livestock breeding		2	2	2	2	III
Challenge 2.2 Water for irrigation							
2.2.1	Surveys to identify water resources for irrigation and haymaking	Rural areas	2	2	2	2	III
2.2.2	Construction and renovation of dams and reservoirs for irrigation	Rural areas	3	3	3	3	III
2.2.3	Headworks, main conveyance channel and irrigation systems	Rural areas	4	4	4	4	I
2.2.4	Improve irrigation management	Rural areas	2	2	2	2	III
2.2.5	Agro technology of irrigated crops and water saving technology	Rural areas	2	2	2	2	III

Most measures under this subsector score good on all policy objectives. The measures identified for 'water for livestock' score well on all objectives, because on the one hand the livestock sector is a major contributor to the national GDP and a large part of Mongolia's population makes a living in this sector, while these measures prevent considerable negative environmental impacts that would be expected when these measures are not implemented.

The infrastructural measures for irrigation do not score very well, because the main justifications for investments in irrigation are not social, economic or environmental, but political objectives to attain self-sufficiency in food production, which does have strategic value, but is not be captured by the analysis framework that was used here. The neutral rankings are low because the ranking on all strategies are low. The rankings on the social strategy is low because the measures only benefit a very few people and the ranking on the environmental strategy is low as there is a likelihood for negative environmental impacts. Investments in irrigation are unlikely to be economically feasible, because irrigation in Mongolia is in most cases supplementary as an insurance against dry spells, but it does not add an additional growing season or shift the growing season for crop cultivation to an economic more beneficial season. The ranking of measure 2.2.3 dropped even further down due to its high investment costs (Cost Class I).

Sub-sector 3. Water for industry, mining and energy

Table 71. Ranking the measures for Sub-sector 3: Water for industry, mining and energy

No	Measure description	Location	Ranking per policy strategy				Cost Class
			Neutral	Social	Economic dev.	Environmental	
Ranking: 1 Very promising; 2 fair; 3 uncertain; 4 poor							
Challenge 3.1 Water for industries							
3.1.1	Surveys to investigate water supply sources for big industries	3 cities	2	2	2	2	III
3.1.2	Implementation of water supplies for new industrial parks	3 cities	2	2	1	2	II
		Soum centers	2	2	1	2	II
3.1.3	Water supplies to industries separate from drinking water supplies	UB City	3	3	3	3	III
		12 urban centers	3	3	3	3	III
3.1.4	Implement separate WWTPs for industries	UB City	3	3	3	2	II
		Urban centers	3	3	3	2	II
		Soum centers	4	4	4	3	II
3.1.5	Reuse of industrial water	National	3	4	3	3	III
Challenge 3.2 Water for mines							
3.2.1	Surveys to investigate mining water supply sources	15 mines	2	2	1	2	III
3.2.2	Implementation of water supplies for new mining areas	21 mines	2	2	1	3	I
		Orkhon-Gobi tra'fer	4	3	4	4	I
3.2.3	Reuse of water used by mines	15 mines	2	2	2	2	II
3.2.4	Treat mine waste water and dispose to the environment	21 mines	3	3	4	2	I
Challenge 3.3 Water for energy							
3.3.1	Research and design of hydropower plants	Various rivers	3	2	3	2	II
3.3.2	Construction of hydropower plants	Shuren	3	2	2	4	I
3.3.3	Monitoring of water regime of hydropower plants	Hydro dams	3	3	3	2	III
3.3.4	Water supply to thermal power plants new and operating	UB City + 2	2	2	2	2	III
3.3.5	Investigations into geothermal potential	Khangai moutains	2	2	2	2	III

Water for industry, mining and energy is probably the most controversial sub-sector because of the sector's potential threats to the environment. The supply of water to the sub-sector is obviously supporting the economic development objective and does not cause real problems with regard to the other objectives. Waste water treatment plants on are always a cost factor and do not generate economic benefits, which explains that all such measures score low on the economic objective. Waste water treatment primarily only has environmental benefits.

Separating industrial water supply from drinking water supply has only few, if any, benefits that justify the investment, especially when (drinking) water treatment is not very intensive and costly as is the case in most places in Mongolia. Reuse of industrial water is a consideration for businesses to make internally depending on the costs of alternatives. For the nation, with regard to the social, economic or environmental objectives it doesn't really make a difference whether the treated waste water is reused or drained on the water system – as long as it is treated!

The treating of waste water from the mines before disposing it, is a costly affair that adversely affects the profitability of mining, but it is highly desirable from the environmental perspective. This is a typical controversial issue that requires balancing the pros and the cons. A similar situation is the construction of hydropower plants. The justification lies in the sustainable generation of energy and reducing the reliance on imported energy, but the dam and associated reservoir in the affected river has major environmental implications. In many countries dam construction also causes major social upheavals, but this is expected to be less the case in Mongolia.

Sub-sector 4. Water for the environment

Table 72. Ranking the measures for Sub-sector 4: Water for the environment

No	Measure description	Location	Ranking per policy strategy				Cost Class
			Neutral	Social	Economic dev.	Environmental	
Ranking:	1 Very promising	2 fair	3 uncertain	4 poor			
Challenge 4.1 Conservation of water resources							
4.1.1	Establish / enforce protection of runoff forming part of watershed areas	23 watersheds	3	3	3	2	III
4.1.2	Establish and enforce protection zones around water bodies	Main rivers	2	2	2	1	III
4.1.3	Assess water resource reserves and enforce water use within the limit	All river basins	3	4	4	3	III
4.1.4	Installation of water meters at water users	UB City	2	3	2	2	III
		Urban areas	2	3	2	2	III
4.1.5	Establish recreational area on river side in cities	UB + other cities	4	3	4	4	III
4.1.6	Establish reservoirs to regulate river runoff and create water storage	Altai and Khangai	4	4	4	4	III
Challenge 4.2 Pollution of water resources							
4.2.1	Protection of water resources from pollution	All river basins	2	2	2	1	II
4.2.2	Implementation of polluter pay principle	All river basins	2	2	1	1	III
4.2.3	Improve sanitation facilities and waste water disposal in ger areas	Ger areas	2	2	3	2	II
Challenge 4.3 Sufficient and clean water for the environment							
4.3.1	Research to determine environmental flow in rivers	22 main rivers	2	2	2	2	III
4.3.2	Implementation of Ramsar convention and increase nr of registered lakes	National	2	2	2	1	IV
4.3.3	Conservation of sustainable ecological conditions wetlands and lakes	National	2	2	2	1	III
4.3.4	Improve irrigation green areas in cities and enforce water supply norms	UB + other cities	3	3	4	3	III
4.3.5	Prevention of negative effects due to lower groundwater levels	Near cities/mines	3	2	3	2	III
Challenge 4.4 Restoration of water resources							
4.4.1	Make inventory, clean / reconstruct damaged and polluted river valleys	Damaged valleys	2	2	3	1	II
4.4.2	Create special protected areas to protect and restore rivers and lakes	Forest/wetlands	2	2	2	1	III
Challenge 4.5 Hazards due to floods, droughts, dzuds and other disasters							
4.5.1	Construction and maintenance of flood protection structures	UB City	2	1	2	2	II
		Urban areas	2	1	2	2	II
4.5.2	Construct drainage systems in urban areas	UB + other cities	2	1	2	2	II
4.5.3	Define ownership and improve O&M of drainage systems in urban area	UB + other cities	2	2	2	2	IV
4.5.4	Establish / enforce water management for drought and desertification	National	2	2	2	2	IV
4.5.5	Installation of rain generators to implement cloud seeding	Upper watersheds	2	2	2	2	III

Except for measure 4.1.2 the measures to address the challenge 'Conservation of water resources' do not score well in this assessment. The environmental measures that have been identified for the rest of the sub-sector generally score quite well and only in a few cases the ranking for the economic objectives are lower than the neutral score, which means that these measures cost more than the economic benefits they generate, but do not have any other negative effects.

Measures to protect areas and restrict the use of water are supporting an environmental conservation policy, but are at the same impose constraints on economic development and social improvement as these measures make certain land and water resources unavailable for economic activities of both companies and for individuals, in particular herders. Moreover effective enforcing of such measures is rather expensive and (direct) economic returns very limited.

The establishment of recreational areas on riverbanks in cities seems a compromise between a desire of city dwellers to recreate at the water side and controlling the negative effects of such recreational activities, but the effect is highly doubtful. The establishment of reservoirs to regulate river flow is highly controversial. The detrimental environmental effects caused by regulating river flows are usually quite considerable, and the environmental benefits of storing water are at the least debatable.

Sub-sector 5. Enabling setting / water governance

Table 73. Ranking the measures for Sub-sector 5: Enabling setting / water governance

No	Measure description	Location	Ranking per policy strategy				Cost Class
			Neutral	Social	Economic dev.	Environmental	
Ranking:	1 Very promising; 2 fair; 3 uncertain; 4 poor						
Challenge 5.1 Legislation for water management							
5.1.1	Coordinate water related laws and make consistent		2	2	2	2	IV
5.1.2	Improve compliance with international treaties and conventions		2	2	2	2	IV
5.1.3	Update and improve rules, procedures, norms and standards		1	1	1	1	IV
5.1.4	Improve enforcement capacity and capability		2	2	2	1	IV
Challenge 5.2 Institutions for water management							
5.2.1	Update status and mandate of authorities in charge of water		2	2	2	2	IV
5.2.2	Improve coordination and cooperation mechanisms		2	2	1	1	IV
5.2.3	Improve operations of water authorities at national and basin levels		2	2	1	1	IV
5.2.4	Strengthen the role of sciencech, professionals, NGOs and civil society		2	2	2	2	IV
5.2.5	Improve exchange, storage, quality control and access to data		2	2	1	1	IV
5.2.6	Develop vision and prepare a work plan for the development of RBOs		2	2	2	2	IV
Challenge 5.3 Financing the water sector							
5.3.1	Renew water pricing policy and improve cost recovery		2	3	2	2	IV
5.3.2	Develop alternative financial sources to finance water sector		2	2	2	2	IV
5.3.3	Improve efficiency of water sector to reduce recurrent costs		3	3	2	3	III
Challenge 5.4 Capacity building for water management							
5.4.1	Improve human resources capacity in water sector		1	1	1	1	IV
5.4.2	Study to improve education and training of water professionals		2	2	2	2	III
5.4.3	Implement recommendations of study (5.4.2)		3	3	3	3	III
Challenge 5.5 Monitoring and research for water management							
5.5.1	Improve and expand monitoring of water resources		2	2	2	2	III
5.5.2	Improve sampling equipment and laboratory facilities.		2	2	2	2	III

No	Measure description	Location	Ranking per policy strategy: Neutral	Social	Economic dev.	Environmental	Cost Class
Ranking:	1 Very promising	2 fair	3 uncertain	4 poor			
5.5.3	Rationalize monitoring programs and formalize		2	2	2	1	IV
5.5.4	Expand and integrate water sector research and studies		2	2	2	2	IV
Challenge 5.6 Data and Information management							
5.6.1	Improve national databases, data quality control and data exchange		3	3	3	2	III
5.6.2	Create water database systems at basin level		3	3	3	2	II
5.6.3	Institutionalize regular detailed publication of results		2	2	2	2	IV
Challenge 5.7 Public awareness of water management and public participation							
5.7.1	Design comprehensive information and awareness raising strategies		3	3	3	3	III
5.7.2	Implement recommended information strategies		2	2	2	2	IV
5.7.3	Provide easy access for the public to relevant information and data		2	1	2	1	IV
5.7.4	Promote and reintroduce traditional protection methods		2	2	2	2	IV
5.7.5	Enhance the role of NGOs in water management at all levels		2	2	2	2	III

By far most of the measures defined under this sub-sector are institutional measures concerning regulations and institutions to improve effective water management. The introduction of new regulations, almost by definition, generally implies a restriction on activities or increasing costs for companies or individuals. Therefore any such measures are bound to be met with some opposition. The fact that most of these measures do not involve a significant investment affects their ranking positively. In many cases the measures under this sub-sector are quite essential in support of the measures identified for the other sub-sectors. Therefore over and above the already fair ranking of most of these measures there are political objectives for these measures to be given a high priority.

8.2. Strategies based on available financial and/or human resources

Implementation of all the measures proposed in the IWM Plan is very costly. The annual funding required for realizing the plan as scheduled amounts to almost 1 trillion MNT, which is about ten times the investment levels over the past years (see Figure 65).

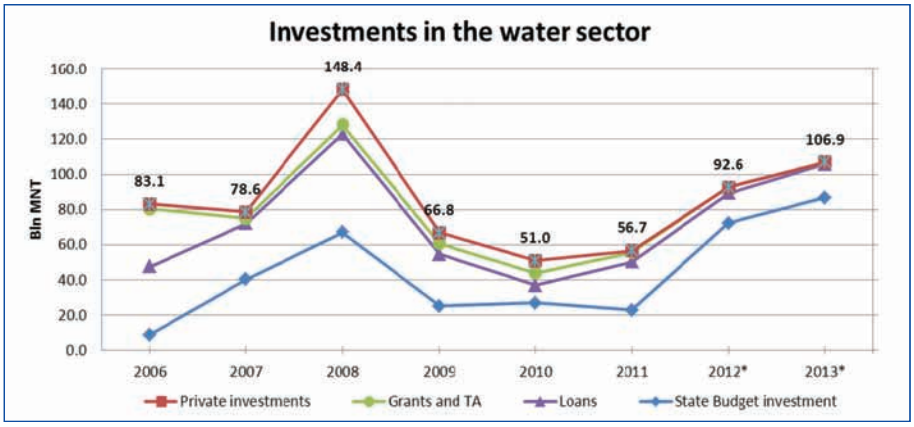


Figure 65. Investments in the water sector since 2006 with projections from 2012

During the past years the government allocated about 10% of the total state budget investments to the water sector (comparing Figure 66 with Figure 65).

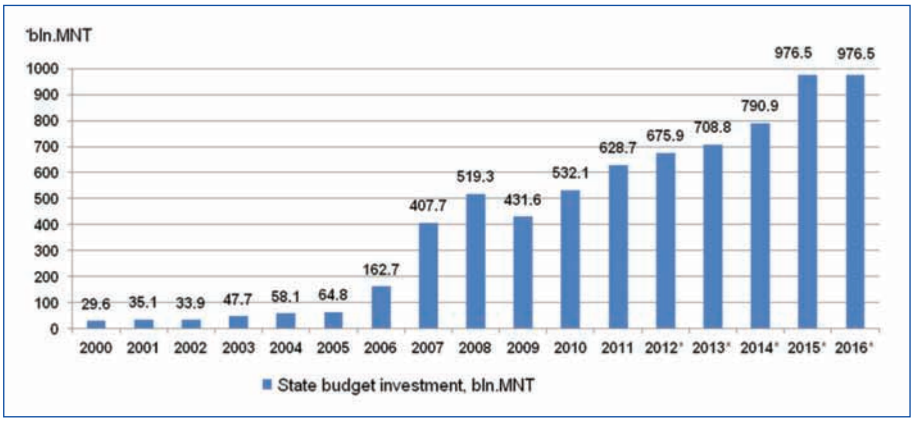


Figure 66. State Budget investments since 2000 with projections from 2012 (Source NDIC 2011)

The contribution of loans to the investments in the water sector was about 50%, but the projections are that will reduce to about 20%. The contributions from grants, Technical Assistance and private sector have been insignificant and are not expected to rapidly increase. Grants in particular should be considered a thing from the past as Mongolia is rapidly approaching the mid-income country status, which will also make cheap loans less accessible.

This means the investments (and associated recurrent costs) would need to increase tenfold to implement the IWM Plan. Whether this will indeed happen cannot just be taken for granted. This IWM Plan therefore takes into account the possibility that financing will become a constraint for implementing the plan.

Another problem that would constrain the implementation of the IWM Plan in a similar way is a potential shortage of adequate and capable human resources. Already insufficient finances, inadequate equipment, shortages of human capacity both in quantity as well as in quality, were cited by actors as the cause for sub-optimal performance of more than 25% of the water management functions (see Chapter 6). The causes of these problems are manifold. In part they are caused by the unattractive salaries that are offered, partly by the limited career options, but also by shortages on the labor market of specialists with the required qualifications. Solving this problem is unlikely to happen overnight; actually this very IWM Plan has included several measures to deal with this issue. This means that the implementation of the IWM Plan might also be constrained due to human resources issues.

When the implementation of the IWM Plan cannot proceed as planned, either due to constraints in financial or in human resources, the planning needs to be adjusted to reflect the actual situation with regard to financing and/or human resources.

In principle there are two basic options for adjusting the IWM Plan in case financial and/or human resources constraints occur:

1. remove a number of measures from the implementation plan
2. slow down the implementation of the measures

Of course when actually faced with such a situation any mix of these solutions may be opted for. In either case the adjustment of the planning will be most effective when the more cost intensive measures are being slowed down or removed. This is also true in cases where human resources constraints prevail that are caused by a lack of financial incentives. When caused by shortage of expertise, other solutions may need to be considered.

The consequences of a decision to drop or slow down the implementation of measures will be an IWM Plan that will fail to fully achieve its targets. This however is unavoidable when the required budgets cannot be provided. The key question now becomes which measures should be slowed down or dropped. The performance assessment and ranking of the measures can be used as a basis for selecting measures of which the implementation needs to be adjusted. General considerations for selecting measures to be slowed down or dropped would be:

- selecting measures that are cost intensive is more effective than selecting low cost measures
- measures with a very low ranking (4: poor) could be considered for cancellation
- measures with a very promising ranking (1: very promising) could be spared

Any proposal to slow down or cut out certain measures will bring out supporters of the affected measure, who will strongly argue in favor of that measure to be spared. Also the ranking of the measures under different strategies in the previous chapter can again be used to make transparent the implications of curtailing the implementation plan.

The impacts of curtailing implementation of the IWM Plan on the targets for the plan have been worked out for a scenario that assumes a shortfall of 20% and one that assumes a shortfall of 40% on the required financial resources for implementing the plan and are presented in Table 74. The following criteria for slowing down and dropping of measures have been applied:

- Implementation of measures with rank 4 is completely postponed or cancelled
- Implementation of measures with rank 3 is slowed down considerably by cutting 60% of the budget shortfall from measures with rank 3
- Implementation of measures with rank 2 is slowed down by cutting 30% of the budget shortfall from measures with rank 2
- Implementation of measures with rank 1 is slowed down slightly by cutting 10% of the budget shortfall from measures with rank 1

Table 74. Estimated reduction of achievements due to budget constraints

Legend: 90-100% 75-90% 50-75% < 50%

Performance indicator	Actual	100% budget available: All strategies – Targets		80% budget available: Achievements per strategy								60% budget available: Achievements per strategy							
				Neutr.		Social		Econ.		Envir.		Neutr.		Social		Econ.		Envir.	
	2010	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021
Sub-sector 1: Water for people																			
1.1 Safe drinking water and optimal waste water treatment in urban areas																			
% of urban people supplied from protected water source	86.7%	90%	95%																
% of urban people having private water supply connection	32.9%	45%	50%																
% of urban people having adequate sanitation	37.7%	50%	70%																
% of urban people with private connection to central sewerage system	30.2%	44%	50%																
Number of normally working domestic WWTPs in urban areas	17 (4)	32 (5)	40 (6)																
Number of army camps/border posts supplied with safe water	?	add 30	add 60																

Legend: 90-100% | 75-90% | 50-75% | < 50%

Performance indicator	Actual 2010	Targets (100% budget available, All strategies) 2015	2021
1.2 Safe drinking water and optimal waste water treatment in rural areas			
% of rural people supplied from protected water source	43.4%	60%	80%
% of rural people having adequate sanitation	< 5%	20%	40%
Number of normally working domestic WWTPs in soum centers	8	25	60
1.3 Water for tourism and sanitorium			
Number of tourists	456,300	1,000,000	> 3,000,000
Number of certified sanatoriums	27	35	40
Sub-sector 2: Water for Food			
2.1 Water for livestock			
Number of new boreholes in rural areas	2635	add 2466	add 5050
Number of new ponds in rural areas	5	add 59	add 132
Number of herdergroups for O&M of boreholes	685	900	1800
2.2 Water for irrigation			
Irrigated area for cereal (ha)	*9,400*	*16,950*	*33,000*
Irrigated area for fodder (ha)	*3,800*	*13,450*	*15,500*
Irrigated area for potatoes (ha)	*9,900*	*11,100*	*12,500*
Irrigated area for vegetables (ha)	*6,100*	*10,800*	*17,300*
Irrigated area for fruit - sea buckthorn (ha)	*600*	*6,900*	*12,500*
Irrigated area for other crops	*7,700*	*800*	*1,200*
Total irrigated area	37,500	60,000	92,000
Sub-sector 3: Water for industry, mining and energy			
3.1 Water for industry			
% of separate industrial water supplies	-	10%*	20%*
% of industries with own waste water treatment facility	-	25%*	50%*
% of industrial waste water reused	-	10%*	20%*
3.2 Water for mining			
Approved assessment study of water resources at 15 strategic mineral deposits	….	8	11
Number of water supplies constructed by mines	….	7	19
% of mines with waste water treatment facility		25%*	50%*
% of mining water reused by mines		50%*	90%*
3.3 Water for energy			
Thermopower plants capacity (MW)	835.7	1885	6385
Hydropower capacity (MW)	27.9	151	471
Sub-sector 4: Water for the environment			
4.1 Conservation of water resources			
% of runoff forming area within protected areas	30.50%	50%*	80%*
Surface water storage volume (McM)	1	2	4
Water use per capita of connected users (l/day)	200-400	200	160
4.2 Pollution of water resources			
Polluter pays principle is active	not	active	active
Number of rivers with pollution	4	0	0
Number of groundwater deposits with pollution	0	0	0
4.3 Sufficient and clean water for the environment			
Number of rivers for which environmental flow is determined	0	5	15
Number of lakes registered under Ramsar	11	15*	20*
4.4 Restoration of water resources			
Number of rivers designated for restoration	0	2	4
% of area defined as protection zone	80%	100%	100%
4.5 Hazards due to floods, droughts, dzuds and other disasters			

80% budget available — Achievements per strategy	60% budget available — Achievements per strategy
Neutr. (2015, 2021) · Social (2015, 2021) · Econ. (2015, 2021) · Envir. (2015, 2021)	Neutr. (2015, 2021) · Social (2015, 2021) · Econ. (2015, 2021) · Envir. (2015, 2021)

Legend: 90-100% | 75-90% | 50-75% | < 50%

		100% budget available		80% budget available								60% budget available							
		All strategies		Achievements per strategy								Achievements per strategy							
Performance indicator	Actual	Targets		Neutr.		Social		Econ.		Envir.		Neutr.		Social		Econ.		Envir.	
	2010	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021	2015	2021
Number of urban people protected against flooding	unknown	122000	150000*																
% of urban area with drainage system	unknown	20%*	40%*																
Number of rain generators in use	21	add 30	add 60																
Sub-sector 5: Enabling setting / water governance																			
5.1 Legislation for water management																			
Numer of water and environmental laws reviewed and updated	….	11 core laws	all laws																
Study options to improve enforcement agencies	…..	done	Implement'd																
5.2 Institutions for water management																			
Institutional framework for IWRM (Figure 60)	…..	in place	updated																
Number of RBCs and RBAs established	3	12	29																
5.3 Financing the water sector																			
Operational budgets of Water Management organisations	……	add 25%	add 25%																
5.4 Capacity building for water management																			
Study options to improve sustained supply water professionals		done	Implement'd																
5.5 Monitoring and research for water management																			
Number of groundwater monitoring wells	20%	50%	100%																
Number of surface water monitoring points	60%	80%	100%																
5.6 Data and Information management																			
Central water sector database	?	in place	open to public																
5.7 Public awareness of water management and public participation																			
At least 2 NGOs engaged long-term for awareness raising	0	in 12 RBs	in 29 RBs																
Ratio public service and civil society members in NWC and RBCs	?	< 3 : 1	1 : 1																

8.3. IWRM approach

Integrated Water Resources Management (IWRM) as an approach was first formulated in the 1990s in order to improve water management by integrating water services and providing good governance, appropriate infrastructure and sustainable financing. Soon after when the scarcity of water became painfully obvious the management and protection of the resource became the focus of IWRM. Lately the concept of Water Security is drawing much attention. The Water Security as a concept entails management of water in a way that ensures enough water of required quality for social and economic development and maintaining the eco-systems for the present and the future generations and minimizing the destructive power of water. Meanwhile the Millennium Development Goals (MDGs) have widely been adopted and most countries have set targets for their MDGs. These MDGs can never be met without economic growth. But to indiscriminately draw on the natural resources to satisfy our demand for economic growth today will seriously jeopardize the availability of resources to sustain future generations. This has resulted in a focus on 'Green Growth", a concept that fosters economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. The contribution of water management to Green Growth lies in prioritizing the protection of the resource, maintaining the eco-systems and taking care of sustainable water availability for our needs now as well as for future generations.

IWRM, Water Security and Green Growth are interlinked as can be seen from their overlapping and complementary characteristics listed in Table 75, which would make Water Security the goal, IWRM the approach to achieve that goal and Green Growth setting the boundary conditions for that approach.

Table 75. Linkages between the concepts of IWRM, Water Security and Green Growth

Characteristics of Water Security [The Goal]	Characteristics of IWRM [The Approach]	Characteristics of Green Growth [The Boundary Conditions]
▪ Ensure enough water for social and economic development ▪ Ensure adequate water for maintaining eco-systems ▪ Sustainable water availability of future generations ▪ Maintain water quality and avoid pollution and degradation ▪ Balance the intrinsic value of water with its uses for human survival and welfare ▪ Harness productive power of water ▪ Minimize the destructive power of water	▪ Sustainable, stable, reasonable and equitable water supply for all consumers and nature ▪ Management at catchment level ▪ Cross-sectoral integration; integrate water, land and environmental management ▪ Full participation of all stakeholders – capacity building ▪ Recognize the economic and social dimensions of water ▪ Information exchange, transparency, openness, accountability. ▪ Reliable and sustainable financing (full cost-pricing complemented by targeted subsidies) ▪ Enabling environment, institutions, and management tools	▪ More effective use of natural resources in economic growth ▪ Valuing eco-systems ▪ Inter-generational economic policies ▪ Increased use of renewable sources of energy ▪ Reduce wasting of resources – and finance ▪ Protection of vital assets from climate related disasters

This IWM Plan carries as subtitle: "Towards a water-secure Mongolia" and recommends the adoption of the Green Growth, Water Security and IWRM concepts to be the guiding principles of water management in Mongolia. The IWRM approach in this IWM Plan is structured according to the five strategy components as introduced in chapter 6, which relate to the five key dimensions of the Water Security Index and Green Growth as indicated in Table 76.

Table 76. Relations between IWRM strategy components, the key dimensions of the Water Security Index and Green Growth

IWRM Strategy Components	Water Security key dimensions					Green Growth
	Household water security	Economic water security	Urban water security	Environmental water security	Resilience to water-related disasters	
1. providing sufficient water of adequate quality	✓	✓	✓	✓		✓
2. improving water use efficiency	✓	✓	✓	✓		✓✓✓
3. protecting the water resources of Mongolia				✓	✓	✓✓
4. improving the management of water	✓	✓	✓	✓	✓	✓✓
5. prevent and mitigate impacts of water calamities					✓	✓

The IWRM strategy components 1 and 2 cover the supply and demand management aspects of water management respectively. Strategy component 2 in particular is a focus point of the Green Growth concept. Strategy components 3 and 4 focus on the sustainable use of water by protecting the resources and by improving the institutional framework, management structures, capabilities and equipment, which make these also important elements for Green Growth. Strategy component 5 deals with the destructive powers of too much or too little water.

The strength of IWRM as a planning tool is to bring about combined solutions for different issues concerning different sub-sectors and to timely identify measures that solve an issue in one sub-sector but have adverse implications on other sub-sectors. The latter can be achieved through applying the methods described in Chapter 8.1, the first through combining similar issues in the five sub-sectors. This is done by looking at the issues within each of the strategy components across the sub-sectors: Water for people, Water for food, Water for industry, mining and energy, Water for the environment and Enabling setting / Water governance.

An overview of how the measures included in the IWM Plan are distributed among the strategy components is presented in Table 77, details may be found in table 78. In the next Chapters 8.3.1 - 8.3.5 the strategy components will each be discussed in more detail.

Table 77. Distribution of measures among the sub-sectors and strategy components

Water Sub-sectors: (see chapter 6.5.3)	Water for people	Water for food and agriculture	Water for industry, mining and energy	Water for the environment	Enabling setting / water governance
Challenges (20) (see chapter 7.3)	3 (chapter 7.3.1)	2 (chapter 7.3.2)	3 (chapter 7.3.3)	5 (chapter 7.3.4)	7 (chapter 7.3.5)
Issues (96): (see chapter 7.3)	17 (chapter 7.3.1)	7 (chapter 7.3.2)	11 (chapter 7.3.3)	23 (chapter 7.3.4)	38 (chapter 7.3.5)
Strategy Components	**88 Measures *)**				
Providing sufficient water of adequate quality	8 (2)	4 (3)	4 (3)	1 (4)	0 (12)
Improving water use efficiency	2 (4)	1 (2)	2 (2)	1 (1)	0 (16)
Protecting the water resources	4 (3)	0 (0)	2 (0)	7 (5)	1 (17)
Improving the management of water	2 (0)	4 (3)	6 (3)	10 (8)	27 (1)
Preventing, and mitigating impacts of, water calamities	0 (3)	0 (2)	0 (2)	2 (7)	0 (12)
*) **Note**: numbers between brackets refer to measures supporting the strategy component (see Table 78)					

8.3.1. Providing sufficient water of adequate quality

Bringing water from the source to where the needs are is the prime objective of water management and covers four out of the five key dimensions of Water Security and is a basic requirement for (economic) growth, also green growth.

There are different needs to be fulfilled, each with its own quality requirements. About 13% of the Mongolian urban population and about 56% of the rural population has no access to drinking water from a protected source. Insufficient access to safe drinking water has a direct bearing on people's health. The measures proposed in this IWM Plan are expected to increase access to safe drinking water by 2021 to 95% and 80% of the urban and rural population respectively.

Water supply for livestock is in a critical state as the number of operational wells is far from adequate. At several locations the quality of surface water unsuitable for cattle drinking. Poor quality of the water provided at livestock water points is a threat to the health of the livestock. As such it limits the economic revenue of the livestock sector. To turn this situation around, about 1000 new wells are required annually till 2021.

The IWM Plan includes for providing water for a quadrupling of the irrigated area and for the fast growing industrial and mining sectors, with about 20 water supply systems for industries and another 20 for mining sites to be constructed by 2021.

Often considered as the water resource, the environment also has water needs. First of all the sustaining of the bio-diversity in general and in particular the rare and endangered species of flora and fauna found in Mongolia requires a reliable and timely supply of water. But equally important is the natural environment's function to provide a natural storage for rain and meltwater, delaying its release and as such regulating river flows to dampen peak flows and prolong base flow. The natural environment will quickly loose this 'sponge' function when deprived of water, which would have severe consequences. Maintaining this function of the environment is one of the water management contributions to green growth. Besides that, water security for the environment is given the same importance as household water security, urban water security and economic water security as a contributor to the National Water Security Index (NWSI). Providing water for the environment in most cases means to prevent that water is diverted away from the natural environment to be used for other purposes. Hence, all measures that improve water use efficiencies reduce the overall water demand leaving more water for the natural environment and thus better guarantee a sustainable supply. The proposed measure to install rain generators for cloud seeding should also be regarded in this context.

Besides a number of direct measures to provide water to meet different needs or bring about specified water qualities, also a range of indirect measures have been identified that support the provision of sufficient quality water. Such supporting measures include surveys to locate and quantify water resources, environmental conservation measures and many institutional and legislative measures.

Summary of measures to provide sufficient water of adequate quality

Direct measures

Water for people

- Construction and renovation of water supply sources, water supply networks and increase the number of connected water supply kiosks in urban areas, soum centers and rural areas
- Improve drinking water quality by implementing sustainable water treatment facilities
- Improve and expand water supply infrastructure for tourist camps and sanatoria
- Develop mineral springs for spa resorts and sanatoria

Water for food and agriculture

- Construction of new and renovation of existing water sources (boreholes, ponds)
- Support to improve water supply of intensive livestock breeding
- Construction and renovation of dams, reservoirs, and conveyance infrastructure for irrigation

Water for industries, mining and energy

- Implementation of water supplies for new industrial parks and mining areas
- Construction of hydropower plants and water supply to thermal power plants

Water for the environment

- Establish reservoirs to regulate river runoff and create water storage

Supporting measures

- Local surveys and exploration studies to identify new or verify existing water resources
- Improve the operation and maintenance of livestock water supply points
- Research and design of hydropower plants
- Conservation of good and sustainable ecological conditions wetlands and lakes by preserving water to maintain biodiversity
- Prevention of groundwater lowering and installation of rain generators
- Update water related laws and combine them in a "Package Law on Water"
- Improve the operation and functioning of all institutions for water management, human resources capabilities, monitoring, sampling
- Develop additional and alternative financial sources to finance the water sector

8.3.2. Improving water use efficiency

Meeting water needs can be achieved by bringing the water to where the needs are (supply management, see chapter 6.5.4), but often there is an alternative solution in reducing the needs by more efficient use of the available water (demand management) through which water can be provided to meet additional needs or keep more water for the environment that bolsters the sustainable use of water. This is probably where water management has to make its most important contribution to green growth. Moreover improving water use efficiencies across the board directly contributes to improving the household water security, the economic water security and the urban water security dimensions of the National Water Security Index (NWSI), while as a result more water will remain available for the environment, also boosting the environmental water security index.

There are a variety of measures that are aimed to improve the water use efficiency. Reuse of water is seen as the most promising in this regard. By 2021 20% of the industrial waste water and 90% of water used by mines is planned to be reused. Through metering the water use in apartments is expected to come down to 160 l/d/capita by 2021. Another direct measure is improving agro technology to increase irrigation efficiencies, but the effects of such a measure are mainly to be found in reducing energy costs for irrigation rather than in water savings, because in most cases irrigation inefficiencies do not lead to water losses but are causing higher return flows, which means that all the ‘excess’ water returns to the system anyhow becoming available for use again downstream.

The several measures to renovate the water supply infrastructure indirectly contribute to improving the water use efficiency through a reduction of water leakage and unaccounted water. Most of the several measures on management improvement can be expected to contribute to improved water use efficiency as well.

Summary of measures to improve water use efficiencies

Direct measures

Water for people
- Reuse of domestic and treated waste water in urban and rural areas

Water for food and agriculture
- Improvement of agro technology of irrigated crops and conduct water saving

Water for industries, mining and energy
- Reuse of industrial water and water used by mines

Water for the environment
- Installation of water meters at water users

Supporting measures
- Renovation of water supply infrastructure
- Improve operation of (livestock) water supply points and irrigation management
- Separating water supplies to industries from drinking water supplies
- Monitoring water regime of hydropower plants
- Update water related laws, rule, norms and standards and improve enforcement capabilities
- Improve the operation and functioning of all institutions for water management, human resources capabilities, monitoring, sampling
- Enhance public awareness on water use and support involvement of NGOs

8.3.3. Protecting the water resources of Mongolia

Protection of the water resources is primarily aimed to prevent deterioration of the resources and to safeguard the quality of the water resources. Such preventive measures are urgently needed as restoring deteriorated or polluted water resources is extremely expensive, very time consuming and in many cases the damage is even irreversible, in particular pollution of groundwater resources. Protection of water resources primarily maintains the environmental water security and as an immediate spin-off keeps the risks for water-related disasters low as a deteriorating natural environment would dramatically increase the risks of flash floods and landslides. The protection of water resources is also an important contribution of water management to green growth.

The 13% of the urban population and about 56% of the rural population in Mongolian without access to safe drinking water is not only due to unavailability of water but in many cases because the quality of the water does not meet the required standards. Polluted drinking water has a direct bearing on people's health, not only resulting in a loss of livelihood and productivity but also in preventable deaths. Water quality standards in urban drinking water supply are generally met, but increasing discharges of untreated municipal wastewater and industrial effluents threaten the resources. Water quality in rural areas is quite often a problem. Many of the water sources are used for both domestic use and livestock watering and lack separate water outlets to avoid pollution. Besides, poor quality of the water provided at livestock water point is a threat to the health of the livestock and has a negative influence on meat production. As such it limits the economic revenue of the livestock sector.

Two core measures are identified for the protection of water resources:

1. measures to establish and enforce protection zones around water supply sources and watersheds
2. measures to reduce the pollution load of effluents and return flows

The first type of measures cover the establishment and enforcing of protection zones to safeguard the quality of groundwater that is supplied to the drinking water distribution networks of Ulaanbaatar, 20 Aimag Centers and 10 other major urban areas by 2021. It further includes the fencing of water points and demarcation of a sanitation zone in rural areas and spring protection for about 740 springs by 2021. This IWM Plan includes measures to protect runoff forming areas from the present 30% to 80% by 2021 that will then cover watersheds that produce 70% of the surface water resources of Mongolia. By 2021 100% of the surface water area (rivers and lakes) will be designated as protection zones.

The second type of measures focuses on the construction, rehabilitation and renovation of waste water treatment plants both for municipal and for industrial sewage. To reduce the pollution load of effluents the number of normally operating WWTPs for municipal sewage will be increased from the present 17 to 40 by 2012 in urban areas and from the present 8 to 60 in rural centers. It is aimed that by 2021 50% of the industries and 50% of the mines will be treating their own waste water and to improve the waste water treatment at 27 army camps and border posts. The package of measures also includes the extension and renovation of the sewerage networks in Ulaanbaatar, the Aimag centers and 12 other major urban centers.

Besides these, measures have been included to restore the 4 rivers that are already polluted and to promote and reintroduce traditional protection methods

The direct measures will be supported by measures that aim to improve the monitoring of river flows, groundwater levels and water quality of both the surface water and the ground water. Other supporting measures related to promotion of awareness and community participation, like organizing water and sanitation advocacy campaigns and training, and national campaigns to increase the awareness of the population on the importance of the protection of river watersheds and stabilization of the water flow in order to prevent water shortages and sustain ecosystem and socio-economic services of river basins. All the measures identified with regard to legislation, institutions and financing for water management will benefit the protection of the water resources of Mongolia as will improving of human resources capacity.

Summary of measures to protect the water resources of Mongolia

Direct measures

Water for people

- Establish and enforce protection zones to safeguard the quality of the groundwater that is supplied to the drinking water distribution networks of Ulaanbaatar, Aimag Centers and other urban areas
- Establish and enforce protection of rural water sources, mainly by fencing off water points and demarcation of sanitation zones.
- Construction and renovation of waste water treatment plants and renovation and expansion of sewerage network

Water for industries, mining and energy

- Treat mine waste water and dispose to the environment
- Implement separate waste water treatment plants for industries

Water for the environment

- Establish and enforce protection of runoff forming part of watershed areas
- Establish and enforce protection zones around water bodies, protection of water resources from pollution and improve sanitation facilities and waste water disposal in ger areas
- Make inventory, clean and reconstruct damaged and polluted river valleys and designate these as special protected areas
- Improve implementation of Ramsar convention and increase the number of lakes and wetlands registered in Ramsar Convention

Supporting measures

- Implementation of polluter pay principle
- Update water related laws, rule, norms and standards and improve enforcement capabilities
- Improve the operation and functioning of all institutions for water management, human resources capabilities, monitoring, sampling
- Expand and integrate water sector research and studies in particular develop knowledgebase on environmental flows
- Improve public awareness on topics related to water quality and quantity protection and stimulate participation in water resource conservation and restoration en the role of NGOs

8.3.4. Improving the management of water

Water management in Mongolia is characterized by a multitude of organizations and institutions that are involved coupled to a poorly developed coordination structure. Legislation on water is not always consistent and enforcement is problematic, also because penalties are often not deterring. Proper water management is impeded by financial and human resources constraints.

Improving the management of water comprises a wide range of activities including institutional restructuring, legislative improvements, capacity building, monitoring and research, etc. Improvements in water management will always touch on water security and green growth objectives in either a positive or a negative way. Therefore improvements should be decided on in the light of improving water security and supporting green growth.

In the MDG-based National Development Strategy the first objective of the Legal Reform Policy states: 'Strengthen government institutions and improve legal environment to ensure transparency and accessibility of public services'. The following of the proposed measures in the CNDS are in particular applicable to the water sector:

- ensure accessibility and transparency of public services
- provide for greater consistency between laws and regulations, eliminate incongruities between articles and provisions of different laws, and complete the encoding of laws in short period and by swift manner,
- create a system of strict obedience to the law

The IWM Plan has translated these into measures specific for water management including the review and update of all water and environmental laws and strengthening the enforcement capacities and capabilities. Proper management of data collection, processing, storage and ensuring quality is a cornerstone of efficient and effective water management. Making these data and information freely available to professionals and the general public is an important step to improve transparency. Inclusion of greater numbers of stakeholders in water management organizations and involvement of NGOs in particular in awareness raising are additional measures to ensure accessibility and transparency.

Other important direct measures to improve water management deal with increasing the number of monitoring pints and monitoring wells. The rapid economic developments in the country, mainly in the mining sector, but also in industry, the energy sector, livestock herding and, irrigated agriculture, combined with a growing and urbanizing population and corresponding increasing domestic water demand, call for a better understanding of the water resources situation, both in terms of water availability and water quality. Combine all this with changes that may be brought about by climate change and the need for improvement of the monitoring system will be clear.

To improve the effectiveness and efficiency of water management the institutional structure would need an overhaul that should accomplish several objectives:

- eliminate overlap in roles and activities and fill the gaps
- facilitate a transition to a basin management model
- establish an effective coordination structure

The measures addressing these objectives include the establishment a National Water Council supported by a small but highly professional National Water Authority above the level of ministries. The NWC coordinates water management at the national level and has a decisive and binding say on all issues regarding water and water management in Mongolia. A parallel structure would be set up at the river basin level with WBCs and WBAs, taking on similar coordinating functions in the 29 river basins.

Summary of measures to improve the management of water

Direct measures

Water for people

- Local surveys and exploration studies to identify new or verify existing water resources

Water for food and agriculture

- Local surveys and exploration studies to identify water resources for new boreholes, ponds, reservoirs, irrigation and haymaking
- Improve the operation and maintenance of livestock water supply points
- Improve irrigation management

Water for industries, mining and energy

- Surveys and exploration studies to investigate water supply sources for big industries and mining
- Separate water supplies to industries from drinking water supplies
- Research of hydropower plants and geothermal potential
- Monitoring of water regime of hydropower plants

Water for the environment

- Exploration and assessment of usable surface water and groundwater resource reserves
- Implementation of polluter pay principle
- Research to determine environmental flow in rivers
- Improve conservation measures
- Mitigating measures to deal with water calamities

Enabling setting / water governance

- Measures to update and improve water legislation
- Measures to improve the efficiency and effectiveness of water management organizations
- Measures to improve financing of the investments and recurrent costs of the water sector
- Measures to improve long term human resources capacity for the water sector
- Measures to improve monitoring, data processing and storage and information dissemination
- Measures to raise public awareness on water issues

Supporting measures

- Construction, repair and renovation of water management infrastructure and equipment
- Installation of water meters at users

8.3.5. Prevent and mitigate impacts of water calamities

An important aspect of water security is a community's or a country's resilience in cases of extreme water events like floods and droughts. Mongolia is not exposed to extreme calamities like cyclones and tsunamis, but floods do occur locally with some frequency, which in a number of cases have caused the loss of lives. A rather common phenomenon is a 'dzud', which occurs every few years. 'Dzud' is a Mongolian term for a variety of meteorological conditions, especially in winter, that make livestock grazing impossible and large numbers of animals die due to starvation and the cold. Another water related calamity is an extremely dry summer that fails to produce enough fodder for the herds. This situation is then exacerbated by the fact that the following winter also does not have much fodder for the already weakened animals to get through the cold period, causing a high death toll among the animals. Some would consider the desertification that is observed as a water calamity as well, but that is debatable since desertification is a more or less continuous process that has more to do with poor pasture management than with extreme water events. However, extreme weather conditions may accelerate the desertification process.

Calamities of a different nature are those that threaten the water resource. Under certain, not completely unrealistic circumstances the water supply of a whole urban center could be wiped out or be made unusable, for instance in case of a chemical spoil upstream of a drinking water intake. In particular surface water bodies like reservoirs are vulnerable to such calamities as they can become unusable within a very short time. Ground water bodies pollute very gradually, but once when polluted will remain unusable for decades.

Building resilience does not only include measures to prevent such calamities, but in particular measures – soft and hard – to deal with such calamities when they happen.

Resilience to water-related disasters is considered a key dimension of national water security and protecting people and assets against such risks is also a characteristic of the green growth concept.

Measures have been included in the IWM Plan to build and maintain defenses against floods in urban areas, where they could cause major damage to vital assets and threaten lives. Examples are the construction of flood protection structures and drainage systems.

All protection measures in the IWM Plan support the prevention or reducing the extremity of water calamities, while the construction and renovation of WWTPs and sewerage systems help to reduce the pollution risks. Soft measures should be considered in the context of the review and update of legislation and restructuring the water management institutions. Close cooperation with the National Emergency Management Agency is of great importance.

Summary of measures to prevent and mitigate impacts of water calamities

Direct measures

Water for the environment

- Construction and maintenance of flood protection structures
- Construct drainage systems in urban areas

Supporting measures

- Update water related laws, rule, norms and standards and improve enforcement capabilities
- Improve the operation and functioning of all institutions for water management, human resources capabilities, monitoring, sampling
- Establish and enforce sanitation and protection zones around water supply sources and water sheds
- Construction and renovation of waste water treatment plants and separate waste water treatment plants for industries
- Treat mine waste water and dispose to the environment
- Make inventory, clean and reconstruct damaged and polluted river valleys
- Establish and enforce water management methodology and rules for drought and desertification conditions
- Installation of rain generators to implement cloud seeding

8.4. Risks and what to do when the future develops differently

The future is called "perhaps", which is the only possible thing to call the future. And the only important thing is not to allow that to scare you. (Tennessee Williams, Orpheus Descending, 1957).

For preparing this IWM Plan a number of assumptions were made on how the future would develop. As it is unlikely that the future will actually develop exactly as assumed several scenarios were defined in a way the actual future developments would almost certainly lay within the extremes of these scenarios. As long as the IWM Plan would satisfy the needs of these ‘boundary’ scenarios it can be expected with reasonable certainty that the needs of the future will be adequately addressed.

However, there are certain events that are beyond the control of the planner, but could dramatically change the course of future developments and future priorities and could pose a risk to the implementation of the IWM Plan or even invalidate the IWM Plan. Two types of risks are distinguished. The first type is the risk that external causes will threaten the implementation of the IWM Plan, which will be referred to as ‘implementation risks’ and will be discussed in chapter . The second type of risks are the ‘resource risks’, or what may happen to the resource as a result of unexpected or very uncertain events such as climate change or accidental toxic spills. These risks are described in chapter 8.4.2.

8.4.1. Implementation risks

Uncertainties about the future always lead to risks in implementing policies and strategies. Circumstances may develop in a different way than anticipated and priorities may change. This means that plans like this IWM Plan require regular updating and should be regarded as a ‘living’ document. There are several kinds of risks that could impede the successful implementation of this IWM Plan. The more plausible risks will be discussed here, together with the way these risks can be mitigated. IWRM provides a continuing planning process that enables dealing with the risks involved and adapting the policies and strategies if this is required to cope with changing circumstances. It enables the inclusion of actions to mitigate the risks.

Political and institutional risks

The successful implementation of a sustainable water management policy heavily relies on the awareness at the highest political level that water is a limited and precious resource in Mongolia that should be taken into account whenever taking major decisions. All economic and social developments (industry, mining, agriculture, tourism and drinking water supply) will require water and will lead to an additional stress on the water system both with respect to the quantity and the quality of the water. In line with the Green Growth' concept, this awareness should include the realization that, when decisions on developments and investments are taken, funds should be allocated for proper treatment of the resulting return flows or wastewater.

A major institutional issue is the cooperation between the key actors in water management. Generally, institutions in Mongolia have been vertically structured. Communications amongst and between organizations have tended to take place at the top level only and were limited to exchanging information. IWRM is increasingly seen as a pillar for green growth and a key element of IWRM is that the actors in water management should increase their cooperation; they are jointly responsible for the implementation of the IWM Plan. At the national level, the proposed National Water Council and at the regional level the Water Basin Councils have a major task to facilitate communication, coordination and cooperation. The agreement between the Mongolian delegation and the representatives of the Global Water Partnership (GWP), during President Elbegdorj's visit to the GWP HQ in Stockholm, Sweden in October 2012, to explore the creation of a GWP Country Water Partnership in Mongolia should be given follow up with high priority as the 80 Country and Regional GWPs already in existence have proven very effective as catalysts for communication, coordination and cooperation in water management.

IWRM aims to integrate the common top-down approach in water resources management with a bottom-up process in which the people that are actually dealing with the water (the farmers, industries, citizens, etc.) are forwarding their demands and plans. This requires a decentralized and integrated organization at a rather low level. Most ministries do have such a decentralized organization structure, but the local organizations are mainly charged with implementing their own ministry's programs. From the perspective of IWRM, cooperation between the decentralized organizations of the various ministries is needed. This issue is not extremely urgent at present, but with the introduction of water management at basin level, the necessary procedures for coordination and cooperation between local organizations should be built in from the onset to avoid time and resource consuming conflicts and frustrations.

For financing of the implementation the IWM Plan relies in part on the assumption that cost recovery returns will considerably improve inter alia through a revision of the water pricing and tariff system. Cost recovery measures are not very popular and often the subject of heated political debate. Water pricing and tariffs are at the heart of the conflict between the financial sustainability objectives and the social concern objectives of water supply. Without proper awareness-raising campaigns and a broad public debate, raising water tariffs can lead to social unrest. In the absence of balancing these two objectives, the result is a vicious cycle of under-financed services, lower-than-needed investment and maintenance and reduced access to water services. This will hurt the poor most as they are the first to suffer from low quality services.

A final political risk is the cooperation on water sharing with Mongolia's two neighboring states Russia and China. The fact that Mongolia does not depend on water flowing in from Russia or China does not mean that Mongolia is completely 'independent' with respect to what it does with its water. Most rivers in Mongolia drain to Russia or China and many Mongolians can be heard expressing their desire to use or store the water inside Mongolia and prevent it from flowing out of the country to their neighbors as it will then be 'lost forever'. Although not for its water, Mongolia - squeezed in between two giant neighbors - is economically highly dependent on

Russia and China. Would Mongolia ever come into conflict with them over water, both neighbors can put enormous pressure on Mongolia through economic measures. Negotiating very clear agreements with its neighbors about the quantities and qualities of water flowing into the neighboring countries and strictly abiding by those agreements should be a high priority of any Mongolian government. Transparency and inclusion of international arbitrators or observers in such trans-boundary agreements and their monitoring is strongly recommended to avoid a trans-boundary water conflict. Such a conflict could trigger economic sanctions from either of the neighbors that have the potential to completely bring Mongolia's development to a standstill. It is conceivable that one day Mongolia could find itself in a position that it cannot refuse demands from its neighbors on its water resources it had not planned for.

Social risks

The IWM Plan includes several measures that cannot be assumed to automatically receive public support, like measures that restrict people's access to natural resources (e.g. increasing protected areas and restricting herding there; diverting river flows to irrigate hayfields; etc.), or increasing the costs of water services (higher water tariffs or introducing polluter charges). People in general object to measures that restrict their freedoms and they will in particular resist measures they perceive as being unfairly harsh on them. Governments have a tendency to impose such measures supported by an enforcement that is based on tough punitive measures as deterrence. In particular for measures that require a change of attitude such an approach is not effective at all, but intensive (and professional) awareness raising that is built on positive incentives (rewards for success, rather than punishment for failures) is much more likely to yield results. It should be appreciated that public awareness raising requires a long and sustained effort and this should be budgeted for as a priority since public rejection of a policy will make it virtual impossible to successfully implement such a policy.

Obtaining the full cooperation of the public requires a level of transparency and openness from the side of the government that has not been customary in the past. Government agencies and government workers are likely to perceive such openness as undermining their authority and vulnerable to misuse by ill-intentioned third parties. As a result they will resist such openness, which in turn will jeopardize successful public awareness raising on issues of national importance.

Examples are the introduction of cost recovery and the polluter-pays principle, the wise and regulated use of the natural resources and the development of a community responsibility for the operation and maintenance of protection schemes.

Environmental risks

The IWM Plan includes many measures to ensure an environmental sustainable use of the water resources in Mongolia. In fact, 'environmental conservation' is one of the three pillars on which the IWM Plan is build. Nevertheless considerations regarding economic development and economic profits could gain the upper hand over environmental quality and violations of standards may be tolerated in view of a high priority for Mongolia's industrial development. This would be the case when there is strong preference for the economic development strategy discussed in Chapter 8.1. Arguments often used in favor of such a strategy (e.g. in the USA) are that industries otherwise would go out of business or that their products would become too expensive for the people to buy. Awareness raising about the importance of a healthy environment and the provision of targeted subsidies should reduce this risk.

Releasing untreated wastewater on the water system is the single most important source of (water) pollution. A major risk lies in the rapid urbanization and industrialization in

Mongolia coupled to the sub-optimal O&M of both municipal en industrial wastewater treatment systems. Wastewater treatment is not an economic interesting activity; it is not attracting private sector investments, municipal wastewater treatment is a burden on national and local governments' budgets and industrial wastewater treatment increases production costs. Cost-recovery schemes are very unpopular and recovery rates generally poor. Consequently many treatment facilities are operating at a sub-optimal level or not even functioning at all and the implementation of WWT schemes is often lagging behind or otherwise unsuccessful, leading to a continuation of the underperformance of the wastewater treatment systems. The concept of the-polluter-pays should be implemented with high priority and the fees and charges should be set to generate adequate funds to cover O&M and possibly (a major proportion of) the investment costs. Procedures need to be set in place to ensure the revenue from the polluter-pays charges are actually channeled back to finance wastewater treatment.

Another environmental risk is the lack of awareness among people that they themselves play a key-role in safeguarding the quality of water, as mentioned also above under social risks. Disposal of waste, both liquid and solid, in the surface water system should be generally considered as unwanted, or even unacceptable. Awareness programs are included in IWM Plan to convince the people that a proper disposal of waste will lead to a healthier environment. The government should provide sufficient facilities to enable such proper disposal.

Financial risks

Financial risks touch on both investment and recurrent costs. The investments are expected to be mainly funded from conventional sources (state budget, loans and some private sector). However, these sources depend on both global and national economic developments which are highly uncertain even within short periods of time. In case the total of funds will become less than required, the consequence will be that the implementation rate of measures will probably be slowed down as discussed in Chapter 1.2. Although very unfortunate, this will have no major consequences for the implementation of the IWM Plan other than that the improved performance of the water management system will be achieved at a later date.

Constraints on recurrent costs represent a more serious risk. Much of the underperformance of existing facilities is the result of insufficient operation and maintenance due to lack of funds. The IWM Plan recognizes this risk and emphasizes an institutional restructuring that eliminates duplication and inefficiencies and that facilitates cost recovery, and making water management more effective through decentralization and stakeholder involvement.

Technical risks

Most of the more important measures proposed in the IWM Plan are based on proven technology in Mongolia. Examples are irrigation systems, rain generators, drinking water systems and wastewater treatment plants. As a result of the experiences that have been gained in the past it can safely be concluded that with regard to such measures there are no major technical risks involved in IWM Plan. However, when untested technical solutions are being proposed when detailing the designs of projects such innovations would need to be studied and thoroughly tested first, either under laboratory conditions or as pilot projects under Mongolian conditions.

In Mongolia there is not very much experience with hydropower and hydropower dams. There are only two hydropower plants with a capacity in excess of 10 MW. Both have become operational in 2008 only and their commissioning was not without problems. One more is planned for and 10 potential dam sites have been designated for study and investigation. A proper study should first be conducted to learn the lessons from the construction of the first two major dams before embarking on additional dam construction.

Another new development is a basin transfer from the Orkhon River to the South Gobi through a 700+ km long pipeline. The project includes a 62 m high dam with reservoir and a 30MW power plant. The dimensions and complexity of this project are considerably larger than any such project undertaken in Mongolia before. Besides the technical risks of undertaking such a first-of-its-kind project there is also the economic feasibility and environmental impacts of this project that need to be thoroughly studied, assessed and weighed against alternative solutions.

A special kind of technical risk is related to the accessibility and reliability of data and information. Besides the need to establish effective coordination procedures as discussed under the institutional risks above, the availability and accessibility of reliable data and information is critical for effective and efficient water management. The ingrained system among institutions and researchers to consider data and information as their assets, even when obtained through public funding, threatens the efficient and effective implementation of the IWM Plan and constrains its detailed planning. The measures that have been identified to change this situation deserve a high priority.

8.4.1. Natural risks and uncertainties

The natural risks and uncertainties relate to changes in climate in Mongolia and to calamities as a result of exceptional conditions that have an effect on the source (water) itself. One of the five key dimensions of Water Security is "Water-related Disaster Resilience". The IWM Plan includes measures related to flooding, dzuds and desertification. Besides that there is also a risk for an environmental disaster like a toxic spill in future. Mongolia's rapid industrialization and urbanization brings about a high concentration of people and activities in relative small locations. This carries with it increased risks of disasters with potentially high numbers of casualties. It is important that municipalities and water managers have contingency plans ready and tested for such eventualities for everybody to know what to do, avoiding mistakes and not to lose time. Such contingency plans for water calamities need to be part of a broader disaster preparedness plan and should probably be led by the National Emergency Management Agency. Without such disaster preparedness plans Mongolia will continue to score low on the criterion "Water-related Disaster Resilience" with regard to water security.

Climate change

Much uncertainty exists on the effects of climate change, both globally as well as for Mongolia. A study using 12 climate models provided an ensemble mean temperature rise projection of 4.5 degrees in winter and 4 degrees in summer by the end of this century. Overall the models indicate an increase of 20 to 25% in winter precipitation, but a clear trend in summer precipitation is not detectable. All models strongly suggest that the potential evapotranspiration during the summer period becomes higher. This will lead to higher water demands in agriculture, lowering of lake levels and a more rapid moisture depletion of pasture land. Although the impact of these climate change effects may affect important aspects of Mongolian life, the changes will happen very gradually and within the planning horizon of this IWM Plan the magnitude of the changes that can be attributed to climate change will be well within the normal variability of the concerned quantities. Therefore no special measures need to be taken within this period to adapt to climate change. For the long term however, it is wise to consider the changes that lay ahead, their impact and how to adapt to that. For example, climate change might lead to natural conditions a hundred years from now that no longer can sustain the traditional nomadic way of life for so many animals and so many families. But nomadic herding may have disappeared by then for completely different reasons (e.g. economic) already. On the other hand the temperature increase and shorter winters would improve the crop production potential, though probably more irrigation would be required considering the expected rise of the potential evapotranspiration.

A trend that is often associated with climate change, but has little scientific proof, is an increasing frequency and amplitude of extreme weather phenomena like rainstorms, cyclones, dry weather and heat and cold waves. These may cause more frequent and more severe flooding and droughts.

Calamities - flooding

Mongolia experiences occasional flooding almost annually, sometimes resulting in loss of life. Flash floods are more dangerous in that respect than the gradual rise in water levels that make rivers burst their banks. In the future the damage caused by floods will increase irrespective of climate change causing more frequent and more severe floods or not. Mongolia is actively pursuing a policy to increase the population growth. The last decade also showed an increasing rate of migration to urban areas and in the near future a rapid industrialization is expected to take place. All these trends contribute to high concentrations of people and valuable infrastructure. A flashflood, which previously would perhaps have passed by unnoticed, would under the new circumstances cause a lot of material damage and probably human casualties. Therefore, while Mongolia develops and becomes more prosperous there is also more to lose and measures to minimize the risk of losing property and lives due to floods need to increase in parallel with these developments. The time and location of devastating floods occurring cannot be predicted and people tend to downplay the danger of floods when they haven't occurred for some time. It is in particular a government's duty to remain vigilant and maintain the levels of preparedness to deal with such disasters. There is a great risk in sacrificing the investments in preventive measures in favor of investments that have more immediate returns. Mongolia's disaster preparedness is a major contributor to the Resilience to water-related disaster dimension of the National Water Security Index.

Calamities - drought

Dry spells are a common phenomenon in the meteorological and hydrological cycles in Mongolia that reoccurs every so many years. Some are local others almost nation-wide. The traditional nomadic lifestyle of Mongolians was fairly well adapted to deal with such events. Current and future developments show a changing demographic pattern, with the population becoming more sedentary and concentrating around the few places with high levels of economic activity. Consequently more people and economic activities rely on fewer water sources, utilizing these closer to their limits than previously. This increases the vulnerability to droughts. Macro planners should base the location and size of urban and industrial centers on water availability during dry spells and consider that as a boundary condition. Trans-basin water transfers are costly and vulnerable and should be avoided as a solution whenever possible.

Calamities - dzud

Dzuds have been part and parcel of Mongolian life since eternity. Dzuds have a number of different manifestations, locally known as 'black dzud', 'white dzud', or 'ice dzud', They all have in common that they make it impossible for the livestock to feed in one way or the other, causing famine. It is not uncommon for dzuds to kill over 1 million head of livestock in a winter. The 1944 record of almost 7 million head of livestock lost was shattered in the 21st century. In 1999/2000, 2000/2001 and 2001/2002, Mongolia was hit by three dzuds in a row, in which a combined number of 11 million animals were lost. In winter 2009-2010 about 17% of the country's entire livestock died.

Although the contribution of livestock herding to the national GDP is expected to continue to decrease, still a considerable percentage of Mongolia's population will depend on livestock herding for a considerable period of time. Dzuds decimate or completely wipe out herds and affected herder families give up their way of life and migrate to the cities searching for employment. After every dzud there is a demographic shift that suddenly increases the pressure on water supplies and sanitation facilities in urban centers. Planners need to calculate this in.

Calamities - earthquake

Mongolia experiences about 10-15 earthquakes every year. Most occur in the northern mountainous regions and generally have a magnitude of less than 5.5 on the Richter scale that do not cause much damage. The largest risk is earthquakes damaging dams and other water infrastructure. Dams that have not been designed to withstand major earthquakes may fail and cause devastating floods when a reservoir empties. Other water infrastructure in particular water supply systems, central heating systems and sewerage systems are vulnerable to earthquakes and damage would disrupt supplies or severely harm the environment. The increasing concentration of people and economic activities amplifies the potential damage caused by earthquakes in general but also with respect to water management infrastructure. This justifies increasing the level of earthquake-proofing designs and construction of water infrastructures, in particular in urban and industrial centers.

Calamities - toxic spills

The possibility of toxic spills is a realistic risk as already proven by the spill in Khongor soum, Darkhan Uul aimag in the year 2007 which contaminated groundwater near the waste water treatment plant. Toxic spills contaminate surface water and groundwater and are transported downstream threatening the ecosystem and the water users. A large risk is the occurrence of dangerous spills from factories or mines along rivers, involving chemical substances (heavy metals, pesticides, oil, etc.). These spills may be a result of an industrial accident or from a deliberate act to dispose of the waste in an illegal, but cheap way. Another cause, even less predictable, could be an accident with a train, a truck or an airplane carrying chemical substances. All necessary precautions should be taken to avoid such spills but it cannot be ruled out that such incidents will happen. It is beyond the scope of the IWM Plan to describe in detail the mitigating actions that should be taken in case spills happen. In general all downstream water intakes should be stopped to take in water. This also includes stopping to pump water from the alluvial aquifers immediately. Although the boreholes would not show increased levels of chemical compounds immediately, continuing to pump would draw the toxic river water into the aquifer and make the aquifer unusable for decades. Cleaning an aquifer is many times more difficult, time consuming and expensive than cleaning a river and riverbed.

The sudden and unforeseen drop in water supply due to such a chemical accident would need to be compensated by transporting water from other sources or otherwise be dealt with (e.g. water rationing). Particular places with high concentrations of people and economic activities will be severely affected and require a rapid response. To effectively and efficiently deal with such events, scenarios should be developed that are part of a broader disaster preparedness program. Having such a plan in place and tested would improve Mongolia's water security.

Table 78. Measures and their relation to the IWRM strategy components

Legend:
Direct measure
Supporting measure

No	Measure description	Strategy components: 1. providing sufficient water of adequate quality	2. improving water use efficiency	3. protecting the water resources of Mongolia	4. improving the management of water	5. prevent and mitigate impacts of water calamities
Sub-sector 1. Water for people						
Challenge 1.1 Safe drinking water and optimal waste water treatment in urban areas						
1.1.1	Establish and enforce sanitation and protection zones			Direct		Supporting
1.1.2	Local surveys and exploration studies at new or existing resources	Supporting			Direct	
1.1.3	Construction and renovation of water supply sources	Direct	Supporting			
1.1.4	Renovation and expansion of water supply network	Direct	Supporting			
1.1.5	Construction and renovation of WWTPs			Direct		Supporting
1.1.6	Renovation and expansion of sewerage network			Direct		
1.1.7	Reuse of domestic and treated waste water		Direct			
1.1.8	Water supply / waste water treatment at army camps & border posts	Direct		Supporting		
Challenge 1.2 Safe drinking water and optimal waste water treatment in rural areas						
1.2.1	Establish and enforce protection zones around water sources.			Direct		Supporting
1.2.2	Surveys of new / existing water resources at soum centers	Supporting			Direct	
1.2.3	Construct water supplies in soum centers and in rural areas	Direct				
1.2.4	Construct small WWTPs in soum centers and organize reuse of water		Direct	Supporting		
1.2.5	Implementing sustainable water treatment facilities	Direct				
Challenge 1.3 Water for tourism and sanatorium						
1.3.1	Improve water supply infrastructure for tourism and sanatorium	Direct	Supporting			
1.3.2	Improve water supply and utilization of high-tech WWTP in tourist camps	Direct	Supporting	Supporting		
1.3.3	Develop mineral springs for spa resorts and sanatoriums	Direct				
Sub-sector 2. Water for food and agriculture						
Challenge 2.1 Water for livestock						
2.1.1	Surveys to identify water resources in rural areas	Supporting			Direct	
2.1.2	Construction of new and renovation of existing water sources	Direct			Supporting	Supporting
2.1.3	Improve O&M of livestock water supply points	Supporting	Supporting		Direct	
2.1.4	Support to improve water supply of intensive livestock breeding	Direct				
Challenge 2.2 Water for irrigation						
2.2.1	Surveys to identify water resources for irrigation and haymaking	Supporting			Direct	
2.2.2	Construction and renovation of dams and reservoirs for irrigation	Direct			Supporting	Supporting
2.2.3	Headworks, main conveyance channel and irrigation systems	Direct				
2.2.4	Improve irrigation management		Supporting		Direct	
2.2.5	Agro technology of irrigated crops and water saving technology		Direct		Supporting	
Sub-sector 3. Water for industry, mining and energy						
Challenge 3.1 Water for industries						
3.1.1	Surveys to investigate water supply sources for big industries	Supporting			Direct	
3.1.2	Implementation of water supplies for new industrial parks	Direct				
3.1.3	Water supplies to industries separate from drinking water supplies		Supporting		Direct	
3.1.4	Implement separate WWTPs for industries			Supporting	Direct	Supporting
3.1.5	Reuse of industrial water		Direct		Supporting	
Challenge 3.2 Water for mines						
3.2.1	Surveys to investigate mining water supply sources	Supporting			Direct	
3.2.2	Implementation of water supplies for new mining areas	Direct				
3.2.3	Reuse of water used by mines		Direct		Supporting	
3.2.4	Treat mine waste water and dispose to the environment			Direct		Supporting
Challenge 3.3 Water for energy						
3.3.1	Research and design of hydropower plants	Supporting			Direct	

No	Measure description	Legend: Direct measure / Supporting measure	Strategy components:	1. providing sufficient water of adequate quality	2. improving water use efficiency	3. protecting the water resources of Mongolia	4. improving the management of water	5. prevent and mitigate impacts of water calamities
3.3.2	Construction of hydropower plants							
3.3.3	Monitoring of water regime of hydropower plants							
3.3.4	Water supply to thermal power plants new and operating							
3.3.5	Investigations into geothermal potential							
	Sub-sector 4. Water for the environment							
	Challenge 4.1 Conservation of water resources							
4.1.1	Establish / enforce protection of runoff forming part of watershed areas							
4.1.2	Establish and enforce protection zones around water bodies							
4.1.3	Assess water resource reserves and enforce water use within the limit							
4.1.4	Installation of water meters at water users							
4.1.5	Establish recreational area on river side in cities							
4.1.6	Establish reservoirs to regulate river runoff and create water storage							
	Challenge 4.2 Pollution of water resources							
4.2.1	Protection of water resources from pollution							
4.2.2	Implementation of polluter pay principle							
4.2.3	Improve sanitation facilities and waste water disposal in ger areas							
	Challenge 4.3 Sufficient and clean water for the environment							
4.3.1	Research to determine environmental flow in rivers							
4.3.2	Implementation of Ramsar convention and increase nr of registered lakes							
4.3.3	Conservation of sustainable ecological conditions wetlands and lakes							
4.3.4	Improve irrigation green areas in cities and enforce water supply norms							
4.3.5	Prevention of negative effects due to lower groundwater levels							
	Challenge 4.4 Restoration of water resources							
4.4.1	Make inventory, clean / reconstruct damaged and polluted river valleys							
4.4.2	Create special protected areas to protect and restore rivers and lakes							
	Challenge 4.5 Hazards due to floods, droughts, dzuds and other disasters							
4.5.1	Construction and maintenance of flood protection structures							
4.5.2	Construct drainage systems in urban areas							
4.5.3	Define ownership and improve O&M of drainage systems in urban area							
4.5.4	Establish / enforce water management for drought and desertification							
4.5.5	Installation of rain generators to implement cloud seeding							
	Sub-sector 5. Enabling setting / water governance							
	Challenge 5.1 Legislation for water management							
5.1.1	Coordinate water related laws and make consistent							
5.1.2	Improve compliance with international treaties and conventions							
5.1.3	Update and improve rules, procedures, norms and standards							
5.1.4	Improve enforcement capacity and capability							
	Challenge 5.2 Institutions for water management							
5.2.1	Update status and mandate of authorities in charge of water							
5.2.2	Improve coordination and cooperation mechanisms							
5.2.3	Improve operations of water authorities at national and basin levels							
5.2.4	Strengthen the role of sciencech, professionals, NGOs and civil society							
5.2.5	Improve exchange, storage, quality control and access to data							
5.2.6	Develop vision and prepare a work plan for the development of RBOs							
	Challenge 5.3 Financing the water sector							
5.3.1	Renew water pricing policy and improve cost recovery							
5.3.2	Develop alternative financial sources to finance water sector							
5.3.3	Improve efficiency of water sector to reduce recurrent costs							

No	Measure description	Legend: Direct measure Supporting measure	Strategy components:	1. providing sufficient water of adequate quality	2. improving water use efficiency	3. protecting the water resources of Mongolia	4. improving the management of water	5. prevent and mitigate impacts of water calamities
Challenge 5.4 Capacity building for water management								
5.4.1	Improve human resources capacity in water sector							
5.4.2	Study to improve education and training of water professionals							
5.4.3	Implement recommendations of study (5.4.2)							
Challenge 5.5 Monitoring and research for water management								
5.5.1	Improve and expand monitoring of water resources							
5.5.2	Improve sampling equipment and laboratory facilities.							
5.5.3	Rationalize monitoring programs and formalize							
5.5.4	Expand and integrate water sector research and studies							
Challenge 5.6 Data and Information management								
5.6.1	Improve national databases, data quality control and data exchange							
5.6.2	Create water database systems at basin level							
5.6.3	Institutionalize regular detailed publication of results							
Challenge 5.7 Public awareness of water management and public participation								
5.7.1	Design comprehensive information and awareness raising strategies							
5.7.2	Implement recommended information strategies							
5.7.3	Provide easy access for the public to relevant information and data							
5.7.4	Promote and reintroduce traditional protection methods							
5.7.5	Enhance the role of NGOs in water management at all levels							

PART G – IMPLEMENTING THE PLAN

9. Implementation plan

9.1. Agreement on implementation of IWM Plan

The Law on Water of Mongolia (2012) Article 4 calls for the development of the Integrated Water Resource Management Plan by the 'Governmental competent authority in charge of water' i.e. the Ministry of Environment and Green Development. According to Article 6, clause 9.1.1 the Government would have to approve the National Integrated Water Resources Management Plan.

By Decree No. 75 of the Prime Minister of Mongolia, dated 26 November 2012 the National Water Committee was appointed in its new position. Annexed to the Prime Minister's Decree are the National Water Committee Rules and one of the NWC's duties as stated in clause 2.1.3 is: "to conduct monitoring of the implementation of the National Integrated Water Resources Management Plan. This makes the NWC the custodian of the IWM Plan.

9.2. Implementation of measures

The execution of the Integrated Water Management Plan of Mongolia is implemented by defining measures for each of the five water sub-sectors. The measures contain the activities required to deal with the described challenges and issues. A description and cost estimate of the measures is included in Table 84. The table contains for each measure:

- a short description of the measure;
- the location of the measure; distinction is made between measures in
  - the capital city Ulaanbaatar,
  - the 21 aimag centers,
  - the other big urban areas (Kharkhorin, Bor Undur, Khotol, Zamiin Uud, Shariin gol, Zuunkharaa, Baganuur and the developing urban areas of Khanbogd and Tsogtsetsii)
  - soum centers,
  - rural areas and
  - the whole country;
- an estimate of the investment costs in million MNT of the measures separated in two periods 2012-2015 and 2016-2021;
  - the costs take into account the budget which is already defined for the years 2012 and 2013;
  - the costs are determined using unit costs from completed or on-going projects and using costs estimated by ministries and national and international organizations and when these were not available using costs as defined in the Water National Program;
- the possible source of the funding of the investment costs by percentage distinguishing funding from state budget, local (aimag, soum) budget, foreign aid or loans and private funds;

- an estimate of the recurrent costs in million MNT of the measure covering operation and maintenance during 2012-2015 and 2016-2021; the recurrent costs are determined using unit costs or percentages of investment costs derived from completed or on-going projects;
- the possible source of the funding of the recurrent costs by percentage distinguishing funding from state or local budget or from the owners of the measure output;
- a short description of the measure and related activities giving - when available - more detail on the contents, output and benefits of the activities.

The investment costs of the measures are indicative as these are based on budget estimates and preliminary cost estimates of planned activities. Feasibility and design studies are required for most measures to provide a more accurate estimate of the costs. The presented costs are considered the best cost estimate currently available. The investment cost estimate for Ulaanbaatar corresponds with the cost estimate made in the Tuul River Basin Integrated Water Management Plan.

9.3. Cost of the measures

9.3.1. Outline of necessary investments

The costs of the measures have been estimated on the basis of the information available. The level of accuracy of the cost information on the various measures varies greatly as the sources are very different; some are based on detailed feasibility studies, others are only rough estimates. However, for initial planning purposes these cost estimates are sufficient. The costs as presented here have been calculated to price levels of 2011 and should be considered indicative.

The investment costs for sub-sector 1 “Water for People” are based on existing plans for the protection and development of the water sources, for the development of the water supply, the sewerage system and the waste water treatment of Ulaanbaatar city, aimag centers and other urban areas, rural soum centers and rural areas and tourist camps and sanatoriums. The major investments concern the Tuul Dam Complex, the water supply systems in Ulaanbaatar, aimag centers and other urban centers and the waste water treatment facilities in Ulaanbaatar. The costs of rural water supplies which are used for livestock but are used for rural domestic water supply also are not included here but are included in sub-sector 2. The total investment costs for sub-sector 1 are:

for the urban areas	3,553.5 bln MNT
for the rural areas	138.5 bln MNT
and for tourism and sanatoriums	58.6 bln MNT

The investment costs for sub-sector 2 “Water for Food” are based on unit costs of boreholes and ponds used in the water supply of livestock and on unit costs for construction and renovation of irrigation systems. The investment costs also include measures to improve the O&M of livestock water supply points by supporting herder groups and to improve irrigation practices by introducing new technologies and supporting irrigation management groups. The total investment costs for sub-sector 2 are:

for livestock water supply	118.5 bln MNT
and for irrigation	441.1 bln MNT

The investment costs for sub-sector 3 “Water for industry, mining and energy” are based on unit costs from completed or on-going projects and on preliminary cost estimates of planned projects. The largest costs involve the water supply to mines with the Orkhon-Gobi water transfer project being the most expensive single activity. Another expensive project is the hydropower dam in the Selenge River at Shuren. The total investment costs for sub-sector 3 are mainly for water supply and wastewater treatment and reach:

for industries	452.7 bln MNT
for mines	2,104.1 bln MNT
and for energy	335.1 bln MNT

The investment costs for sub-sector 4 "Water for the Environment" are smaller than the costs of the other sub-sectors because of the smaller size of the infrastructural projects, which include construction of improved sanitation and drainage systems and construction of flood protection facilities. Flow regulating reservoirs are included but only as far as surveys and studies and not construction activities. The total investment costs for sub-sector 4 are:

for conservation measures	41.6 bln MNT
for protection against pollution	224.1 bln MNT
for environmental measures	3.6 bln MNT
for restoration measures	63.7 bln MNT
and for protection against hazards	215.8 bln MNT

Sub-sector 5 "Enabling setting / water governance" contains mainly administrative and organizational measures and the total investment costs therefore are limited to 73.7 bln MNT. Nevertheless the measures in this sub-sector are crucial in supporting the measures of the other sub-sectors.

Table 79. Summary of investment costs 2012-2021 and sources of funding

Financing source Sub-sector	State budget	Local budget	Foreign	Private	State budget	Local budget	Foreign	Private	Total
	%				Million MNT				
1. Water for people	32%	10%	29%	30%	1,184,447	367,784	1,079,465	1,118,887	3,750,582
2. Water for food	36%	0%	5%	59%	200,293	2,500	28,860	327,963	559,615
3. Water for industries, mining and energy	5%	0%	46%	48%	148,706	0	1,343,534	1,399,593	2,891,833
4. Water for environment	53%	7%	4%	36%	292,392	36,828	21,158	198,354	548,731
5. Enabling setting	100%	0%	0%	0%	73,720	0	0	0	73,720
Total	24%	5%	32%	39%	1,899,558	407,111	2,473,016	3,044,796	7,824,480

The total investment costs amount to 7,824.5 bln MNT until 2021 (see Table 79), with 29% of the costs until 2015 and 71% of the costs from 2016 until 2021. The total recurrent costs till 2021 are expected to reach 1,024.1 bln MNT which is about 13% of the total investment costs. After 2021 the annual recurrent costs on the investments are estimated at about 295 bln MNT at current (= 2011) price levels.

The investments needed to implement the measures included in this plan on average reach almost 1 trln MNT per year, which is about the total project investments from the state budget projection for 2015 (see Figure 66) and about 10 times the total investments in the water sector estimated for 2012 (see Figure 65). As such an increase cannot realistically be expected the portion of the total investment costs that is expected to be financed from government sources, only the costs for measures that are already included in the central government and aimag development and policy plans have been included. These amount to 24% from the state budget and 5% from local budgets. This still requires an average contribution from government sources of an average 300 bln MNT per year till 2021 (excluding the recurrent costs!) or almost four times the estimated state budget investments in the water sector during 2012.

For measure or activities that are not included in the development plans, financing needs to be found through foreign loans and private investors. Private investors are expected to preferably invest in projects with a quick economical return, which could apply for about 39% of the total investments or about 400 bln MNT per year. This would leave about 32% of the total investments to be financed through foreign funding (mainly loans) or an average 350 bln MNT per year. These contributions imply a steep rise from such contributions during the recent past of a modest 10-15 bln MNT per year from foreign loans and about half of that as private investments.

The source of funding of sub-sectors 1 and 2 concerning urban and rural water supply and waste water treatment is expected to be mainly from state, foreign and private budgets. The source of funding of sub-sector 3 concerning industrial and mining water supply and wastewater treatment is mainly from private and foreign sources. The source of funding of sub-sectors 4 and 5 is mainly from the state budget.

Part of the investments has already been budgeted for in existing development and policy plans (see Table 80). The investments not yet budgeted comprise about 30% of the total investments. But remaining 70% mostly related to the 3-rd subsector Water for industry, mining and energy, which an investment sources are will be mainly from private sources.

Table 80. Investment costs already included in existing national and local development plans

Sub-sector	Investments already budgeted (mlnMNT)	Investments not yet budgeted (mln MNT)	Total investments (mln MNT)
1. Water for people	417 159	871 087	1 288 246
2. Water for food	136 526	0	136 526
3. Water for industries, mining and energy	90 579	523 516	614 095
4. Water for environment	37 335	137 466	174 801
5. Enabling setting	200	21 020	21 220
Total	681 798	1 553 090	2 234 887

Explanation: Currently in the approved Development Policy documents of Mongolia doesn't included budget projection after 2016

9.3.2. Outline of recurrent costs

The recurrent costs are required for the operation and maintenance of the output realized by the investments. These costs include staff costs, fuel costs, spare part costs, cost of repairs, etc. The recurrent costs do not include the depreciation and replacement of equipment and constructed installations. The recurrent costs presented here only cover the operation and maintenance costs of the facilities constructed by the defined measures. The recurrent costs presented here do not cover the already existing infrastructure of the water supplies, waste water treatment and other facilities.

The recurrent costs as presented in Table 84 are indicative and may be determined more accurately after feasibility and design studies become available.

The recurrent costs, when determined as a fixed amount per year are determined from available feasibility or design studies of from unit costs per beneficiary per year. The available recurrent cost estimates cover the construction of waste water treatment and sewerage systems and the construction of livestock water supplies. For recurrent costs per year, that are determined as a percentage of the investment costs, the following percentages have been used:

for drinking water supplies:	5 %	for industrial water supply:	5 %
for municipal wastewater treatment:	5 %	for industrial wastewater treatment:	5 %

for livestock water supply:	5 %	for mining water supply:	2.5 %
for irrigation water supply:	9 %	for mining wastewater treatment:	2.5 %
for energy water supply:	5 %	for environmental measures:	5 %
for hydropower dams:	5 %	for flood protection measures:	2 %

For measures completed in the period 2012-2015 it is assumed that recurrent costs will be due for one year on average. For measures completed in the period 2016-2021 the average would be 3 years. The actual number of years for which the recurrent costs will be due depends on the year of delivery of the final output of the measure.

Only 4.6% of the recurrent costs are expected to be financed from the state and local government budgets while 95.4% would be financed by the 'owners'. The 'owners' would be private citizens, e.g. in the case of water meters, or private companies with respect to industrial wastewater treatment etc. But the term 'owners' also includes public entities that are expected to finance their operating and maintenance costs from the returns on charges and fees for their services such as water supply companies like USUG in Ulaanbaatar and state owned enterprises like the new 'Mongol Us'.

Table 81 presents a summary of the estimated recurrent costs. The source of funding of the recurrent costs of sub-sectors 1, 2 and 3 is expected to be mainly financed by the owners i.e. the users of the water supply and wastewater treatment facilities. The source of funding of sub-sector 4 is divided between the state and the owners. The source of funding of sub-sector 5 would be fully financed from the state budget. After 2021 the operation and maintenance costs for the measures will be a continuous burden to the respective budgets. It is estimated that the total of these annual recurrent costs would amount to about 225 bln MNT at current (2011) price levels.

Table 81. Summary of estimated recurrent costs 2012-2021 and the sources of funding

Sub-sector	State or local	Owners	State or local	Owners	Total	Annually > 2012
	%		mln MNT			
1. Water for people	1.3	98.7	5,219	398,228	403,446	76,824
2. Water for food	1.4	98.6	3,164	218,479	221,643	49,552
3. Water for industries, mining and energy	0.0	100.0	0	333,890	333,890	89,350
4. Water for environment	45.2	54.8	21,608	26,191	47,798	7,753
5. Enabling setting	100.0	0.0	17,365	0	17,365	1,387
Total	4.6	95.4	47,356	976,787	1,024,143	224,866

9.4. Organizations involved and responsible

The organizations involved in the decision making and implementation of the 88 measures are the various ministries, the National Water Committee, the River Basin Authorities, the Capital and local governments, the Capital and local representative khurals, the General Agency for Specialized Inspection and the National Emergency Management Agency. The involvement of the organizations in the implementation of the IWM Plan and their role in it is presented in **Error! Reference source not found.**. The following three roles are distinguished:

- responsible role
- cooperative role
- consultative role

Having a *responsible role* means that the organization is responsible for the implementation of the measure and will have to take the lead in the design, financing and execution of the measure. For some measures a shared responsibility is foreseen where two or sometimes three organizations will have the responsibility jointly. Close cooperation between these organizations will be necessary to achieve a successful result.

A *cooperative role* means that an organization is expected to provide support in the planning and execution of the measure. The organization will be involved in the decision making but will not carry full responsibility for the execution of the measure.

Organizations with a *consultative role* will be consulted during the preparation and the execution of the measure. The opinion and the expertise will be required to implement the measure but the organization will not be involved directly.

The Ministry of Environment and Green Development will be responsible for 38 measures, the National Water Committee for 12 measures, the Ministry of Construction and Urban Development for 14 measures, the Ministry of Industry and Agriculture for 13 measures and the River Basin authorities are responsible for 26 measures. The other ministries and organizations are responsible for 1 to 4 measures each.

The Capital and local governments will cooperate in 48 measures and the river basin authorities will cooperate in 46 measures to facilitate the implementation of the measures in their territories. Consultation with the Ministry of Finance is important for the financing of the measures and it is expected to take place with regard to 39 of the measures.

9.5. Managing the implementation of the IWM Plan

The implementation of the IWM Plan is an undertaking of a magnitude and a level of complexity that can only be compared with the development of the mineral deposits in the South Gobi. The difference is that mining developments and the associated projects involve a limited number of highly professional companies and organizations. Implementation of the IWM Plan involves a very large number of organizations of very different capability and experience. Some organizations to be involved first need to be established. The number of projects to be implemented is very high and their geographical distribution covers the whole country. On the other hand the long list of projects included in the IWM Plan include only 2 “mega” projects: the Orkhon-Gobi transfer and the Tuul River dam complex, while other costly measures all comprise a number of similar activities at different locations, which each should be considered as a separate project.

Except for the two “mega” projects, managing the implementation of the IWM Plan comes down to managing the implementation of more than 2500 separate activities that range from construction of water supply systems to formulating rules and regulations for Water Management Organizations, from constructing wastewater treatment plants to cleaning polluted riverbeds, from drilling monitoring wells to training mid-career water sector staff.

It is obvious that the management of all these tasks need to be delegated to the appropriate levels and it also underlines the need for effective coordination, monitoring and reporting to keep track of the progress of the implementation of the IWM Plan.

9.5.1. Control procedures at central governmental level

As per Prime Minister Decree No. 75 the National Water Committee is responsible for the Monitoring of the implementation of the Integrated Water Management Plan. The technical staff of the NWC (the ‘National Water Authority’) will annually prepare a work plan for implementation of measures under the plan. The annual work plan will include the work plans submitted by the Water Basin Authorities c.q. Aimags from the areas where there are no Water Basin Authorities established yet. At the national level these regional work plans are complemented with work plans for inter-basin activities that are managed at the national level.

The annual work plan, including its financing plan is discussed by the full membership of the National Water Committee and the approved plan is binding to all line ministries involved in the activities covered by the plan.

The annual work plan and its budget is then submitted to the cabinet for approval, and inclusion in the national state budget that will be sent to the State Great Khural for approval.

The NWC will require quarterly progress reporting from the regions and the line ministries implementing measures at the national level on the progress of implementation. The Technical staff of the NWC will compile a summary progress report highlighting the deviations from the planned progress. A quarterly progress meeting of the full NWC will discuss the reported issues and decide on the necessary steps to taken to solve these issues. Instructions will be issued accordingly. The Prime Minster, as chairman of the NWC will regularly brief the Government on the status of implementation.

When the situation so requires the NWC may opt to compose a committee from its own membership or to commission an independent consultant to evaluate or investigate specific projects.

The NWC will prepare an annual report on the progress of the activities under the IWM Plan that specifically reports on the achievements with regard to the indicators specified in this IWM Plan. The Annual Report will be submitted to the Government and will be shared with all the line ministries and other institutions involved in the implementation of the IWM Plan.

9.5.2. Control procedures at lower governmental level

The first level of delegation is the Water Basin level. In particular in the context of IWRM the Water Basins would be expected to play a major role in implementation, coordination and monitoring. The Water Basin Authorities will be responsible for coordinating all activities that do not traverse the boundaries of their jurisdiction, the Water Basin.

Where Water Basin organizations have not yet been established that role would be assigned to the respective Aimags.

The Water Basin Authorities c.q. the Aimags will, in close cooperation with the respective line ministry representatives, prepare an annual work plan and financing plan for the implementation of the measures and obtain approval for this work plan from the respective Water Basin Councils or, if not yet present, from the Aimag Citizens Representative Khurals. With this support the work plan will be submitted to the National Water Committee for final approval.

Under the coordination of the Water Basin Authority the respective line ministries through their local branches will be responsible for the actual implementation of the measures under the work plan. The Water Basin Authorities c.q. the Aimag will monitor the progress and report periodically to the NWC, the Water respective Basin Councils and Aimag Citizens Representative Khurals. An annual report will be prepared that specifically will report the progress with respect to the indicators.

The day to day management of activities that do not transverse Soum boundaries will be delegated to the Soum authorities, who will report to the Water Basin Authority c.q. the Aimag.

9.5.3. Quality control procedures at professional level

Quality control over the implementation of measures includes a variety of aspects. Firstly there are the quality standards for all sorts of construction work that would need to be adhered to. The quality standards are there, though they may be updated regularly, and will be included in the respective terms of references, tender documents, programs of work etcetera. The organizations or line ministries in charge of supervising the works will apply the approved procedures for quality control and the State Special Inspection Agency is responsible for enforcing the quality standards.

At the local level the Water Basin Authorities have the responsibility to ensure that measures are implemented at the required quality standards. They will work in close conjunction with the Aimag Special Inspection Department and the Soum Special Inspectors. Reporting on the quality of implementation will be included in the monthly and annual progress reports.

For 'soft' measures, i.e. measures that do not involve construction work, the quality control is quite a different issue. For instance measures like protection of water sheds, training of staff, etcetera do not have approved quality standards. This requires that such activities are described in the annual work plan and, where applicable, in the work contracts the required quality of the end result is clearly described in quantified terms so that it can be monitored. This again is not always possible and the Water Basin Authorities and the NWC may wish to engage NGO's or specialized Institutes to monitor the quality of implementation. In extreme cases the general public may be called upon to report on poorly implemented measures or report offenders and trespassers. The NWC as well as the Water Basin Authorities would need to facilitate and stimulate such public involvement by appointing an officer especially to receive and follow up on such reports, or open a website where the public can report such incidents.

9.6. Expected overall outcome of the IWM Plan of Mongolia

The aim of this IWM Plan is to improve Mongolia's water security as indicated by the sub-title of the Plan. In chapter 6.5.2 the concept of water security has been introduced and according to the ADB's Asian Water Development Outlook 2012 (AWDO-2012) (*in print*) Mongolia's National Water Security Index (NWSI) was 2 in 2010 on a scale from 1 to 5. The NWSI is a measure of the water security status of a country. In Table 82 the indexes and how they relate to the national water security status are explained. It seems appropriate to express the overall outcome of the IWM Plan in terms of its impacts on Mongolia's water security.

Table 82. Water security indices and what they mean

NWSI Index	National Water Security Stage	Description
5	Model	Sustainable local agencies and services, sustained sources of public financing for water and environmental protection and management, sustainable levels of public water consumption, government demonstrating new models of water governance, supporting advanced technology, supporting research and development, initiating or leading international partnerships
4	Effective	Water security initiatives built into key national, urban, basin and rural development master plans; high priority on national development agenda; public investment is reaching appropriate levels; regulation is effective; and public awareness and behavioural change are a government priority

NWSI Index	National Water Security Stage	Description
3	Capable	Continuous capacity building; improving rates of public investment; stronger regulation and enforcement; national development agenda is prioritizing water and environment; and focus is shifting toward improving local technical and financial capacity
2	Engaged	Legislation and policy is supported by government capacity building programs; institutional arrangements are improving; and levels of public investment are increasing (although still be at inadequate rates)
1	Hazardous	Some legislation and policy on water and environment, and inadequate levels of public investment, regulations, and enforcement

The NWSI is composed of five key dimensions (KD) that were developed by several renowned international institutes and organizations[1] and coordinated by the Asian Development Bank:

- **KD1 -** Household Water Security: this index provides an assessment of the extent that a country is satisfying its household water and sanitation needs and improving hygiene for public health in all communities. The Household Water Security index is a composite of three sub-indexes: Access to piped water supply; Access to improved sanitation and Hygiene
- **KD2 -** Productive Economy Indicators: this index provides an assessment of the productive use of water to sustain economic growth in food production, industry and energy. The index is a composite of three sub-indices: Agricultural Water Security Sub-Index; Industry Water Security Sub-Index and Energy Water Security Sub-Index
- **KD3 -** Urban Water Security: this index assesses the status of urban water related services to support vibrant, liveable cities and towns. The index is a composite of three sub-indexes: Urban water supply; Wastewater treated and Drainage (measured as extent of economic damage caused by floods and storms).
- **KD4** – Environmental Water Security: this index measures river basin health and is a composite of four sub-indexes: Watershed disturbance; Pollution; Water resource development and Biological factors.
- **KD5** – Water Related Disaster Resilience: this index measures progress towards establishing resilient communities that can adapt to change. KD5 is a composite indicator that includes evaluation of three types of water-related shock: (i) floods or windstorms, (ii) drought, and (iii) storm surges or coastal floods by assessing: Exposure (population density, growth rate); Basic population vulnerability (poverty rate, land use); Hard coping capacities (telecommunications development) and Soft coping capacities (e.g., literacy rate).

To achieve a 100% water security is virtually impossible; hence not a single country in the world has achieved a NWSI of 5. In Asia and the Pacific New Zealand is the highest scoring country with a NWSI of 4 in 2010. The Republic of Korea, a country with which Mongolia might wish to compare itself, has a NWSI of 3. Table 83 presents a comparison of the scores for the five key dimensions for these countries in comparison with those for Mongolia.

When the measures proposed in this IWM Plan have all been carried out in the time period set for the implementation of the plan, the targets as presented in chapter 7.4

1 For KD1: United Nations Economic and Social Commission for Asia and the Pacific, for KD2: International Water Management Institute and the UN Food and Agriculture Organization, for KD3: International Water Center and PUB Singapore, for KD4: International Water Center and for KD5: International Center for Hazard and Risk Management (ICHARM).

would be achieved and with that the National Water Security Index for Mongolia by 2021 could be estimated (see Table 83 and Figure 67).

Table 83. National water security Indexes in 2010 (acc. AWDO 2012)

Country	KD1	KD2	KD3	KD4	KD5	Total indicator	NWSI
New Zealand	5	4	4	4	3	4.00	4
Korea	5	3	2	2	2	2.80	3
Mongolia	1	2	2	4	1	2.00	2
Mongolia (projection for 2012)	2	4	2	4	1	2.60	2

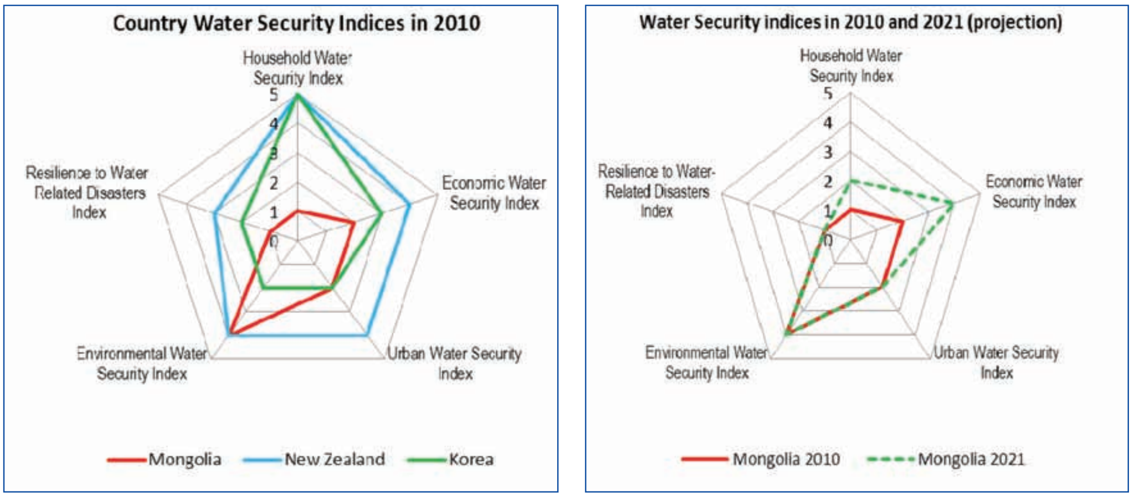


Figure 67. Water security indexes

Implementation of the measures proposed in the IWM Plan would increase the Household Water Security Index from 1 to 2 and the Economic Water Security Index is estimated to increase from 2 to 4. However measures proposed in the IWM Plan that relate to the Urban Water Security Index are expected to keep up with the projected population increase of the urban areas and still leave room for much improvement. The Environmental Water Security Index for Mongolia of 4 already was very high and is estimated to stay at 4. The measures proposed in the plan serve to prevent a deterioration of the environment as population growth and economic development increases the pressure on the environment. The Resilience to Water-related Disasters Index is estimated to remain low at 1. The Resilience Index focuses on coping mechanisms and disaster preparedness, which are issues largely beyond the scope of the IWM Plan. Moreover the rapid urbanisation and fast expanding economic development concentrating in the few urban areas dramatically increases the vulnerability for water-related disasters. This has a strong negative effect on the Resilience Index. However, at the time of publishing of this IMW Plan the Government of Mongolia is commissioning studies and projects on disaster preparedness. The outcome of those may result in an improvement of the Resilience Index by 2021.

Overall the Water Security Indicator is expected to achieve a 30% increase, rising from 2.00 to 2.60, but the NWSI will remain at 2 (the tipping point for the index to change to 3 lies at the indicator value of 2.75). However, this also means that in 2021 Mongolia will be approaching the level of water security of the Republic of Korea in 2010. It should also be realized that without further investments in the water sector the National Water Security Index will rapidly fall, as the increase in population, urbanisation and economic development each in itself cause a serious deterioration of the national water security.

Only to counter such deterioration and maintain the national water security at the same level requires continuing major investments and funding for the water sector. The projected trend of the NWSI for Mongolia does also expose the weak spots of Mongolia's water security and indicates that extra attention is required for household and urban water security and for resilience to water-related disasters. All three indexes have a strong link to the urbanisation trend.

An increase of the National Water Security Index in the future will only be possible when considerable investments are continued to be made in the water sector over and above the investments that will be needed to just keep up with the rate of urbanisation and to maintain the current level of water security.

An action plan for the Integrated Water Management Plan of Mongolia

9.7. An action plan for the Integrated Water Management Plan of Mongolia (IWRM plan) approved by the Government of Mongolia's Resolution No. 389 dated on November 30, 2013

It has been enacted that the IWRM plan is to be drafted by the central public organisation in charge of water issues and to be approved by the Government of Mongolia according to the Article 9 Clause 9.1.1 and the Article 10 Clause 10.1.1 of the updated Law of Mongolia on Water approved by the Parliament of Mongolia in 2012.

The IWRM plan aims at long-term secure water supply required for achieving the development of socio-economic sectors in the future. In other words, the IWRM plan's main goal is to provide water security, one of the main cores of the National Security of Mongolia.

In the IWRM plan, there is a comprehensive inclusion of the water sector's policy and strategy, and the relevant measures that are required for achieving the strategic goal and objectives of, and implementing the development policies and programmes of Mongolia and its sectors.

The measures that are included in the IWRM plan are to be implemented in two phases: the first phase 2014 - 2016 and the second phase 2017 - 2021 under the five main objectives below:

1. Safe drinking water supply;
2. Water supply for agricultural sector;
3. Water supply for manufacturing, mining and energy sectors;
4. Keeping the balance of nature and conservation of water resources;
5. Implementation of an optimum water management and provision of a cross-sectoral coordination.

In total, 86 measures that are required for the implementation of above five main objectives were identified and reflected in the IWRM plan. The required investment for the implementation of these measures from 2014 to 2021would total MNT 7.8 trillion.

According to an estimate for the IWRM plan's investment, MNT 1.9 trillion or 24 percent out of the MNT 7.8 trillion is to be funded from the state budget, MNT 0.4 trillion or 5 percent is from local government budget, MNT 2.5 trillion or 32 percent is from foreign loan and grant aid and MNT 3 trillion or 39 percent is from private sector and other financial sources. The plan could potentially be implemented in public private partnership (PPP).

As of the first quarter of 2013, the preparations for some large infrastructure works that are included in the IWRM plan were launched. For example: a Tuul River Water Complex and a new Central Wastewater Treatment Plan for Ulaanbaatar city and etc.

The IWRM plan is to connect with the Government policy and the socio-economic sector' development plans, implement the two phase – measures until 2021 aimed at optimising the sharply increasing water demand and provide water security.

During the formulation of the IWRM plan, some five discussions were held involving the researchers from water sector and the representatives from the line ministries, governmental and non-governmental organisations in order to reflect the recommendations and feedback from the related stakeholders in the IWRM plan. Another two discussions were also held by the Steering Committee of the "Strengthening Integrated Water Resources Management in Mongolia" project and the

Ministry of Environment and Green Development.

The official recommendations and feedback from 15 line ministries and the National Water Committee were received and reflected in the formulation of a final draft IWRM plan. The final draft was submitted to and approved by the Government of Mongolia on November 30, 2013. The Government Resolution No. 389 that approved the IWRM plan and the plan's measures are attached herewith.

RESOLUTION OF THE GOVERNMENT OF MONGOLIA

November 30, 2013	No. 389	Ulaanbaatar city

About the approval of programme

Based on the Article 9 Clause 1.1 of the Law of Mongolia on Water, aimed at implementation of the Government Resolution No. 24 in 2010, the Government of Mongolia RESOLVES to:

1. Approve the Integrated Water Management Plan of Mongolia (IWRM plan) according to the Appendix.

2. Assign the Minister of Environment and Green Development S. Oyun to provide the integrated policy, inter-sectoral and regional coordination for the IWRM plan and the Secretary at the National Water Committee Ts. Badrakh to monitor the implementation of the IWRM plan.

3. Assign the Minister of Finance Ch. Ulaan and the Minister of Environment and Green Development S. Oyun and the Mayor of Ulaanbaatar city and the provincial governor to reflect the required investment for the implementation of the plan's goal and activities in the state budget every year and make funding for the IWRM plan in connection with a foreign loan, grant aid and projects.

THE PRIME MINISTER OF MONGOLIA	N. ALTANKHUYAG
THE MINISTER OF ENVIRONMENT AND GREEN DEVELOPMENT	S. OYUN

(sealed with a stamp)

Table 84. An action plan for the Integrated Water Management Plan of Mongolia

Appendix Resolution nr.389 of
the Government of Mongolia, 2013

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
Objective 1. Safe drinking water supply						
1.1	Establish and enforce sanitation and protection zones around water supply sources	Ulaanbaatar city, In 21 aimags and Kharkhorin, Bor Undur, Khotol, Zamiin Uud, Shariin gol, Zuunkharaa, Baganuur, Khanbogd, Tsogtsetsii construction of protection zones around existing and new water supply sources; construction of protection around water supply points (kiosks); enforcement of rules and guidelines on water supply sources protection and sanitation zones	MEGD, RBA, Capital and Local government	MCUD, MIA, MH, GASI, NEMA	2014-2021	State budget Local budget
1.2	Local surveys and exploration studies to identify new or verify existing water resources	Comprehensive water resource surveys and studies in existing and new settlement areas; pre-feasibility study of Tuul Dam complex.	MEGD	MED, ME, RBA	2014-2021	State budget Local budget Foreign Concession
		Comprehensive water resource surveys and studies in existing and new settlement areas in Gobi-Sumber, Dundgobi, Dornogobi, Bulgan, Bayan-Ulgii.				Local budget
		Feasibility and design study; construction of dam with hydropower plant and reservoir. Tuul Dam Complex				State budget Local budget Foreign Private
		Improvement of water supply system, including pump stations, reservoirs and pipeline from Taishir Dam				State budget
		Improvement of water supply system, including pump stations, reservoirs and pipelines in 6 urban areas				State budget Foreign
		Kharkhorin, Bor Undur, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd and Kharkhorin, Saikhan, Khutul, Mandal, Zuunkharaa, Tsogt-Tsetsii				State budget
1.3	Renovation and expansion of water supply network and increase of number of connected water supply kiosks	Extension of water supply distribution network at Ulaanbaatar City. Constructed kiosks 400.	MCUD	MED, ME, Capital and Local government, RBA	2014-2021	State budget Local budget Foreign Private
		Extension of water supply distribution networks of 21 aimag centers and Other big urban areas: Kharkhorin, Bor Undur, Zamiin Uud, Shariin Gol, Saikhan/Khutul, Mandal/Zuunkharaa, Khanbogd, Tsogttsetsii				State budget Local budget Foreign Private

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
1.4	Construction and renovation of waste water treatment plants	Renovation, improvement and extension of WWTP's at Ulaanbaatar City: 1. Central WWTP renovation, membrane reactor; 2. Central WWTP improvement of equipment and efficiency; 3. Nisekh/Yarmag new WWTP; 4. Emelt new WWTP; 5. Small treatment plants	MCUD	MEGD, MED, ME, , Capital and Local government, RBA	2014-2021	State budget Local budget Foreign Private
		Renovation and construction of WWTP's in 21 aimag centers and other big urban areas: Kharkhorin, Bor Undur, Saikhan. Khutul, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd, Baganuur until 2015 and Kharkhorin, Mandal. Zuunkharaa, Tsogtsetsii until 2021				State budget Foreign
1.5	Renovation and expansion of sewerage network	Extension and renovation of sewerage system in parts of Ulaanbaatar City, aimag centers and other big urban areas: Kharkhorin, Bor Undur, Saikhan. Khutul, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd, Tsogtsetsii, Baganuur	MCUD	MED, ME, Capital and Local government, RBA	2014-2021	State budget Local budget Foreign Private
1.6	Reuse of domestic and treated waste water	Study and implementation of reuse of treated waste water for use by power plants; study and implement grey water systems in new apartments and public buildings	MEGD	MCUD, MED, ME, RBA	2014-2021	State budget Foreign Private
1.7	Improve water supply and waste water treatment at army camps & border posts	Improved water supply and waste water treatment at 8 military units until 2015. Army camps: Ulaankhus of Bayan-Ulgii aimag, Bulgan of Khovd aimag, Bayanlig of Bayankhongor aimag, Songino of Zavkhan aimag, Zuungovi of Uvs aimag, Delgerkhaan of Khentii aimag, Bayanlig of Bayankhongor aimag, Sergelen of Tuv aimag, Altanbulag	MD, MEGD	MED, ME	2014-2021	State budget
		Improved water supply and waste water treatment at 15 military units until 2015. (Zamiin-Ud, Altanbulag, Gahsuunsuxait, Shiveekhuren, Borshoo, Bichigt, Khangi, Burgastai, Bulgan, Khankh, Zelter, Khuvd, Ingensevstei, Uushig, Kharkhonit, Jaalshand, Khetsuu uul, Sainsuuj, Uzuur-Us, Khukh bulag, Tsagaan-Ovoo, Bayantukhum, Lamt, Kholboo zalaa, Buduun mod, Avdrant, Arbulag, Baga khuree, Urgustei, unit in 117, Khatan suudal)	MD	ME	2014-2021	State budget
1.8	Establish and enforce protection zones around water sources.	Protection of rural water sources mainly concerns fencing of water points and demarcation of a sanitation zone. Number of protected springs:560	MEGD, Capital and Local government	MH, ME, GASI, NEMA, RBA	2014-2021	Local budget
1.9	Local surveys and exploration studies to identify new or verify existing water resources at soum centers	Executed surveys: until 2015: 15 surveys at soum centers, 1352 surveys for boreholes; until 2021: 36 surveys at soum centers, 3380 surveys for boreholes	Capital and Local government, RBA	MEGD, MED, ME	2014-2021	State budget
1.10	Construct water supplies in soum centers and in rural areas for herders and farmers	Constructed water supplies: until 2015: 15 small soum centers, until 2021: 36 soum centers.	MCUD, MIA	MED, ME, ЗДТГ, RBA	2014-2021	State budget
1.11	Construct small waste water treatment plants in soum centers and organize reuse of treated waste water	Constructed waste water treatment plants: until 2015: 15, until 2021: 36 soum centers.	MCUD	MED, ЗДТГ, RBA	2014-2021	State budget Foreign

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
1.12	Construct small waste water treatment plants in soum centers and organize reuse of treated waste water	Analysis and selection of sustainable treatment facilities. Installation of new and replacement of existing equipment. Supervision and training of operators.	RBA	MCUD, ME	2014-2021	State budget
1.13	Improve and expand water supply infrastructure for tourism and sanatorium	This measure applies mainly to tourist facilities in rural areas. Costs included are not from state budget but from private companies. Measures are to be taken by private tourist companies. These include water supply of ger camps and hotels, water supply of tourist attractions, etc.	MCST	MED, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget Local budget Private
1.14	Improve water supply infrastructure and utilization of high-tech WWTP in tourist camps	Water supply and WWTP in tourist camps in Tuul and Terelj river basin, near Khovd and Buyant rivers as well as lakes of Khuvsgul, Ugii and Terkhiin Tsagaan, near Kherlen and Kharkhiraa rivers as well as lakes of Uvs, Khyargas and Khar-Us, near Ikh Tamir, Chuluut, Onon and Balj rivers as well as Gurvan lake.	MCST	MED, GASI, NEMA, Capital and Local government, RBA	2014-2021	Private
1.15	Develop mineral springs for the purpose of spa resorts and sanatoriums	In total 12 springs are to be developed.	MH	MED, GASI, NEMA, Capital and Local government	2014-2021	Private
Objective 2. Water supply for agricultural sector						
2.1	Local surveys and exploration studies to identify water resources for new boreholes, ponds and reservoirs in rural areas	Surveys for ponds at 626 locations until 2015 and 829 locations until 2021	MEGD	MIA, MED, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget
2.2	Construction of new and renovation of existing water sources (boreholes, ponds) based on grazing capacity and desertification condition	Number of boreholes constructed or rehabilitated: 2011-2015 2466 boreholes, 2016-2021 6050 boreholes. Number of ponds rehabilitated 5, constructed 54 (2011-2015). Number of ponds rehabilitated 7, constructed 125 (2016-2021).	MIA	GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget
2.3	Improve the operation and maintenance of livestock water supply points	Support to herder groups: 300 before 2015, 900 in 2015-2021	MIA	GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget Foreign Private
2.4	Support to improve water supply of intensive livestock breeding	Activities are concentrated around Ulaanbaatar, Darkhan and Erdenet	MIA	Capital and Local government, RBA	2014-2021	State budget Private
2.5	Surveys and exploration studies to identify water resources for irrigation and haymaking areas	Surveys for new and for renovated irrigation systems	MEGD	MIA, ME, Capital and Local government, RBA	2014-2021	State budget
2.6	Construction and renovation of dams and reservoirs for irrigation	Total capacity of newly constructed or renovated reservoirs should be sufficient to supply: 62,910 thousand m3/year for 22,000 ha until 2015 and 91,935 thousand m3/year for 32,000 ha until 2021.	MIA	MEGD, ME, Capital and Local government, RBA	2014-2021	State budget Private

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
2.7	Construction and renovation of headworks, main conveyance channel and irrigation systems	Total area newly constructed: 2,900 ha until 2015, 10,600 ha until 2021. Total area renovated: 17,100 ha until 2015, 22,500 ha until 2021.	MIA	ME, Capital and Local government, RBA	2014-2021	State budget Private
2.8	Improve irrigation management	Support of irrigation management groups: 50 until 2015 and 50 until 2021	MIA	ME, Capital and Local government, RBA	2014-2021	Local budget Foreign
2.9	Improvement of agro technology of irrigated crops and conduct water saving technology	Improved use of fertilizers, of herbicides and pesticides, of sprinklers and other modern irrigation systems, of mechanical equipment for sowing, weeding and harvesting, of drought and cold resistant crops, of soil protection technologies, of irrigation water management to avoid salinization of soils by appropriate application of irrigation water	MIA	Capital and Local government, RBA	2014-2021	Private
Objective 3. Water supply for manufacturing, mining and energy sectors						
3.1	Surveys and exploration studies to investigate water supply sources for big industries	Survey for water supply sources at Sainshand, at Ulaanbaatar and at Choir and Nyalga in Gobisumber aimag.	MEGD	ME, Capital and Local government, RBA	2014-2021	State budget Private
3.2	Implementation of water supplies for new industrial parks	Construction of water supplies at Ulaanbaatar, Sainshand, Ulaanbaatar and Choir.	MIA	ME, Capital and Local government, RBA	2014-2021	State budget Private
3.3	Implement water supplies to industries separate from drinking water supplies	Construction of separate drinking water pipes for industrial water supply, implementation of water reuse measures of waste water at the Ulaanbaatar and Aimag centers and big urban areas: Darkhan-uul, Erdenet, Khovd, Uliastai, Zuunmod, Choibalsan, Undurkhaan, Shariin-Gol, Ulaangom, Ulgii, Sukhbaatar, Sainshand	MCUD, MIA	Capital and Local government, RBA	2015-2021	Private
3.4	Implement separate waste water treatment plants for industries	Primary treatment by industries and Industrial WWTP at Ulaanbaatar Installation of waste water treatment plants at industries in aimag centers and urban area and soum centers	MCUD, MIA	MEGD, Capital and Local government, RBA	2014-2021	Foreign Private
3.5	Reuse of industrial water	Survey to investigate the feasibility of waste water reuse by industries	MIA	MEGD, GASI, NEMA, Capital and Local government, RBA	2014-2021	Private
3.6	Surveys and exploration studies to investigate mining water supply sources	Assessment of available water resources at 8 mines until 2015 and at 11 mines. Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Burenkhaan, Shivee Ovoo, Dulaan-Uul, Kharaat	MEGD	MM, MED, ME, RBA	2014-2021	Private

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
3.7	Implementation of water supplies for new mining areas	Construction of water supply at 7 mines Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Tumurtein, Burenkhaan, Choir, Nyalga, Tumurtein Ovoo, Tamsag / Matad, Tsav, Ulaan, Dulaan-Uul, Kharaat	MM	ME, Local Khural, RBA	2014-2021	Private
		Feasibility study (before 2015) and construction (after 2015) of water diversion project to transfer water from Orkhon river to the Gobi for water supply of mines and other water users. Costs cover construction works before 2021 only.				State budget Private
3.8	Reuse of water used by mines	Reduction in water use at mines to improve conservation of water resources Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Tumurtein, Burenkhaan, Choir, Nyalga, Tumurtein Ovoo, Tamsag / Matad, Tsav, Ulaan, Dulaan-Uul, Kharaat	MM, RBA	-	2014-2021	Private
3.9	Research and design of hydropower plants	Surveys of hydropower dams. Aimags Ulgii and Khovd and along the rivers Orkhon, Selenge and other big rivers	MM, GASI, NEMA	RBA	2014-2021	State budget Private
3.10	Construction of hydropower plants	Feasibility study and construction of hydropower dam on Selenge river. Preliminary estimate of investment costs.	ME	БОАЖЯ, MED, ME, RBA	2014-2021	Private
3.11	Monitoring of water regime of hydropower plants	Hydrological information of operation of reservoirs and effect on river regime	RBA	MEGD, ME	2014-2021	State budget
3.12	Water supply to thermal power plants new and operating	Surveys of water sources for power plants, reduction of water losses and improvement of water reuse. Construction costs of new water supplies are assumed to be included in the costs of the power plant and are not included here.	ME	ME, Capital and Local government, RBA	2014-2021	State budget
3.13	Investigations into geothermal potential	Research into possibility of using geothermal energy	ME	Capital and Local government, RBA	2014-2021	State budget Foreign
Objective 4. Keeping the balance of nature and conservation of water resources						
4.1	Establish and enforce protection of runoff forming part of watershed areas	Protection of watershed areas that produce 70 percent of the surface water resources of Mongolia; restoration of forest and vegetation coverage. Watersheds of large and small river basins such as: Orkhon, Kherlen, Tuul, Kharaa, Onon, Khovd, Buyant, Zavkhan, Tsenkher, Ider, Chuluut, Tamir, Selenge, Delgermoron, Tui, Taats, Ongi, Shishkhid, Bulgan, Selbe, Eroo, Tes, Baidrag	MEGD, RBA	ME, GASI, NEMA, Capital and Local government	2014-2021	State budget
4.2	Establish and enforce protection zones around water bodies	Protection of water bodies by detailed zones around rivers and lakes. First priority with the lower parts of the main rivers or at rivers with intensive mining.	MEGD, RBA	ME, GASI, NEMA, Capital and Local government	2014-2021	State budget
4.3	Exploration to assess usable surface water and groundwater resource reserves taking into account recharge and future trends, and enforce water use within the limit which was set	Improved potential exploitable groundwater resources map of Mongolia; Improved assessment of the future available surface water resources by analysis of observed trends in surface water runoff	MEGD, RBA	ME, GASI, NEMA	2014-2021	State budget

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
4.4	Installation of water meters at water users	Reduction in water use in apartments and industries (in combination with outputs of measure 1.1.4). Already many meters installed in recent years.	MCUD, MIA	MEGD, Capital and Local government, RBA	2014-2021	Private
4.5	Establish recreational area on river side in cities	Reduction of degradation of river banks near cities and reduction of pollution of water resources by river side recreation. Most works in Ulaanbaatar.	MCUD	Capital and Local government	2014-2021	State budget Local budget
4.6	Establish reservoirs to regulate river runoff and create water storage	Feasibility studies and design studies of dams and reservoirs. Construction of dams to be decided after completion of studies.	MEGD, MCUD	Capital and Local Khural, ЗДТГ	2014-2021	State budget Foreign
4.7	Protection of water resources from pollution	Make a registration and inventory of polluters	MEGD	ME, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget Local budget
4.8	Implementation of polluter pay principle	Water users will reduce waste water discharge and will be more responsible to execute waste water treatment on site	MEGD	ME, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget Local budget
4.9	Improve sanitation facilities and waste water disposal in ger areas	Better health conditions by improved latrines and water drainage systems in ger areas. Investments in eco- and bio-latrines outside Ulaanbaatar are expected to be smaller due to the limited financial capacity of inhabitants.	MEGD, MCUD	Capital and Local government	2014-2021	State budget Foreign Private
4.10	Research to determine environmental flow in rivers	Preservation of healthy ecological conditions in rivers. Main rivers such as: Selenge, Orkhon, Tuul, Kharaa, Eroo, Onon, Kherlen, Khovd, Buyant, Zavkhan, Tes, Tsenkher, Ider, Chuluut, Tamir, Delgermoron, Shishkhid,Tui, Taats, Ongi, Bulgan, Baidrag	MEGD	ME, Capital and Local government, RBA	2014-2021	State budget Foreign
4.11	Improve implementation of Ramsar convention and increase number of lakes and wetlands registered in Ramsar Convention	Use of international reference for protection of lakes and wetlands. No investment costs required.	MEGD	ME, Capital and Local government, RBA	2014-2021	-
4.12	Conservation of good and sustainable ecological conditions wetlands and lakes by preserving water to maintain biodiversity.	Improved environmental conditions in lakes and wetlands by taking measures to reduce losses of surface water and groundwater	MEGD	ME, Capital and Local government, RBA	2014-2021	State budget
4.13	Improve irrigation technology of green areas in cities and enforce water supply norms	Reduction in water use for watering of green areas. Investment costs mainly in Ulaanbaatar.	MEGD	Capital and Local government, RBA	2014-2021	State budget
4.14	Prevention of negative effects due to lower groundwater levels by human activities	Preservation of natural conditions in wet grassland areas and reduction of risk of drying op shallow groundwater wells. Activity includes hydrogeological mapping in approx. 10 river basins with costs budgeted as recurrent costs.	MEGD	MCUD, MIA, MCST, MM, GASI, NEMA, Capital and Local government, RBA	2014-2021	State budget

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
4.15	Make inventory, clean and reconstruct damaged and polluted river valleys	Restoration of natural conditions in river valleys and protection of water resources	MEGD, RBA	MIA, MM, ME, GASI, NEMA, Capital and Local government	2014-2021	State budget Private
4.16	Create special protected areas to protect and restore rivers and lakes with changing ecological conditions	Protection of areas damaged by mining or other activities and restoration and reforestation activities. Forest and wetland areas in Tuul, Orkhon and other river basins.	MEGD, RBA	MIA, MM, Capital and Local government	2014-2021	State budget Local budget Foreign
4.17	Construction and maintenance of flood protection structures	Better protection against flooding by renovation and construction of flood protection dykes along Tuul, Selbe and Uliastai rivers Better protection against flooding by renovation and construction of flood protection structures	MCUD	ME, Capital and Local government	2014-2021	State budget
4.18	Construct drainage systems in urban areas	Improved drainage of rain water in areas not covered by drainage system and drainage of soil water in areas with high groundwater levels.	MRT	ME, Capital and Local government	2014-2021	State budget
4.19	Define ownership and improve maintenance and management of drainage systems in urban areas	Better maintenance and management of drainage systems in urban areas	MRT	Capital and Local Khural, LOCAL GOVERNMENT, RBA	2014-2021	-
4.20	Establish and enforce water management methodology and rules for drought and desertification conditions	Activities to be carried out by river basin administrations in cooperation with MEGD, MFALI and local authorities.	NEMA, RBA	MEGD, MIA, ME, Capital and Local government	2014-2021	-
4.21	Installation of rain generators to implement cloud seeding	35 rain generators installed until 2015; continuation after 2015 depends on evaluation of effectiveness	MEGD	ME, Capital and Local government	2014-2021	State budget
Objective 5. Implementation of an optimum water management and provision of a cross-sectoral coordination						
5.1	Coordinate, make consistent and update water related laws and combine them in a "Package Law on Water"	Improved drainage of rain water in areas not covered by drainage system and drainage of soil water in areas with high groundwater levels. Better maintenance and management of drainage systems in urban areas Activities to be carried out by river basin administrations in cooperation with MEGD, MFALI and local authorities. 35 rain generators installed until 2015; continuation after 2015 depends on evaluation of effectiveness	MEGD	ME, MJ	2014-2021	-
5.2	Improve compliance with international treaties, conventions and trans-boundary agreements		MEGD	ME, Capital and Local government, RBA	2014-2021	-
5.3	Update and improve rules, procedures, norms, normatives and standards		MEGD	Capital and Local government, RBA	2014-2021	-
5.4	Improve enforcement capacity and capabilities		MEGD	GASI, Capital and Local government, RBA	2014-2021	-

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
5.5	Update status and mandate of responsible government authorities and basin organizations responsible for coordinating water issues	Approval of coordination between institutions involved in water management by reorganizing and strengthening the institutional structure and assigning clear responsibilities to the NWC and MEGD departments and river basin authorities.	MEGD, YYX	ME, MJ	2014-2021	-
5.6	Improve the mechanisms for coordination and cooperation between sectors involved in water issues		MEGD, YYX	MEGD, ME	2014-2021	-
5.7	Improve the operations and relations between authorities in charge of water issues at national and basin level		RBA	MEGD, ME, Capital and Local government	2014-2021	-
5.8	Strengthen the role of scientific research, professional water related organizations, NGOs and civil society in water management	Strengthen institutions involved in water management by training staff, removing budget constraints and by providing means and equipment	MES	MEGD, ME, RBA	2014-2021	-
5.9	Improve exchange, storage, quality control and access to water management data at national and basin levels	Enable exchange of water management data and information between organizations by providing funds for data collection, processing and storage and improve data quality.	RBA	MEGD, ME	2014-2021	-
5.10	Develop a clear vision and prepare a work plan for the development of RBOs and their role in water management	Clarify role and status of WBCs. Support and strengthen WBAs by establishing technical offices for water management at the river basin level.	MEGD, RBA	ME, Capital and Local government	2014-2021	-
5.11	Renew water pricing policy and improve cost recovery	Assess expenditures and determine required financial resources to cover the recurrent costs of water supply and waste water treatment.	MEGD, MCUD, MIA	ME, RBA	2014-2021	State budget
5.12	Develop additional and alternative financial sources to finance the planned investments in the water sector	Improve private financing through PPP-like concepts	MEGD, MCUD, MIA	ME, RBA	2014-2021	State budget
5.13	Improve efficiency of water sector to reduce recurrent costs	Improve coordination and cooperation between water sector organizations involved in planning, management and operation.	MEGD, MCUD, MIA	ME, RBA	2014-2021	State budget
5.14	Improve human resources capacity in water sector	Create employment conditions (in respect of salary, career options, etc.) at par with the private sector; make education centers more responsive to sector's needs; increase enrollment for vocational training among young people by promoting craftsmanship.	RBA	MEGD, БОШУЯ, ME	2014-2021	-
5.15	Carry out study how to improve education and training of water professionals of all levels	Recommend measures to ensure an adequate supply of water managers, water engineers and specialists as well as technicians.	MEGD, RBA	MEGD, БОШУЯ, ME, RBA	2014-2021	State budget

№	Measure description	Activities	Responsible	Cooperate	Phase	Possible source
5.16	Implement recommendations of study to improve education and training of water professionals of all levels	Advise on required changes in the education system at university and vocational levels.	MEGD, RBA	MEGD, БОШУЯ, ME, RBA	2014-2021	State budget
5.17	Improve and expand monitoring of quality and quantity of water resources	Modernize sampling equipment and analysis instruments to cover all important chemical parameters, including heavy metals and organic and inorganic substances.	MEGD	ME, , RBA	2014-2021	State budget
5.18	Improve sampling equipment and laboratory facilities.	Analyse monitoring data to determine usefulness and representativeness.	MEGD, GASI	ME, RBA	2014-2021	State budget
5.19	Rationalize monitoring programs and formalize	Support cooperation between organizations involved in monitoring of surface water, groundwater and water quality.	MEGD	ME, RBA	2014-2021	-
5.20	Expand and integrate water sector research and studies	Establish a central database before 2015 for water sector data where all water related government organizations and research institutes place their data to be accessible for any interested party.	MEGD	БОШУЯ, ME, RBA	2014-2021	-
5.21	Improve national databases, data quality control and data exchange	Establish river basin databases which are connected and deliver data to the central database	MEGD	Ministries of Government of Mongolia, GASI, NEMA, RBA	2014-2021	State budget
5.22	Create water database systems at basin level	Prepare annual reports of monitoring results by central and river basin organizations.	MEGD, RBA	ME, Capital and Local Khural, LOCAL GOVERNMENT	2014-2021	State budget
5.23	Institutionalize regular detailed publication of results	Бүх шатны сав газрын байгууллагууд жил бүр тайлан гаргаж, ажлын үр дүнг хэвлэл мэдээллийн хэрэгсэл, цахим хуудсаар тогтмол мэдээлнэ.	MEGD, RBA	ME	2014-2021	-
5.24	Design, using specialized professionals, comprehensive information and awareness raising strategies for specific target groups	Engage a specialized and reputed firm having knowledge of mass psychology, communication and mass media to design a detailed awareness raising and public mobilization plan.	RBA	ME	2014-2021	State budget
5.25	Implement the recommended information and awareness raising strategies	Engage NGOs in the execution of awareness raising and public mobilization plans.	RBA	ME	2014-2021	-
5.26	Provide easy access for the public to all relevant information and data related to water resources and their use	Create internet access and publish annual reports	MEGD, MCUD, RBA	MIA, MM, ME	2014-2021	-
5.27	Promote and reintroduce traditional protection methods	Aim to connect protection measures of water resources and water quality with traditional protection practices.	MEGD, RBA	ME, Capital and Local government	2014-2021	-
5.28	Enhance the role of NGOs as vehicles for public participation in water management at all levels	Involve NGOs in promotion and awareness raising activities	MEGD, RBA	ME, Capital and Local government	2014-2021	State budget

Table 85. Investment and recurrent costs and funding of measures

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
Objective 1. Safe drinking water supply														
1.1	Establish and enforce sanitation and protection zones around water supply sources	Ulaanbaatar city, In 21 aimags and Kharkhorin, Bor Undur, Khotol, Zamiin Uud, Shariin gol, Zuunkharaa, Baganuur, Khanbogd, Tsogtsetsii construction of protection zones around existing and new water supply sources; construction of protection around water supply points (kiosks); enforcement of rules and guidelines on water supply sources protection and sanitation zones	1,731	2,395	4,126	6	94	-	-	81	1,032	1,113	100	-
1.2	Local surveys and exploration studies to identify new or verify existing water resources	Comprehensive water resource surveys and studies in existing and new settlement areas; pre-feasibility study of Tuul Dam complex.	76,461	89,375	165,836	-	100	-	-	3,517	34,235	37,752	-	100
		Comprehensive water resource surveys and studies in existing and new settlement areas in Gobi-Sumber, Dundgobi, Dornogobi, Bulgan, Bayan-Ulgii.	825	800	1,625	100	-	-	-	-	-	-	-	-
		Feasibility and design study; construction of dam with hydropower plant and reservoir. Tuul Dam Complex	6,500	608,400	614,900	10	4	14	72	-	2,650	2,650	100	-
		Improvement of water supply system, including pump stations, reservoirs and pipeline from Taishir Dam	1,588	2,119	3,707	100	-	-	-	79	794	873	-	100
		Improvement of water supply system, including pump stations, reservoirs and pipelines in 6 urban areas	52,220	-	52,220	5	-	95	-	-	1,668	1,668	-	100
		Kharkhorin, Bor Undur, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd and Kharkhorin, Saikhan, Khutul, Mandal, Zuunkharaa, Tsogt-Tsetsii	10,528	863	11,391	100	-	-	100	523	3,253	3,776	-	100
1.3	Renovation and expansion of water supply network and increase of number of connected water supply kiosks	Extension of water supply distribution network at Ulaanbaatar City. Constructed kiosks 400.	188,075	225,440	413,515	50	8	30	12	9,404	90,239	99,643	-	100
		Extension of water supply distribution networks of 21 aimag centers and Other big urban areas: Kharkhorin, Bor Undur, Zamiin Uud, Shariin Gol, Saikhan/Khutul, Mandal/Zuunkharaa, Khanbogd, Tsogttsetsii	281,304	201,665	482,969	40	10	40	10	11,252	91,713	102,965	-	100

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
1.4	Construction and renovation of waste water treatment plants	Renovation, improvement and extension of WWTP's at Ulaanbaatar City: 1. Central WWTP renovation, membrane reactor; 2. Central WWTP improvement of equipment and efficiency; 3. Nisekh/Yarmag new WWTP; 4. Emelt new WWTP; 5. Small treatment plants	235,065	628,300	863,365	30	10	35	25	2,080	38,610	40,690	-	100
		Renovation and construction of WWTP's in 21 aimag centers and other big urban areas: Kharkhorin, Bor Undur, Saikhan. Khutul, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd, Baganuur until 2015 and Kharkhorin, Mandal. Zuunkharaa, Tsogtsetsii until 2021	66,781	98,923	165,704	45	-	55	-	1,755	19,968	21,723	-	100
1.5	Renovation and expansion of sewerage network	Extension and renovation of sewerage system in parts of Ulaanbaatar City, aimag centers and other big urban areas: Kharkhorin, Bor Undur, Saikhan. Khutul, Zamiin Uud, Shariin Gol, Mandal. Zuunkharaa, Khanbogd, Tsogtsetsii, Baganuur	287,249	452,258	739,507	37	23	10	30	2,730	43,739	46,469	-	100
1.6	Reuse of domestic and treated waste water	Study and implementation of reuse of treated waste water for use by power plants; study and implement grey water systems in new apartments and public buildings	12,500	17,662	30,162	-	26	1	73	375	6,399	6,774	-	100
1.7	Improve water supply and waste water treatment at army camps & border posts	Improved water supply and waste water treatment at 8 military units until 2015. Army camps: Ulaankhus of Bayan-Ulgii aimag, Bulgan of Khovd aimag, Bayanlig of Bayankhongor aimag, Songino of Zavkhan aimag, Zuungovi of Uvs aimag, Delgerkhaan of Khentii aimag, Bayanlig of Bayankhongor aimag, Sergelen of Tuv aimag, Altanbulag	500	500	1,000	100	-	-	-	25	225	250	100	-
		Improved water supply and waste water treatment at 15 military units until 2015. (Zamiin-Ud, Altanbulag, Gahsuunsuxait, Shiveekhuren, Borshoo, Bichigt, Khangi, Burgastai, Bulgan, Khankh, Zelter, Khuvd, Ingensevstei, Uushig, Kharkhonit, Jaalshand, Khetsuu uul, Sainsuuj, Uzuur-Us, Khukh bulag, Tsagaan-Ovoo, Bayantukhum, Lamt, Kholboo zalaa, Buduun mod, Avdrant, Arbulag, Baga khuree, Urgustei, unit in 117, Khatan suudal)	1,455	2,000	3,455	100	-	-	-	73	737	809	100	-

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
1.8	Establish and enforce protection zones around water sources.	Protection of rural water sources mainly concerns fencing of water points and demarcation of a sanitation zone. Number of protected springs:560	880	600	1,480		100	-	-	44	354	398	100	-
1.9	Local surveys and exploration studies to identify new or verify existing water resources at soum centers	Executed surveys: until 2015: 15 surveys at soum centers, 1352 surveys for boreholes; until 2021: 36 surveys at soum centers, 3380 surveys for boreholes	751	1,870	2,621	100	-	-	-	-	-	-	-	-
1.10	Construct water supplies in soum centers and in rural areas for herders and farmers	Constructed water supplies: until 2015: 15 small soum centers, until 2021: 36 soum centers.	9,747	29,412	39,159	100	-	-	-	487	7,336	7,823	-	100
1.11	Construct small waste water treatment plants in soum centers and organize reuse of treated waste water	Constructed waste water treatment plants: until 2015: 15, until 2021: 36 soum centers.	26,406	68,424	94,830	20	-	80	-	1,320	18,185	19,505	-	100
1.12	Construct small waste water treatment plants in soum centers and organize reuse of treated waste water	Analysis and selection of sustainable treatment facilities. Installation of new and replacement of existing equipment. Supervision and training of operators.	100	299	399	100	-	-	-	25	373	398	-	100
1.13	Improve and expand water supply infrastructure for tourism and sanatorium	This measure applies mainly to tourist facilities in rural areas. Costs included are not from state budget but from private companies. Measures are to be taken by private tourist companies. These include water supply of ger camps and hotels, water supply of tourist attractions, etc.	7,518	9,142	16,660	20	60	-	20	376	3,627	4,003	-	100
1.14	Improve water supply infrastructure and utilization of high-tech WWTP in tourist camps	Water supply and WWTP in tourist camps in Tuul and Terelj river basin, near Khovd and Buyant rivers as well as lakes of Khuvsgul, Ugii and Terkhiin Tsagaan, near Kherlen and Kharkhiraa rivers as well as lakes of Uvs, Khyargas and Khar-Us, near Ikh Tamir, Chuluut, Onon and Balj rivers as well as Gurvan lake.	18,800	20,000	38,800	-	-	-	100	190	3,250	3,440	-	100
1.15	Develop mineral springs for the purpose of spa resorts and sanatoriums	In total 12 springs are to be developed.	1,262	1,890	3,152	-	-	-	100	63	662	725	-	100
Sub-sector 1 Grand Total			1,288,246	2,462,337	3,750,583					34,399	369,049	403,447		

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
Objective 2. Water supply for agricultural sector														
2.1	Local surveys and exploration studies to identify water resources for new boreholes, ponds and reservoirs in rural areas	Surveys for ponds at 626 locations until 2015 and 829 locations until 2021	1,252	1,658	2,910	100	-	-	-	-	-	-	-	-
2.2	Construction of new and renovation of existing water sources (boreholes, ponds) based on grazing capacity and desertification condition	Number of boreholes constructed or rehabilitated: 2011-2015 2466 boreholes, 2016-2021 6050 boreholes. Number of ponds rehabilitated 5, constructed 54 (2011-2015). Number of ponds rehabilitated 7, constructed 125 (2016-2021).	32,270	72,588	104,858	60	-	25	15	5,256	58,030	63,286	5	95
2.3	Improve the operation and maintenance of livestock water supply points	Support to herder groups: 300 before 2015, 900 in 2015-2021	1,725	5,175	6,900	45	-	30	25	600	5,700	6,300	-	100
2.4	Support to improve water supply of intensive livestock breeding	Activities are concentrated around Ulaanbaatar, Darkhan and Erdenet	1,750	2,100	3,850	-	50	-	50	70	945	1,015	-	100
2.5	Surveys and exploration studies to identify water resources for irrigation and haymaking areas	Surveys for new and for renovated irrigation systems	315	552	867	100	-	-	-	-	-	-	-	-
2.6	Construction and renovation of dams and reservoirs for irrigation	Total capacity of newly constructed or renovated reservoirs should be sufficient to supply: 62,910 thousand m3/year for 22,000 ha until 2015 and 91,935 thousand m3/year for 32,000 ha until 2021.	6,291	11,032	17,323	30	-	-	70	315	3,542	3,857	-	100
2.7	Construction and renovation of headworks, main conveyance channel and irrigation systems	Total area newly constructed: 2,900 ha until 2015, 10,600 ha until 2021. Total area renovated: 17,100 ha until 2015, 22,500 ha until 2021.	91,000	326,666	417,666	30	-	-	70	8,190	137,340	145,530	-	100

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
2.8	Improve irrigation management	Support of irrigation management groups: 50 until 2015 and 50 until 2021	575	575	1,150	-	50	50		97	676	773	-	100
2.9	Improvement of agro technology of irrigated crops and conduct water saving technology	Improved use of fertilizers, of herbicides and pesticides, of sprinklers and other modern irrigation systems, of mechanical equipment for sowing, weeding and harvesting, of drought and cold resistant crops, of soil protection technologies, of irrigation water management to avoid salinization of soils by appropriate application of irrigation water	1,348	2,744	4,092	-	-	-	100	67	816	883	-	100
Sub-sector 2 Grand Total			136,526	423,090	559,616					14,595	207,049	221,644		
Objective 3. Water supply for manufacturing, mining and energy sectors														
3.1	Surveys and exploration studies to investigate water supply sources for big industries	Survey for water supply sources at Sainshand, at Ulaanbaatar and at Choir and Nyalga in Gobisumber aimag.	9,350	8,320	17,670	50	-	-	50	-	-	-	-	-
3.2	Implementation of water supplies for new industrial parks	Construction of water supplies at Ulaanbaatar, Sainshand, Ulaanbaatar and Choir.	12,240	170,800	183,040	20	-	-	80	612	29,292	29,904	-	100
3.3	Implement water supplies to industries separate from drinking water supplies	Construction of separate drinking water pipes for industrial water supply, implementation of water reuse measures of waste water at the Ulaanbaatar and Aimag centers and big urban areas: Darkhan-uul, Erdenet, Khovd, Uliastai, Zuunmod, Choibalsan, Undurkhaan, Shariin-Gol, Ulaangom, Ulgii, Sukhbaatar, Sainshand	2,250	1,950	4,200	-	-	-	100	76	646	722	-	100
3.4	Implement separate waste water treatment plants for industries	Primary treatment by industries and Industrial WWTP at Ulaanbaatar	42,120	68,120	110,240	-	-	90	10	2,106	22,854	24,960	-	100
		Installation of waste water treatment plants at industries in aimag centers and urban area and soum centers	6,114	120,400	126,514	-	-	80	20	306	19,894	20,200	-	100
3.5	Reuse of industrial water	Survey to investigate the feasibility of waste water reuse by industries	5,000	6,000	11,000	-	-	-	100	125	1,200	1,325	-	100
3.6	Surveys and exploration studies to investigate mining water supply sources	Assessment of available water resources at 8 mines until 2015 and at 11 mines. Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Burenkhaan, Shivee Ovoo, Dulaan-Uul, Kharaat	4,000	3,600	7,600	-	-	-	100	-	-	-	-	-

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
3.7	Implementation of water supplies for new mining areas	Construction of water supply at 7 mines Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Tumurtein, Burenkhaan, Choir, Nyalga, Tumurtein Ovoo, Tamsag / Matad, Tsav, Ulaan, Dulaan-Uul, Kharaat	365,000	450,000	815,000	-	-	-	100	9,125	88,500	97,625	-	100
		Feasibility study (before 2015) and construction (after 2015) of water diversion project to transfer water from Orkhon river to the Gobi for water supply of mines and other water users. Costs cover construction works before 2021 only.	4,160	907,200	911,360	10	-	90	-	104	68,664	68,768	-	100
3.8	Reuse of water used by mines	Reduction in water use at mines to improve conservation of water resources Mines: Asgat, Tsagaan Suvarga, Oyu Tolgoi, Tavan Tolgoi, Nariin Sukhait, Boroo, Shivee Ovoo, Olon Ovoot, Mardai, Dornod, Gurvanbulag, Tumurtein, Burenkhaan, Choir, Nyalga, Tumurtein Ovoo, Tamsag / Matad, Tsav, Ulaan, Dulaan-Uul, Kharaat	146,526	223,568	370,094	-	-	-	100	3,663	38,747	42,410	-	100
3.9	Research and design of hydropower plants	Surveys of hydropower dams. Aimags Ulgii and Khovd and along the rivers Orkhon, Selenge and other big rivers	11,340	15,000	26,340	50	-	50	-	-	-	-	-	-
3.10	Construction of hydropower plants	Feasibility study and construction of hydropower dam on Selenge river. Preliminary estimate of investment costs.	4,160	300,000	304,160	-	-	100	-	-	46,248	46,248	-	100
3.11	Monitoring of water regime of hydropower plants	Hydrological information of operation of reservoirs and effect on river regime	150	300	450	100	-	-	-	86	858	944	-	100
3.12	Water supply to thermal power plants new and operating	Surveys of water sources for power plants, reduction of water losses and improvement of water reuse. Construction costs of new water supplies are assumed to be included in the costs of the power plant and are not included here.	1,185	2,480	3,665	100	-	-	-	59	728	787	-	100
3.13	Investigations into geothermal potential	Research into possibility of using geothermal energy	500	-	500	50	-	50	-	-	-	-	-	-
Sub-sector 3 Grand Total			614,095	2,277,738	2,891,833					16,262	317,631	333,893		
Objective 4. Keeping the balance of nature and conservation of water resources														

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
4.1	Establish and enforce protection of runoff forming part of watershed areas	Protection of watershed areas that produce 70 percent of the surface water resources of Mongolia; restoration of forest and vegetation coverage. Watersheds of large and small river basins such as: Orkhon, Kherlen, Tuul, Kharaa, Onon, Khovd, Buyant, Zavkhan, Tsenkher, Ider, Chuluut, Tamir, Selenge, Delgermoron, Tui, Taats, Ongi, Shishkhid, Bulgan, Selbe, Eroo, Tes, Baidrag	1,570	1,500	3,070	100				79	696	775	100	-
4.2	Establish and enforce protection zones around water bodies	Protection of water bodies by detailed zones around rivers and lakes. First priority with the lower parts of the main rivers or at rivers with intensive mining.	300	600	900	100				15	180	195	100	-
4.3	Exploration to assess usable surface water and groundwater resource reserves taking into account recharge and future trends, and enforce water use within the limit which was set	Improved potential exploitable groundwater resources map of Mongolia; Improved assessment of the future available surface water resources by analysis of observed trends in surface water runoff	500	1,000	1,500	100				-	-	-	-	-
4.4	Installation of water meters at water users	Reduction in water use in apartments and industries (in combination with outputs of measure 1.1.4). Already many meters installed in recent years.	6,436	8,003	14,439				100	644	6,262	6,906	-	100
4.5	Establish recreational area on river side in cities	Reduction of degradation of river banks near cities and reduction of pollution of water resources by river side recreation. Most works in Ulaanbaatar.	5,000	10,000	15,000	80	20			250	3,000	3,250	-	100
4.6	Establish reservoirs to regulate river runoff and create water storage	Feasibility studies and design studies of dams and reservoirs. Construction of dams to be decided after completion of studies.	2,000	4,700	6,700	50		50		60	783	843	100	-
4.7	Protection of water resources from pollution	Make a registration and inventory of polluters	8,462	57,494	65,955	50	50			85	2,233	2,318	100	-
4.8	Implementation of polluter pay principle	Water users will reduce waste water discharge and will be more responsible to execute waste water treatment on site	200	400	600	50	50			274	1,642	1,916	100	-

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
4.9	Improve sanitation facilities and waste water disposal in ger areas	Better health conditions by improved latrines and water drainage systems in ger areas. Investments in eco- and bio-latrines outside Ulaanbaatar are expected to be smaller due to the limited financial capacity of inhabitants.	42,075	115,500	157,575	10		10	80	520	5,460	5,980	-	100
4.10	Research to determine environmental flow in rivers	Preservation of healthy ecological conditions in rivers. Main rivers such as: Selenge, Orkhon, Tuul, Kharaa, Eroo, Onon, Kherlen, Khovd, Buyant, Zavkhan, Tes, Tsenkher, Ider, Chuluut, Tamir, Delgermoron, Shishkhid,Tui, Taats, Ongi, Bulgan, Baidrag	450	900	1,350	50		50				-		
4.11	Improve implementation of Ramsar convention and increase number of lakes and wetlands registered in Ramsar Convention	Use of international reference for protection of lakes and wetlands. No investment costs required.			-					274	821	1,095	100	
4.12	Conservation of good and sustainable ecological conditions wetlands and lakes by preserving water to maintain biodiversity.	Improved environmental conditions in lakes and wetlands by taking measures to reduce losses of surface water and groundwater	100	200	300	100				137	411	547	100	
4.13	Improve irrigation technology of green areas in cities and enforce water supply norms	Reduction in water use for watering of green areas. Investment costs mainly in Ulaanbaatar.	1,104	500	1,604	100				55	166	221		100
4.14	Prevention of negative effects due to lower groundwater levels by human activities	Preservation of natural conditions in wet grassland areas and reduction of risk of drying op shallow groundwater wells. Activity includes hydrogeological mapping in approx. 10 river basins with costs budgeted as recurrent costs.	100	200	300	100				142	849	991	100	
4.15	Make inventory, clean and reconstruct damaged and polluted river valleys	Restoration of natural conditions in river valleys and protection of water resources	20,300	40,600	60,900	5			95	47	283	330	100	
4.16	Create special protected areas to protect and restore rivers and lakes with changing ecological conditions	Protection of areas damaged by mining or other activities and restoration and reforestation activities. Forest and wetland areas in Tuul, Orkhon and other river basins.	750	2,000	2,750	30	20	50		38	525	563	100	

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
4.17	Construction and maintenance of flood protection structures	Better protection against flooding by renovation and construction of flood protection dykes along Tuul, Selbe and Uliastai rivers	36,434	72,734	109,168	100				729	8,736	9,465	50	50
		Better protection against flooding by renovation and construction of flood protection structures	34,670	30,000	64,670	100				693	5,960	6,654	50	50
4.18	Construct drainage systems in urban areas	Improved drainage of rain water in areas not covered by drainage system and drainage of soil water in areas with high groundwater levels.	13,650	27,300	40,950	100				273	3,276	3,549	50	50
4.19	Define ownership and improve maintenance and management of drainage systems in urban areas	Better maintenance and management of drainage systems in urban areas			-					547	547	1,095	100	
4.2	Establish and enforce water management methodology and rules for drought and desertification conditions	Activities to be carried out by river basin administrations in cooperation with MEGD, MFALI and local authorities.			-					274	274	547	100	
4.21	Installation of rain generators to implement cloud seeding	35 rain generators installed until 2015; continuation after 2015 depends on evaluation of effectiveness	700	300	1,000	100				140	420	560	100	
Sub-sector 4 Grand Total			174,801	373,930	548,731					5,274	42,525	47,799		
Objective 5. Implementation of an optimum water management and provision of a cross-sectoral coordination														
5.1	Coordinate, make consistent and update water related laws and combine them in a "Package Law on Water"	Improved drainage of rain water in areas not covered by drainage system and drainage of soil water in areas with high groundwater levels. Better maintenance and management of drainage systems in urban areas Activities to be carried out by river basin administrations in cooperation with MEGD, MFALI and local authorities. 35 rain generators installed until 2015; continuation after 2015 depends on evaluation of effectiveness			-					31	154	185	100	-
5.2	Improve compliance with international treaties, conventions and trans-boundary agreements				-					7	33	40	100	-
5.3	Update and improve rules, procedures, norms, normatives and standards				-					31	62	93	100	-
5.4	Improve enforcement capacity and capabilities				-					300	500	800	100	-

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
5.5	Update status and mandate of responsible government authorities and basin organizations responsible for coordinating water issues	Approval of coordination between institutions involved in water management by reorganizing and strengthening the institutional structure and assigning clear responsibilities to the NWC and MEGD departments and river basin authorities.			-					30	50	80	100	
5.6	Improve the mechanisms for coordination and cooperation between sectors involved in water issues				-					10	10	20	100	
5.7	Improve the operations and relations between authorities in charge of water issues at national and basin level				-					10	10	20	100	
5.8	Strengthen the role of scientific research, professional water related organizations, NGOs and civil society in water management	Strengthen institutions involved in water management by training staff, removing budget constraints and by providing means and equipment			-					10	10	20	100	
5.9	Improve exchange, storage, quality control and access to water management data at national and basin levels	Enable exchange of water management data and information between organizations by providing funds for data collection, processing and storage and improve data quality.			-					100	200	300	100	
5.10	Develop a clear vision and prepare a work plan for the development of RBOs and their role in water management	Clarify role and status of WBCs. Support and strengthen WBAs by establishing technical offices for water management at the river basin level.			-					27	67	94	100	
5.11	Renew water pricing policy and improve cost recovery	Assess expenditures and determine required financial resources to cover the recurrent costs of water supply and waste water treatment.	30	50	80	100				1	1	2	100	
5.12	Develop additional and alternative financial sources to finance the planned investments in the water sector	Improve private financing through PPP-like concepts	30	50	80	100				1	1	2	100	

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
5.13	Improve efficiency of water sector to reduce recurrent costs	Improve coordination and cooperation between water sector organizations involved in planning, management and operation.	300	500	800	100				6	10	16	100	
5.14	Improve human resources capacity in water sector	Create employment conditions (in respect of salary, career options, etc.) at par with the private sector; make education centers more responsive to sector's needs; increase enrollment for vocational training among young people by promoting craftsmanship.			-					3,000	5,000	8,000	100	
5.15	Carry out study how to improve education and training of water professionals of all levels	Recommend measures to ensure an adequate supply of water managers, water engineers and specialists as well as technicians.	2,000	-	2,000	100						-		
5.16	Implement recommendations of study to improve education and training of water professionals of all levels	Advise on required changes in the education system at university and vocational levels.	-	10,000	10,000	100						-		
5.17	Improve and expand monitoring of quality and quantity of water resources	Modernize sampling equipment and analysis instruments to cover all important chemical parameters, including heavy metals and organic and inorganic substances.	3,000	5,000	8,000	100				60	100	160	100	
5.18	Improve sampling equipment and laboratory facilities.	Analyse monitoring data to determine usefulness and representativeness.	3,000	5,000	8,000	100				60	100	160	100	
5.19	Rationalize monitoring programs and formalize	Support cooperation between organizations involved in monitoring of surface water, groundwater and water quality.			-					30	50	80	100	
5.2	Expand and integrate water sector research and studies	Establish a central database before 2015 for water sector data where all water related government organizations and research institutes place their data to be accessible for any interested party.			-					30	50	80	100	
5.21	Improve national databases, data quality control and data exchange	Establish river basin databases which are connected and deliver data to the central database	260	100	360	100				82	206	288	100	
5.22	Create water database systems at basin level	Prepare annual reports of monitoring results by central and river basin organizations.	10,000	30,000	40,000	100				1,647	4,118	5,766	100	

№	Measure description	Activities	Investment, *mln MNT*			Possible source, %				Recurrent costs, *mln MNT*			Source, %	
			Phase		Total	State budget	Local budget	Foreign	Private	Phase		Total	State or local budget	Owners
			2014-2016	2017-2021						2014-2016	2017-2021			
5.23	Institutionalize regular detailed publication of results	Бүх шатны сав газрын байгууллагууд жил бүр тайлан гаргаж, ажлын үр дүнг хэвлэл мэдээллийн хэрэгсэл, цахим хуудсаар тогтмол мэдээлнэ.			-					30	50	80	100	
5.24	Design, using specialized professionals, comprehensive information and awareness raising strategies for specific target groups	Engage a specialized and reputed firm having knowledge of mass psychology, communication and mass media to design a detailed awareness raising and public mobilization plan.	2,000	-	2,000	100				-	-	-	-	-
5.25	Implement the recommended information and awareness raising strategies	Engage NGOs in the execution of awareness raising and public mobilization plans.			-					300	500	800	100	-
5.26	Provide easy access for the public to all relevant information and data related to water resources and their use	Create internet access and publish annual reports			-					30	50	80	100	-
5.27	Promote and reintroduce traditional protection methods	Aim to connect protection measures of water resources and water quality with traditional protection practices.			-					30	50	80	100	-
5.28	Enhance the role of NGOs as vehicles for public participation in water management at all levels	Involve NGOs in promotion and awareness raising activities	600	1,800	2,400	100				30	90	120	100	-
Sub-sector 5 Grand Total			21,220	52,500	73,720					5,892	11,473	17,365		
TOTAL SUB-SECTORS 1-5			2,234,887	5,589,593	7,824,480	24	5	32	39	76,420	947,723	1,024,143	5	95

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ANNEX 1. Water basin summaries

The water basin summaries contain information on each of the 29 water basins regarding water demand, water resources, water quality and ecology, population numbers, livestock numbers and areas of the soums located inside the basin. The summaries also provide detailed information on the issues and the measures identified for each water basin.

The *Water demand by sector* is summarized by annual total for each sector for the years 2008, 2010, 2015 and 2021. The demand is ranked according the 2010 water demand. The source of water which is used to supply the demand is indicated and additional information is provided under the remarks. The 2015 and 2021 sectoral water demand projection refers to the medium scenario demand estimate. The total 2015 and 2021 water demand projections of the low and high scenario are also presented.

The *Water resources* include the possible use of the annual surface water and groundwater resources. The surface water resources represent the annual river flow. The groundwater resources represent the annual volume of the potential exploitable and the exploitable resources. The surface water resources include the surface water which is generated within the river basin only. Inflow from other upstream river basins is stated under remarks.

The *surface water resources* are based on the specific runoff map which provides an estimate of the total annual mean river basin runoff. The runoff estimate is verified using observed river discharges at monitoring stations inside the river basin. The observed river discharges are used to estimate the 50% and 10% river runoff representing the runoff which is expected in an average year and is expected in a low runoff year with a probability of 10%. The environmental flow required to maintain ecological conditions is subtracted from the discharge to obtain an estimate of the possible usable surface water resources. The environmental flow (ecological resource) is determined based on percentages provided for all river basins in the “Surfacewater Monograph” (Davaa, Myagmarjav, 1999).

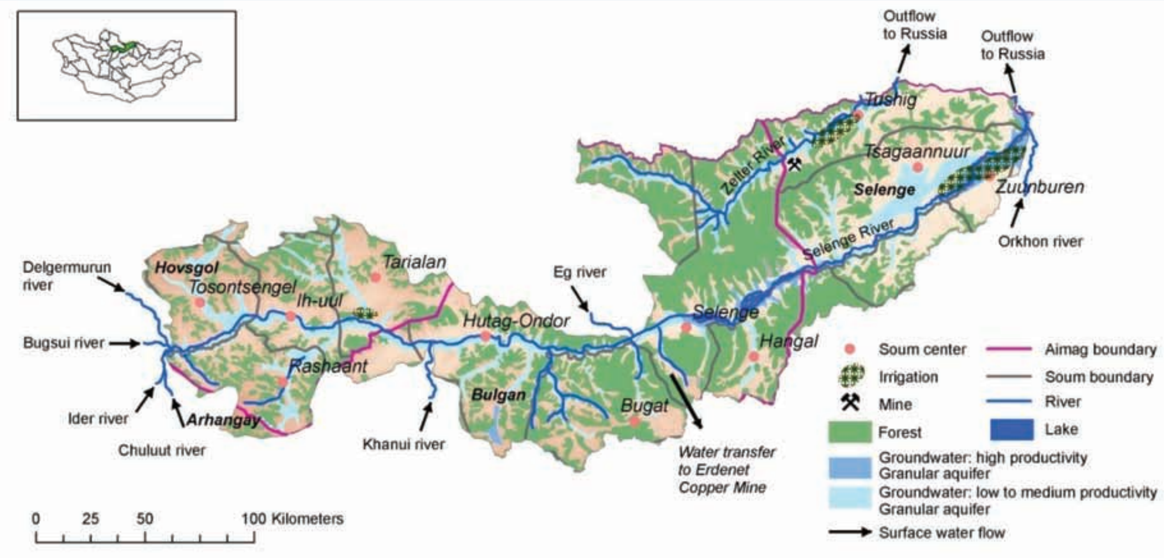
The *groundwater resources* represent the potential exploitable groundwater resources and the exploitable groundwater resources in the river basin. The potential exploitable groundwater resources are based on the estimate of the renewable groundwater resources. The exploitable groundwater resources are based on the approved groundwater resources of groundwater deposits in the basin. The exploitable groundwater resources are used in the water balance.

The *water quality, vegetation, ecology and biodiversity* table summarizes the main properties of these items in the river basin.

The *Issues in the river basin* summarize the main pressures active in each river basin due to changing conditions of water supply, water demand, water resources, water quality and ecology. These changing conditions relate to changes caused by climate change or by man-made interventions.

The *Measures* include the activities planned to mitigate the effect of the issues as incorporated in the national water management plan and presented in Table 88. The *Challenge* number relates to the numbers used in this table. Quantities were estimated for the measures in each water basin based on the activities described in sectoral plans and other national plans: the “Water National Programme”, the “Environmental Master Plan of Mongolia” and the “National Action Program on Climate Change”.

1. Selenge Basin



Water demand by sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	11.60	13.71	23.59	36.23	50% groundwater 50% surface water	• More groundwater use is expected in the future
Livestock	3.14	2.83	3.83	4.57	55% groundwater 45% surface water	• From surface water, springs and groundwater supply points
Drinking water	0.09	0.11	0.15	0.24	75% groundwater 25% surface water	• Surface water use is expected to reduce to 10% in 2021
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	50% groundwater 50% surface water	• Small demand for industries and transport
Mining	0.33	0.03	0.04	0.08	100% surface water	• Mining at Zelter River
Energy	0.00	0.00	0.00	0.00		• No power stations, no hydropower
Other	0.04	0.05	0.09	0.23	100% groundwater	• Tourism water demand
Water transfer	15.32	15.14	15.00	15.00	100% groundwater	• Supply to Erdenet in Orkhon Basin
Total Demand	30.62	31.99	42.86	56.54	Medium scenario	
			28.90	35.47	Low scenario	
			51.47	74.01	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	277.3	165.2	Net possible use (does not include inflow from upstream basins)
Groundwater	Pot.	Expl.	
Granular aquifer	697	90.3	Akhai Gunii Khoshuu deposit used for supply of Erdenet
Total Resources	1,537	627.1	Conclusion: Water resources exceed demand by sufficient margin

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Selenge River (incl. inflow from Delgermurun, Bugsui, Ider, Chuluut, Khanui and Eg River)	5,891	3,721	5,125	3,238	765.8	483.8	Based on Zuunburen runoff data
Zelter River	574	408	499	355	74.6	53.0	
Total Resources	6465	4129	5624	3592	840.4	536.8	Outflow to Russia

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported
Groundwater	• No quality issues reported
Vegetation	• Pasture: 50% of the basin area; condition is relatively stable • Forests: 42% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insect diseases
Ecology and biodiversity	• There are no protected areas in this river basin • The Selenge River is important for the preservation of endangered fish species, such as the Taimen and Sturgeon.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
	Establish protection zones around 15 springs	1.2
Water resources are not adequate	Local surveys to identify resources for 41 rural area boreholes	1.2
	Local surveys to identify resources for 16 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 41 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
Organisation of water supply O&M to be improved	Establishment of and support to 23 pasture management herder groups	2.1
	Establishment of and support to 4 irrigation management groups	2.2
Irrigation area to be extended	Construction of 520 ha irrigated area (indicative area)	2.2
	Renovation of 610 ha irrigated area (indicative area)	2.2
Hydropower capacity to be extended	Research and design of hydropower plant on Selenge River	3.3
Runoff forming area needs better protection	Protect the watersheds of the Selenge and Zelter rivers by implementing state or local protection	4.1
Environmental flow to be maintained	Determine environmental flow and study effect on river flow regime due to planned HPP dams at Artsat, Buren, Shuren	4.3

Issues in the river basin	Measures in period 2016-2021	Chall.
Water sources are vulnerable to pollution	Establish protection zones around 10 springs	1.2
Water resources are not adequate	Local surveys to identify resources for 103 rural area boreholes	1.2
	Local surveys to identify resources for 24 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 103 rural area boreholes	1.2
	Construction of 4 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
Organisation of water supply O&M to be improved	Establishment of and support to 47 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 950 ha irrigated area (indicative area)	2.2
	Renovation of 860 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Selenge and Zelter rivers by implementing state or local protection	4.1

Data by aimag:

Selenge river basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Bulgan	14,504.7	46.2
Selenge	8,688.8	27.7
Khovsgol	7,966.8	25.4
Arkhangai	230.0	0.7
Orkhon	4.6	-
Total river basin area	31,395.0	100.0

Selenge river basin livestock numbers			
Aimag	2010	2015	2021
Bulgan	347,663	421,399	438,567
Selenge	194,027	231,514	236,839
Khovsgol	656,795	733,447	705,290
Arkhangai	10,258	11,840	11,560
Orkhon	0	0	0
Total river basin area	1,208,743	1,398,200	1,392,255

Selenge river basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Bulgan	8,382	5,417	13,799	8,218	5,311	13,529	8,436	5,452	13,889
Selenge	5,508	2,580	8,088	5,509	2,581	8,090	5,722	2,680	8,403
Khovsgol	7,691	9,306	16,997	7,616	9,216	16,832	7,901	9,560	17,462
Arkhangai	0	188	188	0	185	185	0	190	190
Orkhon	0	0	0	0	0	0	0	0	0
Total river basin area	21,581	17,491	39,072	21,344	17,292	38,636	22,060	17,883	39,943

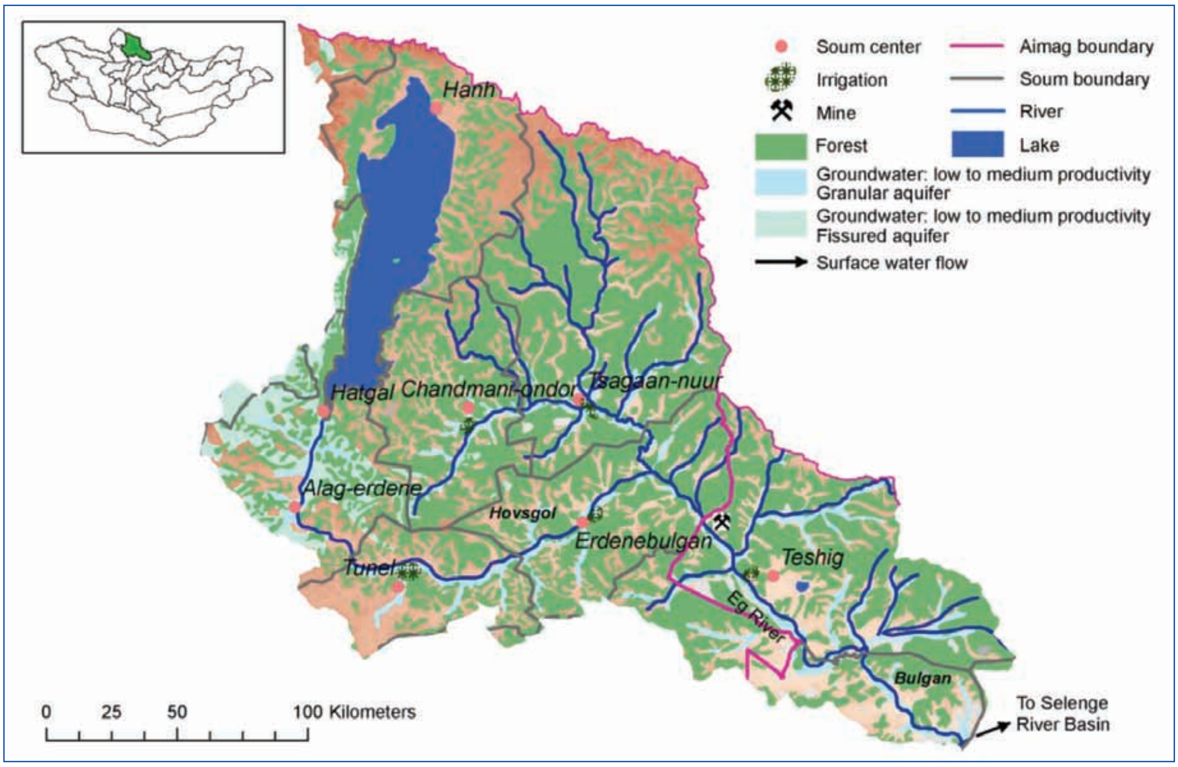
Data by soum:

Selenge river basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	Tsetserleg	0	188	188	0	185	185	0	190	190
Bulgan	Bayan-Agt	0	346	346	0	339	339	0	348	348
	Bugat	734	881	1,615	720	864	1,583	739	887	1,625
	Selenge	1,878	1,429	3,307	1,841	1,401	3,242	1,890	1,438	3,328
	Teshig	0	399	399	0	391	391	0	401	401
	Khangal	3,645	791	4,436	3,574	776	4,349	3,669	796	4,465
	Khutag	2,125	1,572	3,697	2,083	1,541	3,624	2,139	1,582	3,721
Selenge	Zuunburen	1,838	351	2,189	1,838	352	2,190	1,909	365	2,275
	Tushig	1,027	449	1,476	1,027	449	1,476	1,067	466	1,533

Selenge river basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
	Khushaat	0	348	348	0	348	348	0	361	361
	Shaamar	0	10	10	0	10	10	0	10	10
	Tsagaannuur	2,643	1,422	4,065	2,644	1,422	4,066	2,746	1,477	4,223
Khuvsgul	Ikh-Uul	1,374	2,761	4,135	1,361	2,734	4,095	1,412	2,836	4,248
	Rashaant	1,801	1,824	3,625	1,784	1,806	3,590	1,850	1,874	3,724
	Tarialan	3,298	1,905	5,203	3,266	1,887	5,153	3,388	1,957	5,345
	Tosontsengel	1,218	2,816	4,034	1,206	2,789	3,995	1,251	2,893	4,144
Total river basin		21,581	17,491	39,072	21,344	17,292	38,636	22,060	17,883	39,943

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area of soum in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Arkhangai	Tsetserleg	230.0	9.0	6.0	10,258	11,840	11,560
Bulgan	Bayan-Agt	561.9	18.0	15.9	28,384	33,618	33,823
Bulgan	Bugat	2,750.7	85.1	76.8	54,119	66,280	69,536
Bulgan	Orkhon	12.1	0.3	-			
Bulgan	Selenge	4,780.6	97.8	100.0	66,203	82,165	87,614
Bulgan	Teshig	1,558.7	19.1	16.8	12,381	14,517	15,255
Bulgan	Khangal	1,563.4	94.4	90.2	68,444	82,943	86,612
Bulgan	Khutag	3,277.2	57.6	64.5	118,133	141,876	145,727
Orkhon	Orkhon	4.6	0.8	-			
Selenge	Altanbulag	19.7	0.8	-			
Selenge	Baruunburen	476.9	16.8	-			
Selenge	Zuunburen	589.8	48.9	42.5	24,537	29,219	29,832
Selenge	Sant	13.7	1.0	-			
Selenge	Sukhbaatar	0.4	0.9	-			
Selenge	Tushig	2,557.1	100.0	100.0	35,282	43,004	44,989
Selenge	Khushaat	1,159.4	57.2	45.6	11,411	14,454	15,784
Selenge	Tsagaannuur	33.3	100.0	100.0	121,331	143,078	144,364
Selenge	Shaamar	3,838.4	5.2	6.9	1,466	1,760	1,870
Khuvsgul	Ikh-Uul	1,946.4	95.7	100.0	205,706	233,740	225,783
Khuvsgul	Rashaant	1,929.7	96.2	100.0	158,207	174,986	167,634
Khuvsgul	Tarialan	1,962.8	57.1	69.1	101,234	113,309	111,558
Khuvsgul	Tosontsengel	1,921.6	92.9	94.4	191,648	211,411	200,315
Khuvsgul	Tunel	122.6	3.4	-			
Khuvsgul	Erdenebulgan	83.8	1.8	-			
Total river basin		31,395.0			1,208,743	1,398,200	1,392,255

2. Khuvsgul Lake - Eg Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	1.96	1.94	2.65	3.35	60% groundwater 40% surface water	• From surface water; springs and groundwater supply points
Irrigation	0.15	0.18	0.31	0.47	100% surface water	• No groundwater use
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	50% groundwater 50% surface water	• Small demand for industries and transport
Drinking water	0.05	0.07	0.10	0.13	63% groundwater 37% surface water	• Surface water use is expected to reduce to 20% in 2021
Mining	0.00	0.06	0.09	0.17	100% surface water	• Gold ore mine
Energy	0.00	0.00	0.00	0.00		• No power stations
Other	0.08	0.09	0.18	0.45	100% groundwater	• Tourism water demand will increase in future
Total Demand	2.35	2.45	3.49	4.78	Medium scenario	
			3.21	4.23	Low scenario	
			3.77	5.05	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	401	276.2	
Groundwater	Pot.	Expl.	
Granular and fissured aquifers	432	0.2	Small deposit at Hanh soum on north side of Khuvsgul lake
Total Resources	833	276.4	Conclusion: Water resources exceed demand by far

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Eg river	2,971	2,046	2,570	1,770	401.1	276.2	Outflow to Selenge River Basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported • Khuvsgul Lake: no quality issues reported
Groundwater	• no quality issues reported
Vegetation	• Pasture: 37% of the basin area; condition is relatively stable • Forests: 48% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insect diseases
Ecology and biodiversity	• Khovsgol Lake NP protects the lake and its taiga environment. • The forests are important as wildlife habitat • The Eg River is important for the preservation of endangered fish species, such as the Taimen.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 42 rural area boreholes	1.2
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for 15 ponds	2.1
Water supply infrastructure is inadequate	Construction of 42 rural area boreholes	1.2
	Construction of reservoirs for irrigation water supply	2.2
	Construction of 1 pond for livestock water supply	2.1
Waste water treatment inadequate, not working or not available	Construction of high-tech WWTP in tourist camps near Khuvsgul Lake	1.3
Mineral springs are underused	Develop mineral spring at Zart, Tsetsuukh, Bulnain of Khuvsgul aimag	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 35 pasture management herder groups	2.1
	Establishment of and support to 2 irrigation management groups	2.2
Irrigation area to be extended	Construction of 100 ha irrigated area (indicative area)	2.2
	Renovation of 260 ha irrigated area (indicative area)	2.2
Hydropower capacity to be extended	Research and design of hydropower plant on Eg River	3.3
Runoff forming area needs better protection	Protect the watersheds of the Eg River by implementing state or local protection	4.1
Environmental flow to be maintained	Determine environmental flow and study effect on river flow regime due to planned HPP dam at Urumgut	4.3

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 106 rural area boreholes	1.2
	Local surveys to identify resources for 23 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 106 rural area boreholes	1.2
	Construction of 3 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
Organisation of water supply O&M to be improved	Establishment of and support to 70 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 290 ha irrigated area (indicative area)	2.2
	Renovation of 260 ha irrigated area (indicative area)	2.2
Hydropower capacity to be extended	Construction of Urumgut hydropower plant on Eg River	3.3
Runoff forming area needs better protection	Protect the watersheds of the Eg River by implementing state or local protection	4.1

Data by aimag:

Khuvsgul Lake - Eg River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Khuvsgul	33,077.8	79.0
Bulgan	8,793.2	21.0
Total river basin area	41,871.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Khuvsgul	497,718	588,132	619,142
Bulgan	126,333	149,983	155,754
Total river basin area	624,051	738,115	774,897

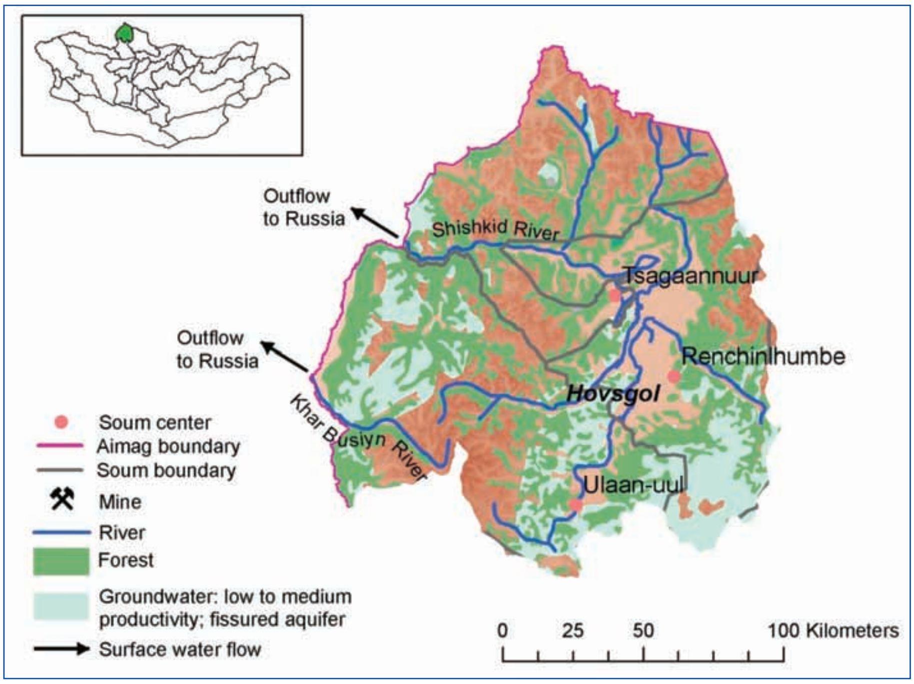
Khuvsgul Lake - Eg River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Khuvsgul	9,445	11,668	21,113	9,353	11,554	20,908	9,703	11,987	21,690
Bulgan	1,030	2,839	3,869	1,010	2,784	3,794	1,037	2,858	3,895
Total river basin area	10,475	14,507	24,982	10,363	14,338	24,702	10,740	14,845	25,584

Data by soum:

Khuvsgul Lake - Eg River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bulgan	Teshig	1,030	1,974	3,004	1,010	1,936	2,946	1,037	1,987	3,024
	Khutag	0	865	865	0	848	848	0	871	871
Khuvsgul	Alag-Erdene	2,973	0	2,973	2,944	0	2,944	3,054	0	3,054
	Khatgal	690	2,247	2,937	683	2,225	2,909	709	2,308	3,017
	Renchinlkhumbe	0	695	695	0	688	688	0	714	714
	Tarialan	0	852	852	0	844	844	0	875	875
	Tunel	1,143	1,762	2,905	1,132	1,745	2,877	1,174	1,810	2,985
	Khankh	1,457	1,032	2,489	1,443	1,022	2,465	1,497	1,060	2,557
	Tsagaan-Uur	917	1,560	2,477	908	1,545	2,453	942	1,603	2,545
	Chandmana-Undur	1,136	1,883	3,019	1,125	1,865	2,990	1,167	1,934	3,102
	Erdenebulgan	1,129	1,637	2,766	1,118	1,621	2,739	1,160	1,682	2,842
Total river basin		10,475	14,507	24,982	10,363	14,338	24,702	10,740	14,845	25,584

Aimag	Soum	Area in river basin (km^2)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Bulgan	Selenge	87,2	1,8	0,0			
	Teshig	6.545,5	80,9	83,2	61,314	71,896	75,548
	Khutag	2.160,5	38,3	35,5	65,019	78,087	80,206
Khuvsgul	Alag-Erdene	3.848,4	85,4	78,7	119,393	133,928	131,662
	Khatgal	0,0	100,0	100,0	27,072	32,269	35,084
	Ikh-Uul	82,7	4,1	0,0			
	Renchinlkhumbe	1.218,7	15,6	17,4	21,612	27,460	30,167
	Tarialan	1.462,1	42,9	30,9	45,269	50,669	49,886
	Tosontsengel	14,4	0,7	0,0			
	Tunel	2.780,7	77,8	74,7	100,586	111,780	108,284
	Khankh	6.162,0	99,2	100,0	38,818	53,417	63,748
	Tsagaan-Uur	8.786,4	100,0	100,0	28,881	38,674	47,628
	Chandmana-Undur	4.189,9	100,0	100,0	55,410	67,929	75,532
	Erdenebulgan	4.532,7	98,2	100,0	60,677	72,006	77,150
Total river basin		41.871,0			624,051	738,115	774,897

3. Shishkhid Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	0.71	0.65	1.00	1.30	30% groundwater 70% surface water	• From surface water; springs and groundwater supply points
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	50% groundwater 50% surface water	• Small demand for industries and transport
Drinking water	0.02	0.03	0.03	0.05	52% groundwater 48% surface water	• Surface water use is expected to reduce to 30% in 2021
Mining	0.00	0.00	0.00	0.00		• No mining
Energy	0.00	0.00	0.00	0.00		• No power stations
Irrigation	0.00	0.00	0.00	0.00		• No engineered irrigation
Other	0.02	0.02	0.04	0.09	100% groundwater	• Tourism water demand will increase in future
Total Demand	0.84	0.81	1.23	1.64	Medium scenario	
			1.16	1.54	Low scenario	
			1.28	1.71	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	39.0	29.6	Actual resource is much larger because this resource is based on runoff at Renchinlkhumbe soum center
Groundwater	Pot.	Expl.	
Fissured aquifer	206	0.2	Small deposit at Renchinlkhumbe soum center
Total Resources	245	29.8	Conclusion: Water resources exceed demand by far

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Shishkhid River	519	395	481	365	39.0	29.6	Outflow to Russia;
Khar Busiyn river	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported • Lakes: small lakes are drying up
Groundwater	• No quality issues reported
Vegetation	• Pasture: 57% of the basin area. • Forests: 38% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insect diseases
Ecology and biodiversity	• The Khordol Sardag Nuruu SPA in the south-eastern part of the basin contains a wide variety of landscapes and supports many rare flora and fauna species. • The forests are important for wildlife and support of the reindeers of the Tsataan people.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 19 rural area boreholes	1.2
	Local surveys to identify resources for 23 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 19 rural area boreholes	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 17 pasture management herder groups	2.1
	Establishment of and support to 1 irrigation management group	2.2
Irrigation area to be extended	Construction of 80 ha irrigated area (indicative area)	2.2
	Renovation of 80 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Shishkhid and Khar Busiyn River by implementing state or local protection	4.1
Drop in lake levels or drying up of lakes	Create special protected areas to protect and restore rivers and lakes with changing ecological conditions	4.4

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 48 rural area boreholes	1.2
	Local surveys to identify resources for 9 ponds	2.1
Water supply infrastructure is inadequate	Construction of 48 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 35 pasture management herder groups	2.1
Runoff forming area needs better protection	Protect the watersheds of the Shishkhid and Khar Busiyn River by implementing state or local protection	4.1

Data by aimag:

Shishkhid River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Khuvsgul	20,362.0	100.0
Total river basin area	20,362.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Khuvsgul	191,177	242,392	265,911
Total river basin area	191,177	242,392	265,911

Shishkhid River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Khuvsgul	2,743	6,319	9,062	2,716	6,257	8,974	2,818	6,491	9,309
Total river basin area	2,743	6,319	9,062	2,716	6,257	8,974	2,818	6,491	9,309

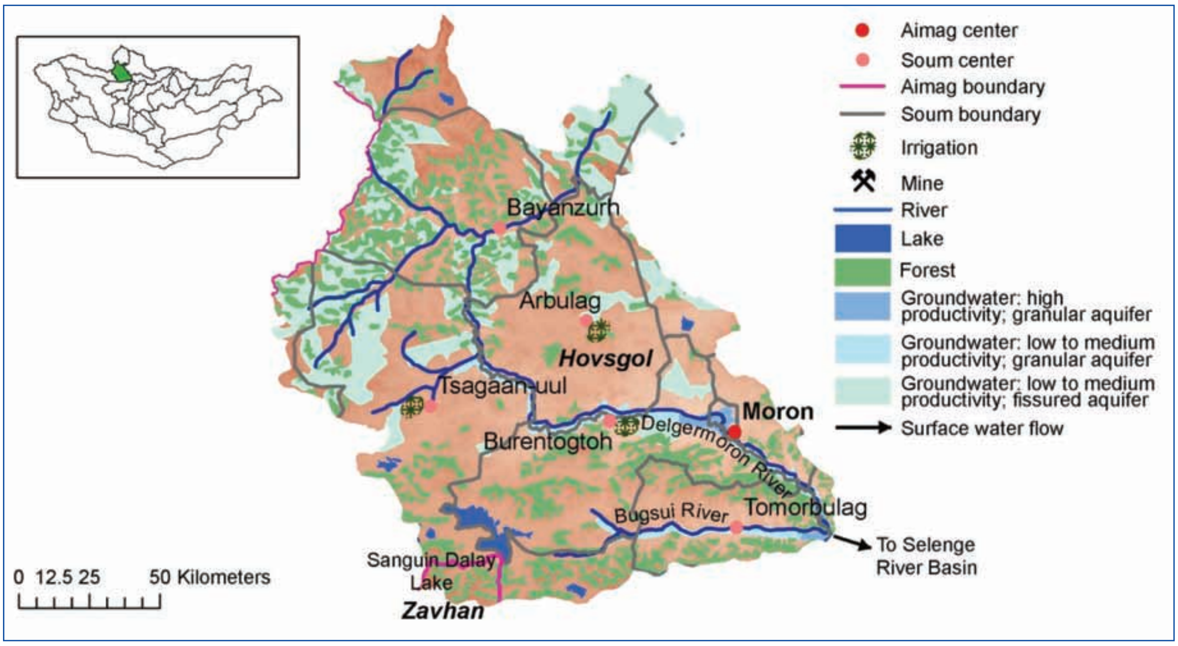
Data by soum:

Shishkhid River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Khuvsgul	Renchinlkhumbe	814	3,297	4,111	806	3,265	4,071	836	3,388	4,224
	Ulaan-Uul	1,185	2,173	3,358	1,174	2,152	3,326	1,217	2,233	3,450
	Tsagaannuur	744	848	1,592	737	840	1,577	764	871	1,636
Total river basin		2,743	6,319	9,062	2,716	6,257	8,974	2,818	6,491	9,309

Aimag	Soum	Area in river basin (km^2)	% of soum area in river basin	% of grassland area in river basin
Khuvsgul	Alag-Erdene	18,0	0,4	0,0
	Bayanzurkh	7,7	0,2	0,0
	Renchinlkhumbe	6.429,3	82,3	82,6
	Ulaan-Uul	8.266,9	81,6	73,1
	Khankh	49,7	0,8	0,0
	Tsagaannuur	5.590,4	100,0	100,0
Total river basin		20.362,0		

Livestock numbers		
2010	2015	2021
102,594	130,356	143,208
78,266	98,148	106,569
10,317	13,888	16,135
191,177	242,392	265,911

4. Delgermurun Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm^3/year					
Livestock	2.88	2.41	3.13	3.61	45% groundwater 55% surface water	• From surface water; springs and groundwater supply points
Drinking water	0.46	0.52	0.80	0.98	92% groundwater 8% surface water	• Surface water use is expected to reduce to 2% in 2021
Industry, transport, roads, construction	0.06	0.08	0.11	0.15	50% groundwater 50% surface water	• Small demand for industries and transport
Energy	0.06	0.04	0.05	0.07		• Energy plant at Moron
Mining	0.00	0.00	0.00	0.00		• No mining
Irrigation	0.00	0.00	0.00	0.00		• No engineered irrigation
Other	0.02	0.02	0.04	0.09	100% groundwater	• Tourism water demand will increase in future
Total Demand	3.48	3.07	4.12	4.89	Medium scenario	
			3.90	4.59	Low scenario	
			4.71	5.39	High scenario	

Water Resources	Mm^3/year		Remarks
Surface water	50%	10%	
Possible use	81.0	47.6	
Groundwater	Pot.	Expl.	
Granular and fissured aquifers	229	2.7	Main groundwater deposit at Moron: 2.4 Mm^3/year
Total Resources	310	50.3	Conclusion: Water resources exceed demand by far

Surface water resources Mm^3/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Delgermurun River	1,037	614	959	568	77.8	46.0	
Bugsui River	43	21	40	20	3.2	1.6	
Total Resources	1,080	635	999	587	81.0	47.6	Outflow to Selenge River Basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported
Groundwater	• No quality issues reported
Vegetation	• Pasture: 80% of the basin area; condition is relatively stable • Forests: 21% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insect diseases
Ecology and biodiversity	• There are no protected areas in this river basin

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Enforce protection of groundwater sources at Moron aimag center	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Surveys to identify new or verify existing water resources at Moron aimag center for drinking water and industrial water supply including thermal power plant	1.1 3.1
	Local surveys to identify resources for 21 rural area boreholes	1.2
	Local surveys to identify resources for 6 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Moron aimag center	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks at Moron aimag center	1.1
	Construction of 21 rural area boreholes	1.2
Sewerage network inadequate	Renovation and expansion of sewerage network at Moron aimag center	1.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 19 pasture management herder groups	2.1
	Establishment of and support to 1 irrigation management group	2.2
Irrigation area to be extended	Construction of 100 ha irrigated area (indicative area)	2.2
	Renovation of 537 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Delgermurun and Bugsui rivers by implementing state or local protection	4.1
Risk of disasters by flooding	Rehabilitate, construct and maintain flood protection facilities at Moron	4.5

Issues in the river basin	Measures in period 2016-2021	Chall.
Sewerage network inadequate	Renovation and expansion of sewerage network at Moron aimag center	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Moron aimag center	1.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Water resources are not adequate	Local surveys to identify resources for 52 rural area boreholes	1.2
	Local surveys to identify resources for 10 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 52 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 38 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 160 ha irrigated area (indicative area)	2.2
	Renovation of 540 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Delgermurun and Bugsui rivers by implementing state or local protection	4.1
Hydropower capacity to be extended	Research and design of hydropower plant on Delgermurun River at Chargat	3.3

Data by aimag:

Delgermurun River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Khuvsgul	22,970.5	98.5
Zavkhan	353.5	1.5
Total river basin area	23,324.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Khuvsgul	1,120,399	1,270,789	1,234,386
Zavkhan	11,922	14,498	15,087
Total river basin area	1,132,321	1,285,287	1,249,472

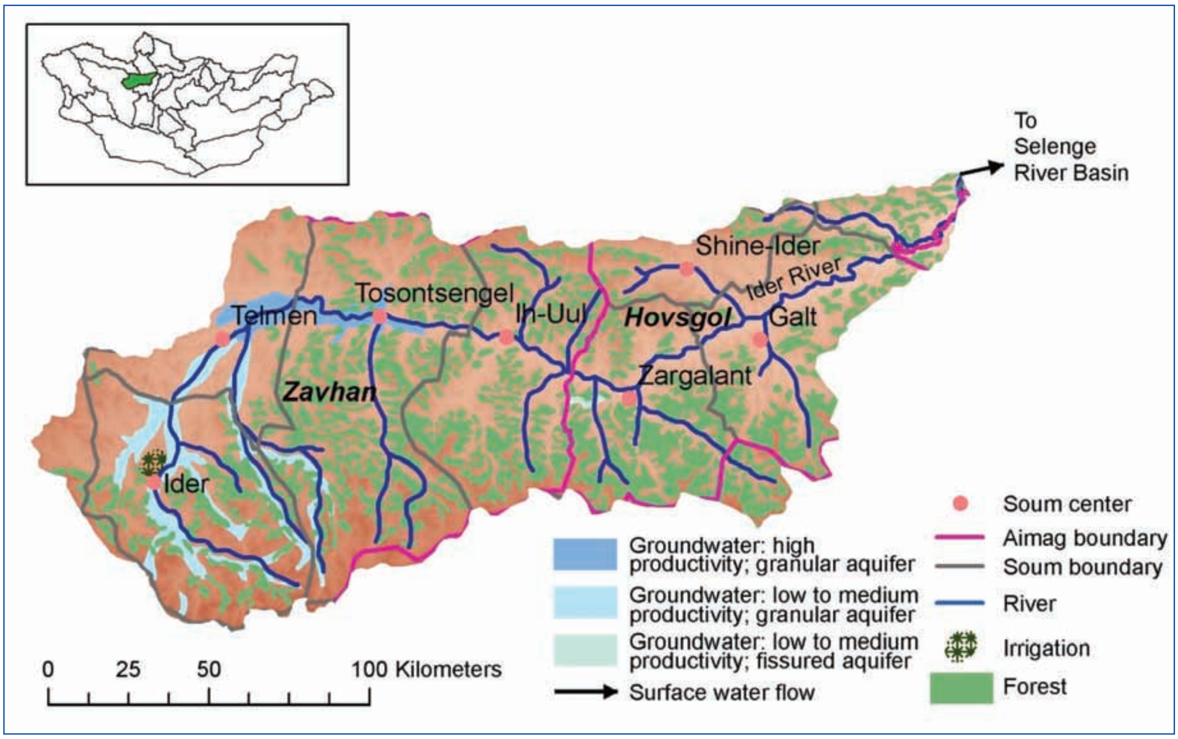
Delgermurun River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Khuvsgul	39,883	18,161	58,044	39,496	17,985	57,481	40,973	18,658	59,631
Zavkhan	0	461	461	0	448	448	0	452	452
Total river basin area	39,883	18,622	58,505	39,496	18,432	57,928	40,973	19,110	60,083

Data by soum:

Delgermurun River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Khuvsgul	Alag-Erdene	0	0	0	0	0	0	0	0	0
	Arbulag	706	3,226	3,932	699	3,195	3,894	725	3,314	4,039
	Bayanzurkh	883	3,139	4,022	874	3,109	3,983	907	3,225	4,132
	Burentogtokh	608	3,270	3,878	602	3,238	3,840	625	3,359	3,984
	Murun	36,141	0	36,141	35,790	0	35,790	37,129	0	37,129
	Tosontsengel	0	167	167	0	165	165	0	172	172
	Tumurbulag	622	2,577	3,199	616	2,552	3,168	639	2,648	3,287
	Tunel	0	597	597	0	591	591	0	613	613
	Ulaan-Uul	0	800	800	0	792	792	0	822	822
	Tsagaan-Uul	923	3,520	4,443	914	3,485	4,399	948	3,616	4,564
	Tsetserleg	0	211	211	0	209	209	0	217	217
	Shine-Ider	0	655	655	0	648	648	0	673	673
Zavkhan	Ikhuul	0	461	461	0	448	448	0	452	452
Total river basin		39,883	18,622	58,505	39,496	18,432	57,928	40,973	19,110	60,083

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Khuvsgul	Alag-Erdene	639,9	14,2	21,3	7,327	8,734	9,495
	Arbulag	3.681,0	100,0	100,0	204,723	236,499	232,324
	Bayanzurkh	3.855,1	99,8	100,0	155,589	176,454	173,530
	Burentogtokh	3.845,6	100,0	100,0	191,986	219,667	213,176
	Murun	102,2	100,0	100,0	130,163	142,040	134,439
	Renchinlkhumbe	164,0	2,1	0,0			
	Tosontsengel	131,2	6,4	5,6	11,369	12,541	11,883
	Tumurbulag	1.852,7	73,3	73,4	127,637	136,597	125,156
	Tunel	671,9	18,8	25,3	34,067	37,859	36,674
	Ulaan-Uul	1.864,0	18,4	26,9	28,801	36,117	39,216
	Tsagaan-Uul	4.895,4	79,2	79,9	177,201	204,344	199,442
	Tsetserleg	462,7	6,2	6,5	9,343	10,913	10,815
	Shine-Ider	804,8	39,3	32,1	42,193	49,025	48,235
Zavkhan	Ikhuul	353,5	9,3	9,6	11,922	14,498	15,087
Total river basin		23.324,0			1,132,321	1,285,287	1,249,472

5. Ider Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	2.44	1.75	2.35	2.75	40% groundwater 60% surface water	• From surface water; springs and groundwater supply points
Irrigation	0.47	0.56	0.96	1.47	100% surface water	• Irrigation mainly near Tosontsengel
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	50% groundwater 50% surface water	• Small demand for industries and transport
Drinking water	0.07	0.09	0.12	0.17	61% groundwater 39% surface water	• Surface water use is expected to reduce to 20% in 2021
Energy	0.00	0.00	0.00	0.00		• No power stations
Mining	0.00	0.00	0.00	0.00		• No mining
Other	0.00	0.00	0.00	0.00		• No tourism
Total Demand	3.09	2.52	3.59	4.58	Medium scenario	
			3.20	3.89	Low scenario	
			4.12	5.30	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	53.3	29.7	
Groundwater	Pot.	Expl.	
Granular and fissured aquifers	129	0.5	Small deposit only
Total Resources	182	30.2	Conclusion: Water resources exceed demand by far

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Ider River	710	396	657	366	53.3	29.7	Outflow to Selenge River Basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported
Groundwater	• No quality issues reported
Vegetation	• Pasture: 71% of the basin area; condition is relatively stable • Forests: 29% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insect diseases
Ecology and biodiversity	• The Tarvagatai Nuruu NP is located in the mountainous Khangai range in the south-west of the basin.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 25 rural area boreholes	1.2
	Local surveys to identify resources for 11 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 25 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 17 pasture management herder groups	2.1
	Establishment of and support to 2 irrigation management groups	2.2
Irrigation area to be extended	Construction of 20 ha irrigated area (indicative area)	2.2
	Renovation of 333 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Selenge and Zelter rivers by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Tosontsengel)	1.2
	Local surveys to identify resources for 63 rural area boreholes	1.2
	Local surveys to identify resources for 15 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of water supply in1 soum center (Tosontsengel)	1.2
	Construction of 2 ponds for livestock water supply	2.1
	Construction of 63 rural area boreholes	1.2
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 1 soum center (Tosontsengel)	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 34 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 220 ha irrigated area (indicative area)	2.2
	Renovation of 130 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Ider River by implementing state or local protection	4.1

Data by aimag:

Ider River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Zavkhan	14,997.1	65.0
Khuvsgul	7,399.6	32.1
Arkhangai	664.3	2.9
Total river basin area	23,061.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Zavkhan	343,425	409,760	416,366
Khuvsgul	424,443	476,721	458,083
Arkhangai	10,980	13,627	14,583
Total river basin area	778,849	900,108	889,033

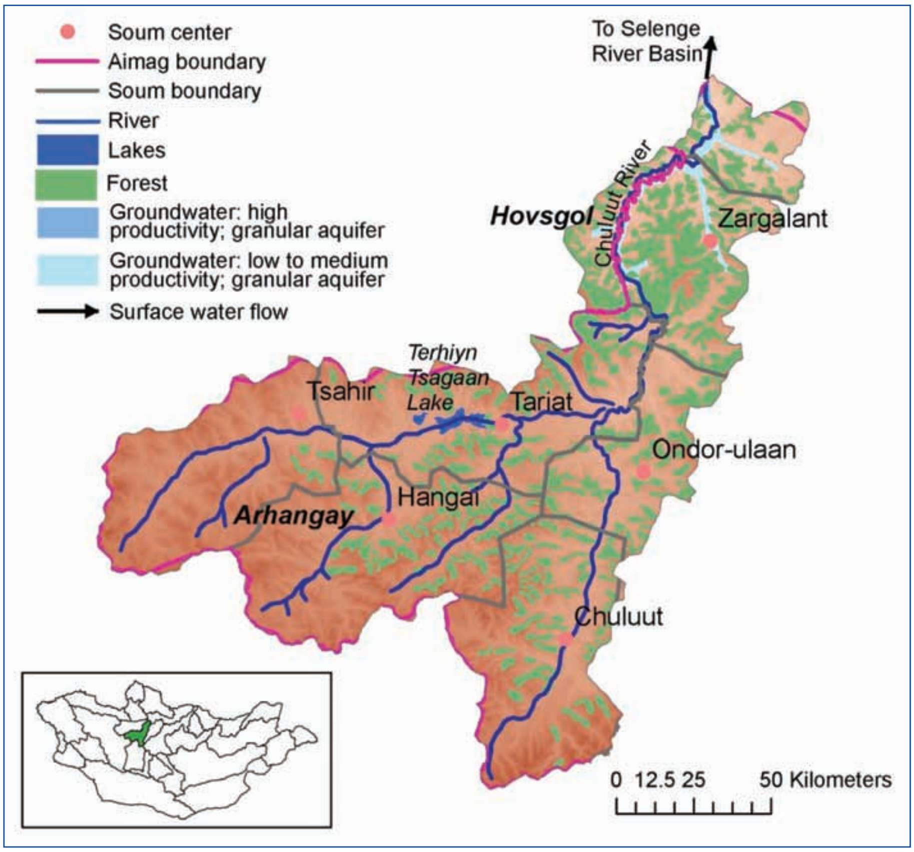
Ider River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Zavkhan	6,411	12,054	18,465	6,223	11,700	17,923	6,291	11,830	18,121
Khuvsgul	3,671	9,743	13,414	3,635	9,649	13,284	3,771	10,010	13,781
Arkhangai	0	286	286	0	282	282	0	290	290
Total river basin area	10,082	22,084	32,166	9,858	21,631	31,489	10,063	22,129	32,192

Data by soum:

Ider River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	Tariat	0	286	286	0	282	282	0	290	290
Khuvsgul	Galt	779	3,622	4,401	771	3,587	4,359	800	3,721	4,522
	Jargalant	1,293	3,802	5,095	1,280	3,765	5,046	1,328	3,906	5,234
	Tumurbulag	0	934	934	0	925	925	0	959	959
	Shine-Ider	1,599	1,385	2,984	1,583	1,372	2,955	1,643	1,423	3,066
Zavkhan	Tosontsengel	4,219	4,232	8,451	4,095	4,108	8,203	4,140	4,153	8,293
	Ider	547	1,954	2,501	531	1,897	2,428	537	1,918	2,454
	Ikhuul	1,144	4,342	5,486	1,110	4,214	5,325	1,123	4,261	5,384
	Telmen	501	1,384	1,885	486	1,343	1,829	492	1,358	1,849
	Yaruu	0	143	143	0	139	139	0	140	140
Total river basin		10,082	22,084	32,166	9,858	21,631	31,489	10,063	22,129	32,192

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Arkhangai	Tariat	442,0	10,8	6,5	10,980	13,627	14,583
	Tsakhir	105,8	3,2	0,0			
	Tsetserleg	116,5	4,6	0,0			
Khuvsgul	Galt	2.818,7	80,6	83,5	161,058	174,673	163,434
	Jargalant	2.650,7	99,0	100,0	127,880	148,844	147,264
	Rashaant	6,0	0,3	0,0			
	Tumurbulag	674,5	26,7	26,6	46,256	49,502	45,356
	Tsetserleg	7,5	0,1	0,0			
	Shine-Ider	1.242,2	60,7	67,9	89,249	103,701	102,029
Zavkhan	Aldarkhaan	101,2	1,4	0,0			
	Tosontsengel	5.301,1	99,4	100,0	100,669	119,803	121,666
	Ider	3.715,2	99,6	100,0	69,990	81,863	81,100
	Ikhuul	3.422,3	90,1	90,4	112,266	136,521	142,066
	Otgon	22,7	0,4	0,0			
	Telmen	2.014,6	57,6	60,5	54,351	64,467	64,627
	Yaruu	420,0	8,4	8,7	6,149	7,106	6,908
Total river basin		23.061,0			778,849	900,108	889,033

6. Chuluut Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	2.27	2.06	2.97	3.81	40% groundwater 60% surface water	• From surface water; springs and groundwater supply points
Industry, transport, roads, construction	0.05	0.06	0.08	0.10	50% groundwater 50% surface water	• Small demand for industries and transport
Drinking water	0.05	0.06	0.08	0.11	58% groundwater 42% surface water	• Surface water use is expected to reduce to 25% in 2021
Energy	0.00	0.00	0.00	0.00		• No power stations
Mining	0.00	0.00	0.00	0.00		• No mining
Irrigation	0.00	0.00	0.00	0.00		• No engineered irrigation
Other	0.02	0.02	0.04	0.09	100% groundwater	• Tourism water demand will increase in future
Total Demand	2.39	2.21	3.17	4.11	Medium scenario	
			3.00	3.89	Low scenario	
			3.28	3.68	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	13.9	6.2	
Groundwater	Pot.	Expl.	
Granular aquifers	86	0.1	Small deposit at Undur Ulaan soum
Total Resources	100	6.4	Conclusion: Water resources exceed demand by sufficient margin

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Chuluut River	185	83	171	77	13.9	6.2	Outflow to Selenge River Basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported
Groundwater	• No quality issues reported
Vegetation	• Pasture: 81% of the basin area; condition is relatively stable • Forests: 21% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insect diseases
Ecology and biodiversity	• Fresh water Terhiyn Tsagaan Lake is a Ramsar site and NP. It is an important site for fish and migratory waterfowl. • The Noyon Khangai NP is an important wildlife area with historical significance.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 27 rural area boreholes	1.2
	Local surveys to identify resources for 14 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 27 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Waste water treatment inadequate, not working or not available	Construction of high-tech WWTP in tourist camps near Terkhiin Tsagaan Lake and along Chuluut River	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 27 pasture management herder groups	2.1
	Establishment of and support to 1 irrigation management group	2.2
Irrigation area to be extended	Construction of 100 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Chuluut River by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 66 rural area boreholes	1.2
	Local surveys to identify resources for 21 ponds	2.1
Water supply infrastructure is inadequate	Construction of 66 rural area boreholes	1.2
	Construction of 3 ponds for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 54 pasture management herder groups	2.1
Runoff forming area needs better protection	Protect the watersheds of the Chuluut River by implementing state or local protection	4.1

Data by aimag:

Chuluut River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Arkhangai	19,208.6	95.7
Khuvsgul	759.7	3.8
Bayankhongor	79.3	0.4
Zavkhan	30.4	0.2
Total river basin area	20,078.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Arkhangai	643,765	760,526	821,411
Khuvsgul	31,826	34,516	32,295
Bayankhongor	0	0	0
Zavkhan	0	0	0
Total river basin area	675,590	797,057	855,727

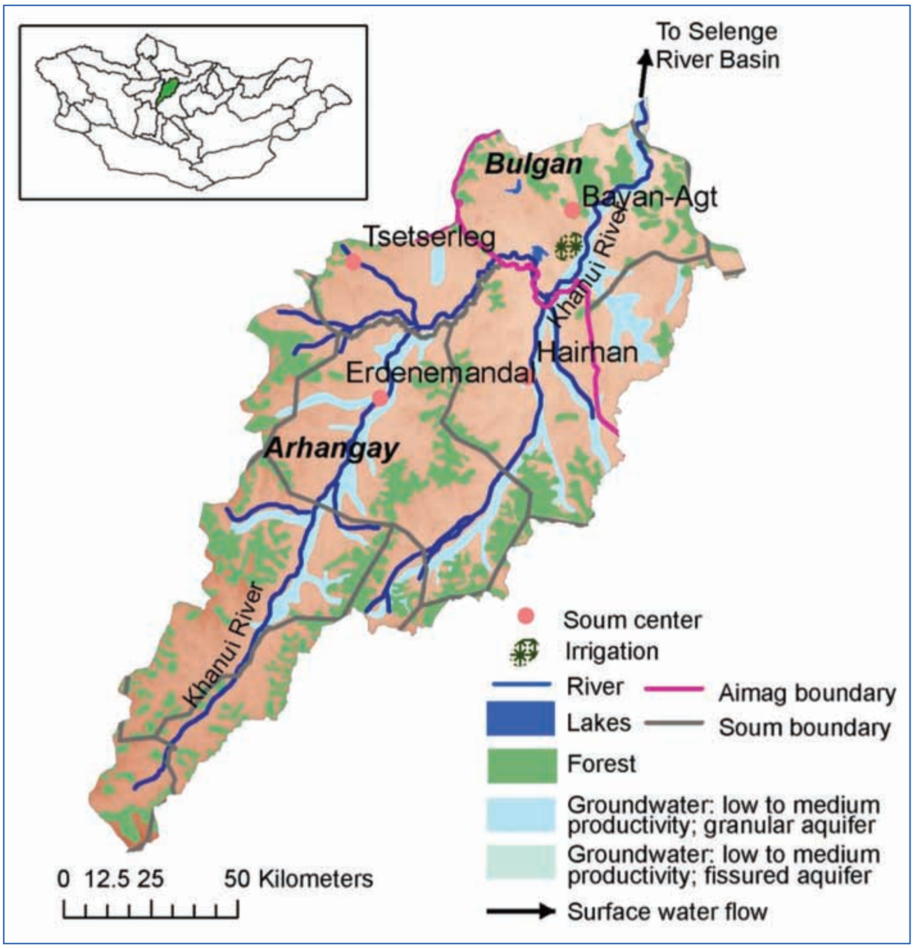
Chuluut River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	5,043	15,755	20,798	4,969	15,524	20,493	5,103	15,942	21,046
Khuvsgul	0	716	716	0	709	709	0	735	735
Bayankhongor	0	0	0	0	0	0	0	0	0
Zavkhan	0	0	0	0	0	0	0	0	0
Total river basin area	5,043	16,470	21,513	4,969	16,233	21,202	5,103	16,678	21,781

Data by soum:

Chuluut River basin population										
Aimag	Soum	2010		2015			2021			
		urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	Jargalant	1,145	2,221	3,366	1,128	2,188	3,316	1,159	2,247	3,406
	Undur-Ulaan	1,141	1,892	3,033	1,124	1,864	2,989	1,155	1,915	3,069
	Tariat	601	4,119	4,720	592	4,058	4,651	608	4,168	4,776
	Khangai	801	2,025	2,826	789	1,995	2,785	811	2,049	2,860
	Chuluut	710	2,684	3,394	700	2,645	3,345	718	2,716	3,435
	Tsakhir	645	1,654	2,299	636	1,630	2,265	653	1,674	2,326
	Tsetserleg	0	1,160	1,160	0	1,143	1,143	0	1,174	1,174
Zavkhan	Galt	0	716	716	0	709	709	0	735	735
Total river basin		5,043	16,470	21,513	4,969	16,233	21,202	5,103	16,678	21,781

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Arkhangai	Jargalant	2.234,0	78,6	74,1	92,850	105,406	104,897
	Ikhtamir	4,9	0,1	0,0			
	Undur-Ulaan	1.840,9	42,0	41,4	80,998	101,455	109,070
	Tariat	3.654,4	89,2	93,5	157,947	196,023	209,769
	Khangai	3.877,9	99,3	100,0	80,871	66,861	81,892
	Chuluut	3.405,3	86,1	87,7	101,439	132,721	150,046
	Tsakhir	3.194,9	96,5	100,0	66,229	84,851	94,260
	Tsetserleg	996,3	39,3	37,1	63,430	73,208	71,477
Bayankhongor	Galuut	5,1	0,1	0,0			
	Gurvanbulag	44,8	1,0	0,0			
	Jargalant	29,4	0,7	0,0			
Khuvsgul	Galt	679,2	19,4	16,5	31,826	34,516	32,295
	Jargalant	26,8	1,0	0,0			
	Rashaant	53,7	2,7	0,0			
Zavkhan	Ikhuul	19,0	0,5	0,0			
	Otgon	11,4	0,2	0,0			
Total river basin		20.078,0			675,590	795,042	853,706

7. Khanui Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	2.73	2.45	3.36	3.99	40% groundwater 60% surface water	• From surface water; springs and groundwater supply points
Industry, transport, roads, construction	0.05	0.06	0.08	0.10	50% groundwater 50% surface water	• Small demand for industries and transport
Drinking water	0.04	0.06	0.08	0.10	56% groundwater 44% surface water	• Surface water use is expected to reduce to 25% in 2021
Energy	0.00	0.00	0.00	0.00		• No power stations
Mining	0.00	0.00	0.00	0.00		• No mining
Irrigation	0.00	0.00	0.00	0.00		• No engineered irrigation
Other	0.00	0.00	0.00	0.00		• No tourism
Total Demand	2.82	2.57	3.51	4.19	Medium scenario	
			3.34	3.98	Low scenario	
			3.89	4.25	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	13.9	11.8	
Groundwater	Pot.	Expl.	
Granular aquifers	96	0.2	Small deposit at Tsetserleg soum, Arkhangai aimag
Total Resources	110	12.0	Conclusion: Water resources exceed demand by sufficient margin

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Khanui River	231	197	217	185	13.9	11.8	Outflow to Selenge River Basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported
Groundwater	• No quality issues reported
Vegetation	• Pasture: 81% of the basin area; condition is relatively stable • Forests: 20% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insect diseases
Ecology and biodiversity	• The Khanui River has it's source in the Khangai Nuruu NP

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 22 rural area boreholes	1.2
	Local surveys to identify resources for 11 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 22 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 20 pasture management herder groups	2.1
	Establishment of and support to 1 irrigation management group	2.2
Irrigation area to be extended	Construction of 120 ha irrigated area (indicative area)	2.2
	Renovation of 3 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Khanui River by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 54 rural area boreholes	1.2
	Local surveys to identify resources for 17 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 54 rural area boreholes	1.2
	Construction of 3 ponds for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 40 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 250 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Khanui River by implementing state or local protection	4.1

Data by aimag:

Khanui River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Arkhangai	12,151.0	77.1
Bulgan	3,583.9	22.7
Khuvsgul	20.0	0.1
Total river basin area	15,755.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Arkhangai	758,344	893,015	901,786
Bulgan	224,483	268,778	272,999
Khuvsgul	0	0	0
Total river basin area	982,827	1,161,793	1,174,784

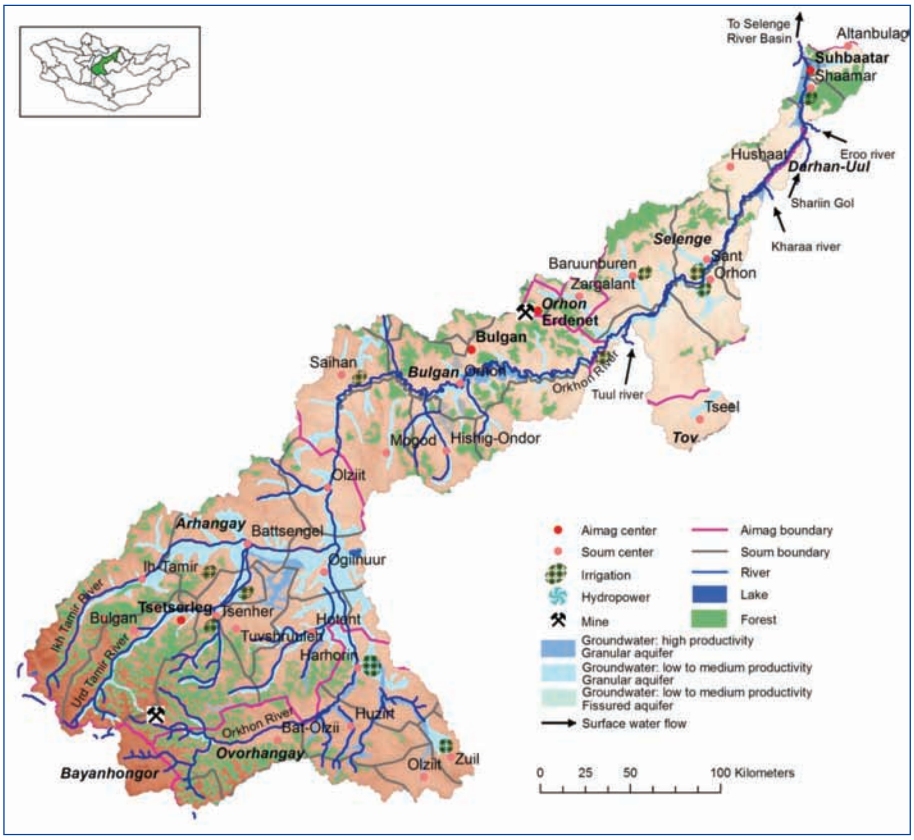
Khanui River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	2,744	14,177	16,921	2,704	13,969	16,673	2,777	14,346	17,122
Bulgan	830	2,657	3,487	814	2,605	3,419	835	2,675	3,510
Khuvsgul	0	0	0	0	0	0	0	0	0
Total river basin area	3,574	16,834	20,408	3,518	16,574	20,092	3,612	17,020	20,633

Data by soum:

Khanui River basin population										
Aimag	Soum	2010		2015			2021			
		urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	Jargalant	0	776	776	0	765	765	0	785	785
	Ikhtamir	0	1,068	1,068	0	1,053	1,053	0	1,081	1,081
	Undur-Ulaan	0	2,678	2,678	0	2,639	2,639	0	2,710	2,710
	Khairkhan	873	2,859	3,732	860	2,817	3,677	883	2,893	3,776
	Chuluut	0	377	377	0	371	371	0	381	381
	Tsetserleg	780	1,779	2,559	769	1,753	2,521	789	1,800	2,589
	Erdenemandal	1,091	4,640	5,731	1,075	4,572	5,647	1,104	4,695	5,799
Bulgan	Bayan-Agt	830	1,827	2,657	814	1,792	2,605	835	1,839	2,675
	Saikhan	0	830	830	0	814	814	0	835	835
Total river basin		3,574	16,834	20,408	3,518	16,574	20,092	3,612	17,020	20,633

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Arkhangai	Battsengel	141,7	4,0	0,0			
	Jargalant	610,3	21,4	25,9	32,454	36,842	36,665
	Ikhtamir	1.266,5	25,8	25,6	47,735	59,123	62,804
	Undur-Ulaan	2.550,9	58,0	58,6	114,650	143,606	154,384
	Khairkhan	2.495,5	97,1	100,0	188,453	207,508	197,611
	Chuluut	527,8	13,3	12,3	14,227	18,614	21,044
	Tsetserleg	1.198,2	47,1	56,9	97,282	112,279	109,623
	Erdenemandal	3.360,0	100,0	100,0	263,544	315,042	319,655
Bulgan	Bayan-Agt	2.547,9	82,0	84,1	150,130	177,818	178,901
	Saikhan	917,1	33,0	33,0	74,353	90,960	94,098
	Khutag	118,9	2,1	0,0			
Khuvsgul	Ikh-Uul	4,0	0,2	0,0			
	Rashaant	16,0	0,8	0,0			
Total river basin		15.755,0			982,827	1,161,793	1,174,784

8. Orkhon Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Mining	15.88	16.54	17.34	18.36	95% groundwater 5% surface water	Gold mines in upper part of the Orkhon river basin
Irrigation	10.37	12.26	21.09	32.39	100% surface water	Irrigated areas located in upper and lower part of the Orkhon river
Livestock	9.29	7.31	10.42	12.62	50% groundwater 50% surface water	From surface water; springs and groundwater supply points
Drinking water	5.12	5.43	7.74	8.38	97% groundwater 3% surface water	Major demand at Erdenet
Energy	1.45	1.70	2.28	3.24	100% groundwater	Thermal energy plant at Erdenet, energy plants at Bulgan and Sukhbaatar
Industry, transport, roads, construction	0.85	0.76	1.43	2.33	100% groundwater	Manufacturing industries at Erdenet and Sukhbaatar
Other	0.14	0.16	0.18	0.20	100% groundwater	Tourism and green area demand
Total Demand	43.12	44.17	60.49	77.51	Medium scenario	
			52.21	60.18	Low scenario	
			68.81	102.38	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	221.6	99.7	Net possible use after subtracting inflow from upstream basins
Groundwater	Pot.	Expl.	
Granular aquifers	838	117.0	17 deposits in all parts of the basin
Total Resources	1,060	216.7	Conclusion: Water resources exceed demand by sufficient margin

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Orkhon River (incl. inflow from Tuul, Kharaa, Shariin Gol, Eroo River)	3417	2051	2956	1774	461.3	276.9	Outflow to Selenge River Basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: heavy metals pollution and increased turbidity due to mining in upper part of Orkhon River increased sulphate concentration originating from Erdenet mine and possibly fertilizers
Groundwater	• no quality issues reported
Vegetation	• Pasture: 79% of the basin area; condition is deteriorating due to increased livestock numbers especially near urban centers and due to decrease in soil moisture caused by climate change • Forests: 14% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases • Vegetation near water bodies is affected negatively by overuse and trampling
Ecology and biodiversity	• Fresh water Ogii Nuur is a Ramsar site. It is important for fish, water fowl and livestock. • The main rivers have their sources in the Khangai Nuruu NP in the south of the basin

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in all urban areas	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Surveys to identify new or verify existing water resources for drinking water and industrial water supply in urban areas: Tsetserleg, Bulgan, Erdenet, Sukhbaatar and Kharkhorin	1.1 3.1
	Local surveys to identify resources for 79 rural area boreholes	1.2
	Local surveys to identify resources for 42 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate and inefficient	Construction and renovation of water supply sources at Kharkhorin	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Increase number of private connections in urban areas and install water meters	4.1
	Construction of 79 rural area boreholes	1.2
	Construction of 4 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Erdenet and Sukhbaatar using industrial water sources or reused water	3.1
	Construction of water supply for Erdenet mine including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Bulgan	1.1
	Construction of high-tech WWTP in tourist camps at Ugii Nuur and along Ikh Tamir river	1.3
	Construction of WWTP for industries at Erdenet	3.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Water supply and/or sanitation at army camp below standard	Installation of water supply, water treatment and sanitation at Altanbulag	1.1
Mineral springs are underused	Develop mineral spring at Tsenkher of Arkhangai, Khujirt of Ovorkhangai	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 58 pasture management herder groups	2.1
	Establishment of and support to 5 irrigation management groups	2.2
Irrigation area to be extended	Construction of 560 ha irrigated area (indicative area)	2.2
	Renovation of 3733 ha irrigated area (indicative area)	2.2
	Rehabilitate irrigation systems, construct water reservoirs, improve irrigation efficiency	
Hydropower capacity to be extended	Research and design of hydropower plants on Orkhon River at Khishigundur and Ulaankhunkh	3.3
Risk of disasters by flooding	Rehabilitate, construct and maintain flood protection facilities at Khujirt, Kharkhorin and Tsetserleg	4.5
Runoff forming area needs better protection	Protect the watersheds of the Orkhon, Urd Tamir, Khoit Tamir rivers by implementing state or local protection	4.1
Environmental flow to be maintained	Determine environmental flow and study effect on river flow regime due to planned dams in Orkhon and Tamir rivers including dam for Orkhon-Gobi diversion	4.3
River valleys are damaged due to mining	Make inventory, clean and reconstruct damaged and polluted river valleys	4.4

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Yusunzuil)	1.2
	Local surveys to identify resources for 198 rural area boreholes	1.2
	Local surveys to identify resources for 61 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2

Issues in the river basin	Measures in period 2016-2021	Chall.
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Tsetserleg, Bulgan and Sukhbaatar	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Construction of water supply in1 soum center (Yusunzuil)	1.2
	Construction of 198 rural area boreholes	1.2
	Construction of 9 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Erdenet and Sukhbaatar using industrial water sources or reused water	3.1
	Construction of water supply for Erdenet mine including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP Tsetserleg, Erdenet, Sukhbaatar and Kharkhorin	1.1
	Construction of small WWTP at 1 soum center (Yusunzuil)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 116 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 1810 ha irrigated area (indicative area)	2.2
	Renovation of 5135 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Orkhon, Urd Tamir, Khoit Tamir rivers by implementing state or local protection	4.1
River valleys are damaged due to mining	Make inventory, clean and reconstruct damaged and polluted river valleys	4.4

Data by aimag:

Orkhon River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Arkhangai	20,443.4	38.2
Bulgan	11,717.9	21.9
Selenge	9,882.2	18.5
Uvurkhangai	8,514.6	15.9
Tov	1,013.5	1.9
Bayankhongor	838.2	1.6
Orkhon	832.0	1.6
Darkhan-Uul	213.4	0.4
Total river basin area	53,455.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Arkhangai	1,040,986	1,245,399	1,271,263
Bulgan	706,789	848,574	865,091
Selenge	495,476	584,565	590,696
Uvurkhangai	401,186	470,268	468,845
Tov	64,867	75,869	75,370
Bayankhongor	21,379	27,075	29,793
Orkhon	169,199	192,668	190,920
Darkhan-Uul	16,029	20,033	21,669
Total river basin area	2,915,911	3,464,450	3,513,648

Orkhon River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	27,400	22,005	49,405	26,999	21,683	48,682	27,727	22,268	49,994
Bulgan	15,642	7,985	23,627	15,336	7,829	23,165	15,744	8,037	23,781
Selenge	41,443	7,403	48,846	41,453	7,405	48,858	43,055	7,691	50,746
Uvurkhangai	17,431	12,337	29,768	17,262	12,218	29,479	17,801	12,599	30,401
Tov	630	1,202	1,832	621	1,184	1,805	637	1,214	1,851
Bayankhongor	0	670	670	0	660	660	0	680	680
Orkhon	86,060	1,809	87,869	96,436	2,027	98,463	109,327	2,298	111,625
Darkhan-Uul	2,595	326	2,921	2,747	345	3,092	2,922	367	3,289
Total river basin area	191,201	53,738	244,939	200,853	53,351	254,204	217,212	55,155	272,367

Data by soum:

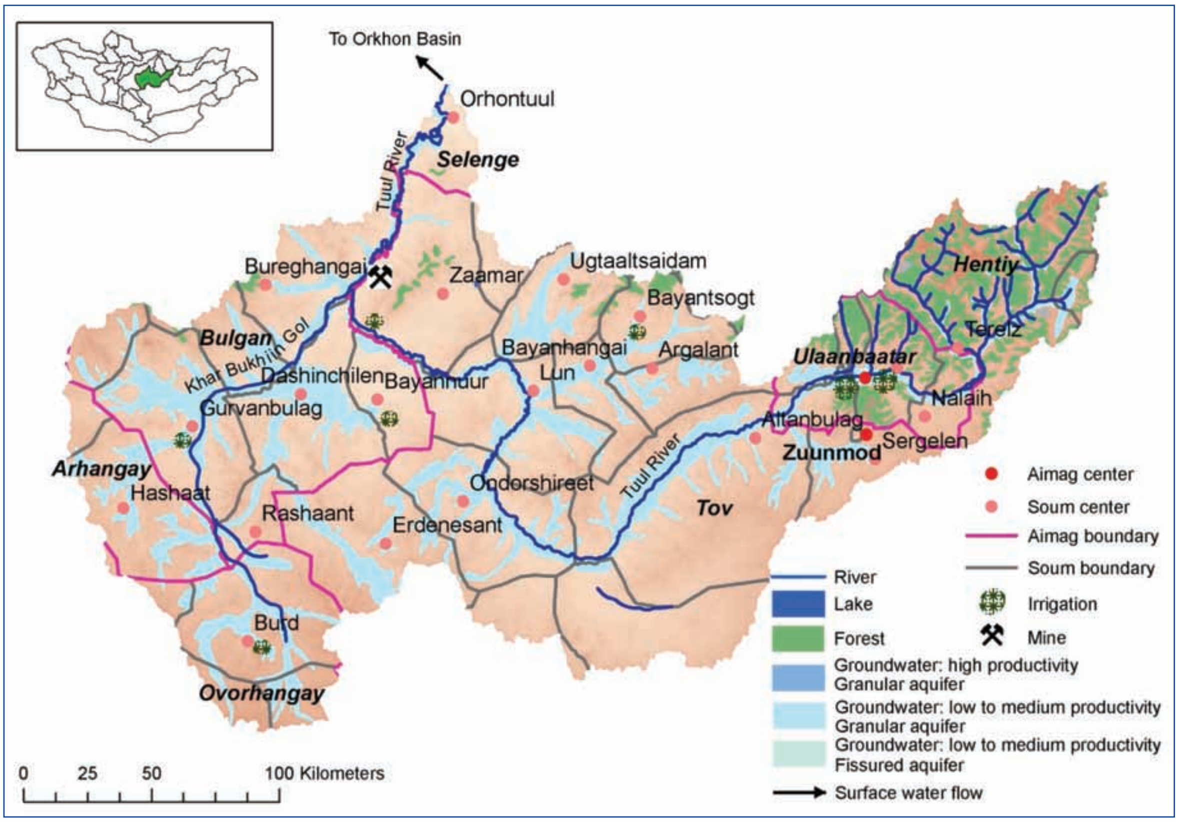
Orkhon River basin population										
Aimag	Soum	2010		2015			2021			
		urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	Battsengel	1,051	2,694	3,745	1,036	2,655	3,690	1,064	2,726	3,790
	Bulgan	972	1,464	2,436	958	1,443	2,400	984	1,481	2,465
	Ikhtamir	1,057	3,105	4,162	1,042	3,059	4,101	1,070	3,142	4,211
	Ugiinuur	629	1,964	2,593	620	1,935	2,555	636	1,987	2,624
	Ulziit	801	2,239	3,040	789	2,206	2,995	811	2,266	3,076
	Tuvshruulekh	1,088	2,192	3,280	1,072	2,160	3,232	1,101	2,218	3,319
	Khashaat	0	365	365	0	360	360	0	369	369
	Khotont	782	3,542	4,324	771	3,490	4,261	791	3,584	4,376
	Tsenkher	966	4,441	5,407	952	4,376	5,328	978	4,494	5,471
	Erdenebulgan	20,054	0	20,054	19,760	0	19,760	20,293	0	20,293
Bayankhongor	Erdenetsogt	0	670	670	0	660	660	0	680	680

Orkhon River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bulgan	Bugat	0	266	266	0	261	261	0	268	268
	Bulgan	11,638	770	12,408	11,410	755	12,165	11,714	775	12,489
	Buregkhangai	0	623	623	0	611	611	0	627	627
	Mogod	579	1,557	2,136	568	1,526	2,094	583	1,567	2,150
	Orkhon	959	1,965	2,924	940	1,927	2,867	965	1,978	2,943
	Saikhan	1,211	1,685	2,896	1,187	1,652	2,839	1,219	1,696	2,915
	Khangal	0	86	86	0	84	84	0	87	87
	Khishig-Undur	1,255	1,033	2,288	1,230	1,013	2,243	1,263	1,040	2,303
	Altanbulag	4,067	359	4,426	4,068	359	4,427	4,225	373	4,598
	Baruunburen	1,283	1,567	2,850	1,283	1,567	2,851	1,333	1,628	2,961
	Zuunburen	0	476	476	0	476	476	0	494	494
	Orkhon	1,013	1,067	2,080	1,013	1,067	2,080	1,052	1,108	2,160
	Orkhontuul	0	1,658	1,658	0	1,658	1,658	0	1,723	1,723
	Saikhan	6,745	982	7,727	6,747	983	7,729	7,007	1,021	8,028
	Sant	1,575	650	2,225	1,575	650	2,226	1,636	675	2,312
	Sukhbaatar	21,942	123	22,065	21,947	123	22,071	22,795	128	22,923
	Khushaat	991	415	1,406	991	415	1,406	1,030	431	1,461
Selenge	Shaamar	3,827	106	3,933	3,828	106	3,934	3,976	110	4,086
Tov	Tseel	630	1,202	1,832	621	1,184	1,805	637	1,214	1,851
Darkhan-Uul	Orkhon	2,595	326	2,921	2,747	345	3,092	2,922	367	3,289
Orkhon	Orkhon	84,950	0	84,950	95,192	0	95,192	107,917	0	107,917
	Jargalant	1,110	1,809	2,919	1,244	2,027	3,271	1,410	2,298	3,708
Uvurkhangai	Bat-Ulzii	4,091	2,290	6,381	4,051	2,268	6,319	4,178	2,339	6,517
	Zuil	858	582	1,440	850	576	1,426	876	594	1,470
	Z-Bayan-Ulaan	0	687	687	0	680	680	0	701	701
	Ulziit	560	795	1,355	555	788	1,342	572	812	1,384
	Uyanga	0	683	683	0	677	677	0	698	698
	Kharkhorin	9,040	3,371	12,411	8,952	3,339	12,291	9,232	3,443	12,675
	Khujirt	2,882	3,929	6,811	2,854	3,891	6,745	2,943	4,012	6,956
Total river basin		191,201	53,738	244,939	200,853	53,351	254,204	217,212	55,155	272,367

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Arkhangai	Battsengel	3.364,5	96,0	100,0	194,826	231,637	234,147
	Bulgan	3.204,4	100,0	100,0	57,158	73,707	82,322
	Ikhtamir	3.573,2	73,6	74,4	138,728	171,828	182,524
	Ugiinuur	1.379,1	82,4	82,1	125,374	145,652	143,377
	Ulziit	1.710,3	100,0	100,0	149,564	175,012	173,453
	Tuvshruulekh	1.180,1	100,0	100,0	48,570	56,648	56,195
	Khairkhan	73,7	2,9	0,0			
	Khashaat	424,0	16,4	16,7	37,593	43,504	42,461
	Khotont	2.332,5	100,0	100,0	107,441	124,796	123,029
	Chuluut	7,8	0,2	0,0			
	Tsenkher	3.131,5	99,8	100,0	107,676	133,118	141,283
	Erdenebulgan	62,4	100,0	100,0	74,055	89,499	92,473
Bayankhongor	Galuut	5,0	0,1	0,0			
	Erdenetsogt	833,1	20,6	20,9	21,379	27,075	29,793
Bulgan	Bugat	474,1	14,9	23,2	16,348	20,022	21,006
	Bulgan	88,4	100,0	100,0	47,337	56,619	57,943
	Buregkhangai	1.460,4	42,1	37,7	77,066	89,357	87,942
	Mogod	2.189,1	78,0	74,0	142,351	171,942	175,780
	Orkhon	3.972,2	99,7	100,0	183,514	219,861	224,125
	Saikhan	1.841,6	67,0	67,0	150,958	184,677	191,046
	Selenge	19,2	0,4	0,0			
	Khangal	91,3	5,6	9,8	7,436	9,012	9,410
	Khishig-Undur	1.469,6	60,6	54,9	81,778	97,084	97,839
	Khutag	112,0	2,0	0,0			
Selenge	Altanbulag	672,0	27,7	36,5	12,527	15,435	16,399
	Baruunburen	2.325,0	83,2	100,0	127,101	149,533	149,792
	Zuunburen	606,7	51,1	57,5	33,196	39,531	40,361
	Orkhon	1.036,7	82,3	83,0	70,330	82,080	81,942
	Orkhontuul	1.994,0	68,2	71,9	110,103	128,351	127,217
	Saikhan	543,2	41,8	47,6	36,503	42,876	43,004
	Sant	1.332,0	99,0	100,0	62,564	73,762	74,355
	Sukhbaatar	46,3	99,1	100,0	13,514	16,518	18,367
	Khushaat	853,9	42,8	54,4	13,613	17,243	18,830
	Shaamar	472,5	74,9	75,4	16,025	19,235	20,431

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Tov	Jargalant	7,4	0,0	0,0			
	Zaamar	2,8	0,1	0,0			
	Sumber	4,3	0,8	0,0			
	Ugtaal	1,5	0,1	0,0			
	Tseel	997,5	61,1	65,0	64,867	75,869	75,370
Darkhan-Uul	Orkhon	213,4	48,0	47,8	16,029	20,033	21,669
Orkhon	Orkhon	560,1	99,2	100,0	122,452	136,174	132,236
	Jargalant	271,8	100,0	100,0	46,747	56,494	58,684
Uvurkhangai	Bat-Ulzii	2.566,3	99,6	100,0	87,354	105,666	109,659
	Burd	23,6	0,9	0,0			
	Zuil	564,9	28,9	24,4	22,675	24,164	22,199
	Z-Bayan-Ulaan	537,2	21,5	20,2	12,415	14,360	14,075
	Ulziit	731,2	37,3	36,5	32,035	37,221	36,465
	Uyanga	402,7	13,3	10,1	12,594	15,105	15,608
	Kharkhorin	2.034,6	88,8	86,6	133,236	154,881	152,332
	Khujirt	1.654,0	100,0	100,0	100,878	118,872	118,508
Total river basin		53.455,0			2,915,911	3,464,450	3,513,648

9. Tuul Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm^3/year					
Drinking water	41.28	45.85	60.69	64.01	100% groundwater	• Ulaanbaatar supply from well fields
Energy	25.36	22.78	30.48	43.24	100% groundwater	• Thermal power plants at Ulaanbaatar
Livestock	6.41	6.39	8.81	10.32	67% groundwater 33% surface water	• From surface water; springs and groundwater supply points
Mining	8.35	5.74	7.40	7.00	100% groundwater	• Gold mines at Zaamar
Irrigation	2.99	3.54	6.08	9.34	100% groundwater	• Small scale irrigation of vegetables near Ulaanbaatar and other locations
Industry, transport, roads, construction	1.76	3.69	5.16	7.70	100% groundwater	• Industries at Ulaanbaatar and Zuunmod
Other	0.04	2.24	2.25	2.38	100% groundwater	• Tourism and green area demand
Total Demand	86.18	90.23	120.87	143.99	Medium scenario	
			105.99	114.40	Low scenario	
			142.10	200.80	High scenario	

Water Resources	Mm^3/year		Remarks
Surface water	50%	10%	
Possible use	63.1	30.5	
Groundwater	Pot.	Expl.	
Granular aquifers	638	142.8	21 deposits with large ones in upper part of the basin
Total Resources	701	173.3	Conclusion: Water resources need further exploration to cover demand if high scenario becomes a reality

Surface water resources Mm^3/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Tuul River	697	338	655	317	63.1	30.5	Outflow to Orkhon River Basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: organic pollution and heavy metals originating from Ulaanbaatar urban area pollution of heavy metals and high turbidities originating from Zaamar mine area
Groundwater	• Pollution reported in Ulaanbaatar urban area and in some wells used for water supply in industrial area of Ulaanbaatar;

Vegetation	• Pasture: 85% of the basin area; condition is deteriorating due to increased livestock numbers especially near urban centers and due to decrease in soil moisture caused by climate change • Forests: 7% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases • Vegetation near water bodies is affected negatively by overuse and trampling
Ecology and biodiversity	• The upstream part of the basin is located in the forested Khan Khentii SPA and the Gorkhi-Terelj NP. • The Khustai Nuruu NP is an important wildlife area including reintroduced Przewalski horses.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources at Ulaanbaatar, Nalaikh and Zuunmod	1.1
	Implementation of protection zones along surface water sources	4.1
	Establish recreational areas along the Tuul and Selbe River at Ulaanbaatar	4.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Ulaanbaatar and Zuunmod for drinking water and for industrial water supply including thermal power plants	1.1 3.1
	Local surveys to identify resources for 80 rural area boreholes	1.2
	Local surveys to identify resources for 32 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate and inefficient	Construction and renovation of water supply sources at Ulaanbaatar, Nalaikh and Zuunmod	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Increase number of private connections in urban areas and install water meters	4.1
	Study feasibility and implement water reuse and recycling technologies	3.1
	Construct separate water supply for industries in Ulaanbaatar and Zuunmod using industrial water sources or reused water	3.1
	Construction of 80 rural area boreholes	1.2
	Construction of 3 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Ulaanbaatar	1.1
	Construction of high-tech WWTP in tourist camps	1.3
	Construction of WWTP for industries at Ulaanbaatar	3.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Water supply and/or sanitation at army camp below standard	Installation of water supply, water treatment and sanitation at Sergelen soum of Tuv aimag	1.1
Mineral springs are underused	Develop mineral spring at Yestii, Ar Janchivlan, Uvur Janchivlan	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 170 pasture management herder groups	2.1
	Establishment of and support to 6 irrigation management groups	2.2
Irrigation area to be extended	Construction of 437 ha irrigated area (indicative area)	2.2
	Renovation of 351 ha irrigated area (indicative area)	2.2
Hydropower capacity to be extended	Research and design of hydropower plant on Tuul River	3.3
Risk of disasters by flooding	Rehabilitate, construct and maintain flood protection facilities at Ulaanbaatar (Chingeltei, Khailaast) and Zuunmod	4.5
Runoff forming area needs better protection	Protect the watersheds of the Tuul River by implementing state or local protection	4.1
Environmental flow to be maintained	Determine environmental flow and study effect on river flow regime due to planned Tuul-Complex dam in Tuul river	4.3
River valleys are damaged due to mining	Make inventory, clean and reconstruct damaged and polluted river valleys	4.4

Issues in the river basin	Measures in period 2016-2021	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources at Ulaanbaatar	1.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Ulaanbaatar for drinking water and industrial water supply	1.1 3.1
	Local surveys to identify resources for 2 soum centers (Lun, Argalant)	1.2
	Local surveys to identify resources for 160 rural area boreholes	1.2
	Local surveys to identify resources for 42 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Ulaanbaatar and Zuunmod	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Construction of water supply in2 soum centers (Lun, Argalant)	1.2
	Construction of 160 rural area boreholes	1.2
	Construction of 7 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries in Ulaanbaatar and Zuunmod using industrial water sources or reused water	3.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Ulaanbaatar	1.1
	Construction of small WWTP at 2 soum centers (Lun, Argalant)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 170 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 960 ha irrigated area (indicative area)	2.2
	Renovation of 586 ha irrigated area (indicative area)	2.2
Hydropower capacity to be extended	Construction of hydropower plant on Tuul River	3.3
Runoff forming area needs better protection	Protect the watersheds of the Tuul River by implementing state or local protection	4.1
River valleys are damaged due to mining	Make inventory, clean and reconstruct damaged and polluted river valleys	4.4

Data by aimag:

Tuul River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Tov	29,667.9	59.2
Bulgan	10,280.9	20.5
Uvurkhangai	3,664.9	7.3
Ulaanbaatar	3,145.2	6.3
Arkhangai	2,486.3	5.0
Selenge	828.8	1.7
Total river basin area	50,074.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Tov	1,357,707	1,581,579	1,561,811
Bulgan	887,963	1,034,438	1,019,923
Uvurkhangai	233,486	267,747	258,994
Ulaanbaatar	116,488	146,863	163,980
Arkhangai	214,850	248,753	243,056
Selenge	43,030	50,162	49,719
Total river basin area	2,853,523	3,331,558	3,299,504

Tuul River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Tov	27,644	15,158	42,802	27,239	14,936	42,175	27,934	15,316	43,250
Bulgan	5,536	8,050	13,586	5,428	7,892	13,320	5,572	8,102	13,674
Uvurkhangai	544	3,670	4,214	539	3,635	4,174	556	3,748	4,304
Ulaanbaatar	1,125,433	0	1,125,433	1,322,274	0	1,322,274	1,485,751	0	1,485,751
Arkhangai	1,140	2,248	3,388	1,123	2,215	3,339	1,154	2,275	3,429
Selenge	1,311	648	1,959	1,311	648	1,959	1,362	673	2,035
Total river basin area	1,161,608	29,774	1,191,382	1,357,914	29,326	1,387,240	1,522,327	30,115	1,552,442

Data by soum:

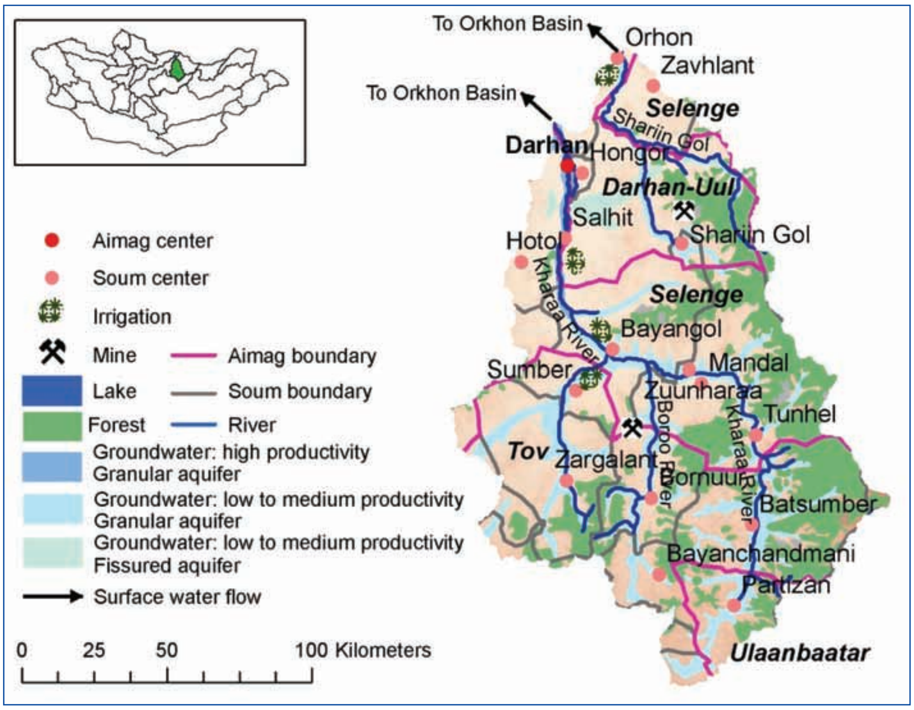
Tuul River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Arkhangai	Ugiinuur	0	428	428	0	422	422	0	433	433
	Khashaat	1,140	1,820	2,960	1,123	1,793	2,917	1,154	1,842	2,995
Bulgan	Bayannuur	698	961	1,659	684	942	1,627	703	967	1,670
	Buregkhangai	833	1,030	1,863	817	1,010	1,826	838	1,037	1,875
	Gurvanbulag	1,243	1,890	3,133	1,219	1,853	3,072	1,251	1,902	3,153
	Dashinchilen	1,075	1,287	2,362	1,054	1,262	2,316	1,082	1,295	2,377
	Mogod	0	547	547	0	536	536	0	551	551
	Rashaant	1,687	1,486	3,173	1,654	1,457	3,111	1,698	1,496	3,194
	Khishig-Undur	0	849	849	0	832	832	0	854	854
Selenge	Orkhontuul	1,311	648	1,959	1,311	648	1,959	1,362	673	2,035
Tov	Altanbulag	863	1,940	2,803	850	1,912	2,762	872	1,960	2,832
	Argalant	781	681	1,462	770	671	1,441	789	688	1,477
	Bayandelger	0	46	46	0	45	45	0	46	46
	Bayan-Unjuul	696	649	1,345	686	639	1,325	703	655	1,359
	Bayankhangai	783	644	1,427	772	635	1,406	791	651	1,442
	Bayantsogt	846	917	1,763	834	904	1,737	855	927	1,782
	Buren	0	454	454	0	447	447	0	458	458
	Zaamar	3,782	1,302	5,084	3,727	1,283	5,010	3,822	1,316	5,137
	Zuunmod	15,295	0	15,295	15,071	0	15,071	15,455	0	15,455
	Lun	903	1,701	2,604	890	1,676	2,566	912	1,719	2,631
	Undurshireet	357	1,459	1,816	352	1,438	1,789	361	1,474	1,835
	Sergelen	487	431	918	480	425	904	492	435	927
	Ugtaal	1,403	916	2,319	1,382	903	2,285	1,418	926	2,344
	Tseel	0	407	407	0	401	401	0	411	411
	Erdene	0	1,448	1,448	0	1,427	1,427	0	1,463	1,463
	Erdenesant	1,448	2,164	3,612	1,427	2,132	3,559	1,463	2,186	3,650

Tuul River basin population

Aimag	Soum	2010		2015			2021			
		urban	rural	total	urban	rural	total	urban	rural	total
Ulaanbaatar	Bayangol	185,104	0	185,104	217,482	0	217,482	244,408	0	244,408
	Bayanzurkh	265,997	0	265,997	312,524	0	312,524	351,218	0	351,218
	Nalaikh	31,458	0	31,458	36,961	0	36,961	41,537	0	41,537
	Khanuul	112,055	0	112,055	131,655	0	131,655	147,955	0	147,955
	Songinokhairkhan	246,464	0	246,464	289,559	0	289,559	325,176	0	325,176
	Sukhbaatar	136,917	0	136,917	160,866	0	160,866	180,783	0	180,783
	Chingeltei	147,438	0	147,438	173,227	0	173,227	194,674	0	194,674
Uvurkhangai	Bayan-Undur	0	383	383	0	379	379	0	391	391
	Burd	544	2,332	2,876	539	2,310	2,848	556	2,382	2,937
	Zuil	0	434	434	0	430	430	0	443	443
	Kharkhorin	0	522	522	0	517	517	0	533	533
Total river basin		1,161,608	29,774	1,191,382	1,357,914	29,326	1,387,240	1,522,327	30,115	1,552,442

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Arkhangai	Ugiinuur	298,2	17,6	17,9	27,335	31,756	31,260
	Khashaat	2.188,1	83,6	83,3	187,515	216,997	211,796
Bulgan	Bayannuur	1.016,7	100,0	100,0	83,547	97,293	96,239
	Buregkhangai	2.033,3	57,9	62,3	127,354	147,664	145,325
	Gurvanbulag	2.697,9	100,0	100,0	262,945	304,556	297,668
	Dashinchilen	2.324,0	100,0	100,0	177,489	207,688	205,829
	Mogod	625,1	22,0	26,0	50,015	60,412	61,760
	Rashaant	616,7	100,0	100,0	119,433	137,072	132,728
	Khishig-Undur	967,3	39,4	45,1	67,180	79,754	80,374
Selenge	Orkhontuul	828,8	28,0	28,1	43,030	50,162	49,719
Tov	Altanbulag	5.358,7	94,0	94,4	125,679	148,262	148,371
	Argalant	980,7	86,7	84,7	51,287	59,949	59,369
	Batsumber	9,8	0,4	0,0			
	Bayandelger	286,2	13,1	7,4	7,860	9,231	9,180
	Bayan-Unjuul	2.257,9	46,8	46,1	70,858	81,643	79,399
	Bayankhangai	1.004,9	100,0	100,0	74,822	86,196	84,014
	Bayantsogt	1.337,9	90,2	88,7	67,086	79,157	79,213
	Bayanchandmana	34,4	5,6	0,0			
	Bornuur	3,5	0,3	0,0			
	Buren	762,7	20,2	18,5	31,499	36,134	34,969
	Delgerkhaan	2,2	0,1	0,0			
	Jargalant	3,7	0,2	0,0			
	Zaamar	2.818,5	99,9	100,0	164,831	190,707	186,895
	Zuunmod	19,4	100,0	100,0	31,971	38,403	39,261
	Lun	2.557,1	100,0	100,0	187,789	217,802	213,610
	Mungunmorit	27,0	0,4	0,0			
	Undurshireet	2.639,7	100,0	100,0	144,029	166,866	163,624
	Sergelen	1.107,6	29,0	28,8	18,121	19,236	18,041
	Ugtaal	1.411,4	90,4	90,9	88,930	104,778	104,890
	Tseel	388,4	23,5	22,0	21,955	25,679	25,510
	Erdene	4.130,8	50,6	62,1	92,358	109,857	111,571
	Erdenesant	2.525,4	74,0	71,6	178,632	207,681	203,894
Ulaanbaatar	Bayangol	23,8	100,0	100,0	32	8	3
	Bayanzurkh	1.236,5	99,9	100,0	38,483	50,815	58,282
	Nalaikh	697,5	99,9	100,0	39,709	46,373	48,625
	Khanuul	513,1	100,0	100,0	29,104	38,305	43,608
	Songinokhairkhan	375,9	31,0	6,8	3,811	4,694	5,353
	Sukhbaatar	208,7	99,9	100,0	3,842	5,616	7,374
	Chingeltei	89,6	98,7	100,0	1,507	1,051	735
Uvurkhangai	Bayan-Undur	510,3	14,4	15,9	25,927	29,953	29,194
	Burd	2.463,4	92,7	93,4	170,029	195,805	189,671
	Zuil	431,4	21,8	18,2	16,914	18,024	16,558
	Kharkhorin	259,8	11,2	13,4	20,616	23,965	23,571
Total river basin		50.074,0			2,853,523	3,329,543	3,297,483

10. Kharaa Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	9.29	10.97	18.88	29.00	50% groundwater 50% surface water	Irrigation of wheat fields and vegetables
Drinking water	4.29	4.31	5.04	5.39	95% groundwater 5% surface water	Surface water use is expected to reduce to 2% in 2021; Major demand at Darkhan
Energy	3.90	3.90	5.22	7.40	100% groundwater	Power station at Darkhan
Mining	5.90	4.11	3.33	5.43	100% groundwater	Boroo gold mine and Shariin gol coal mine
Livestock	2.94	2.72	3.93	4.91	45% groundwater 55% surface water	From surface water; springs and groundwater supply points
Industry, transport, roads, construction	0.94	1.03	1.43	2.09	95% groundwater 5% surface water	Manufacturing and heavy industries at Darkhan
Other	0.05	0.06	0.11	0.26	100% groundwater	Tourism and green area water demand
Total Demand	27.31	27.09	37.94	54.47	Medium scenario	
			30.05	37.56	Low scenario	
			45.37	77.22	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	25.9	12.8	
Groundwater	Pot.	Expl.	
Granular aquifers	182	52.6	Main deposits at Darkhan (15.4 Mm³/year) and Boroo mine (35 Mm3/year)
Total Resources	208	65.4	Conclusion: additional groundwater resources to be explored to supply increase in irrigation demand

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Kharaa River	382	189	359	178	22.9	11.4	
Shaariin Gol	50	24	47	22	3.0	1.4	
Total Resources	432	213	406	200	25.9	12.8	Outflow to Orkhon River Basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: pollution of heavy metals originating from Boroo mine area Increased turbidity levels due to irrigation
Groundwater	• Shallow groundwater: pollution of heavy metals reported near Boroo mine area
Vegetation	• Pasture: 58% of the basin area; condition relatively stable except near urban centers • Forests: 27% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases • Vegetation near water bodies is affected negatively by overuse and trampling
Ecology and biodiversity	• There are no protected areas in this basin. • Fish stock is declining due to overfishing and deteriorating surface water quality

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources at Darkhan	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Khotol, Shariin Gol and Zuunkharaa for drinking water and industrial water supply	1.1 3.1
	Local surveys to identify resources for 44 rural area boreholes	1.2
	Local surveys to identify resources for 18 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Boroo mine	3.2
Water supply infrastructure is inadequate and inefficient	Construction and renovation of water supply sources at Shariin Gol and Zuunkharaa	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Increase number of private connections in urban areas and install water meters	4.1
	Construction of 44 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Darkhan and Shariin Gol using industrial water sources or reused water	3.1
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Khotol and Shariin Gol	1.1
	Construction of WWTP for industries at Darkhan	3.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 17 pasture management herder groups	2.1
	Establishment of and support to 9 irrigation management groups	2.2
Irrigation area to be extended	Construction of 352 ha irrigated area (indicative area)	2.2
	Renovation of 2056 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Kharaa River by implementing state or local protection	4.1
Risk of disasters by flooding	Rehabilitate, construct and maintain flood protection facilities at Darkhan	4.5

Issues in the river basin	Measures in period 2016-2021	Chall.
Water sources are vulnerable to pollution	Protection of water sources at Khotol, Shariin Gol and Zuunkharaa	1.1
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Bayanchandman)	1.2
	Local surveys to identify resources for 110 rural area boreholes	1.2
	Local surveys to identify resources for 26 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Boroo mine	3.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Khotol	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Construction of water supply in1 soum center (Bayanchandman)	1.2
	Construction of 110 rural area boreholes	1.2
	Construction of 4 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Darkhan and Shariin Gol using industrial water sources or reused water	3.1
	Construction of water supply for Boroo mine including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Darkhan and Zuunkharaa	1.1
	Construction of small WWTP at 1 soum center (Bayanchandman)	1.2
		2.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 34 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 510 ha irrigated area (indicative area)	2.2
	Renovation of 2110 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Kharaa River by implementing state or local protection	4.1

Data by aimag:

Kharaa River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Tov	7,326.0	41.4
Selenge	6,559.2	37.1
Darkhan-Uul	2,968.8	16.8
Ulaanbaatar	843.0	4.8
Total river basin area	17,697.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Tov	412,932	497,448	513,312
Selenge	317,928	383,467	396,811
Darkhan-Uul	231,679	276,661	284,425
Ulaanbaatar	52,226	64,338	73,363
Total river basin area	1,014,765	1,221,914	1,267,911

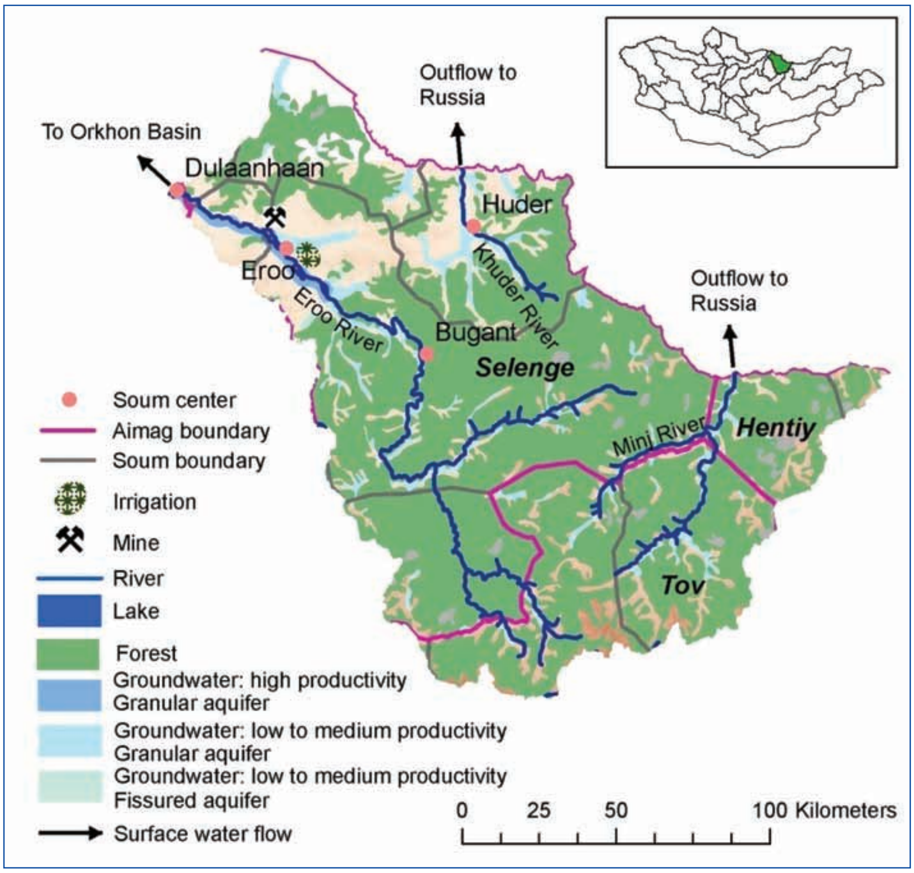
Kharaa River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Tov	8,621	15,182	23,803	8,495	14,960	23,454	8,711	15,341	24,052
Selenge	27,727	5,319	33,046	27,734	5,320	33,054	28,805	5,526	34,331
Darkhan-Uul	87,644	4,435	92,079	92,773	4,687	97,460	98,679	4,977	103,656
Ulaanbaatar	5,800	0	5,800	6,830	0	6,830	7,909	0	7,909
Total river basin area	129,792	24,936	154,728	135,831	24,967	160,798	144,105	25,843	169,949

Data by soum:

Kharaa River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Selenge	Bayangol	3,458	2,039	5,497	3,459	2,040	5,498	3,593	2,118	5,711
	Javkhlant	902	556	1,458	902	557	1,459	937	578	1,515
	Mandal	23,367	1,424	24,791	23,373	1,424	24,797	24,276	1,479	25,755
	Orkhon	0	218	218	0	219	219	0	227	227
	Saikhan	0	1,082	1,082	0	1,082	1,082	0	1,124	1,124
Tov	Argalant	0	123	123	0	121	121	0	124	124
	Batsumber	2,606	4,147	6,753	2,568	4,086	6,654	2,633	4,190	6,824
	Bayantsogt	0	117	117	0	115	115	0	118	118
	Bayanchandmana	1,379	2,351	3,730	1,359	2,317	3,675	1,393	2,376	3,769
	Bornuur	1,519	3,298	4,817	1,497	3,250	4,746	1,535	3,333	4,867
	Jargalant	2,231	3,992	6,223	2,198	3,934	6,132	2,254	4,034	6,288
	Sumber	886	822	1,708	873	810	1,683	895	831	1,726
	Ugtaal	0	92	92	0	90	90	0	93	93
	Tseel	0	240	240	0	237	237	0	243	243
	Darkhan	77,434	113	77,547	81,965	112	82,078	87,184	110	87,294
	Orkhon	0	313	313	0	331	331	0	352	352
	Khongor	2,517	3,279	5,796	2,664	3,471	6,135	2,834	3,692	6,526
Darkhan-Uul	Shariin gol	7,693	730	8,423	8,143	773	8,916	8,662	822	9,484
Ulaanbaatar	Songinokhairkhan	5,800	0	5,800	6,830	0	6,830	7,909	0	7,909
Total river basin		129,792	24,936	154,728	135,831	24,967	160,798	144,105	25,843	169,949

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Selenge	Bayangol	1.888,6	100,0	100,0	130,708	155,579	158,069
	Eruu	118,8	1,4	0,0			
	Javkhlant	645,2	53,7	55,2	45,111	52,671	52,375
	Mandal	2.797,8	57,3	86,7	87,520	111,206	122,244
	Orkhon	226,7	17,7	17,0	14,405	16,812	16,783
	Orkhontuul	113,0	3,8	0,0			
	Saikhan	769,1	58,2	52,4	40,184	47,200	47,340
Tov	Argalant	151,1	13,3	15,3	9,264	10,829	10,724
	Batsumber	2.427,7	98,9	100,0	69,096	89,347	99,903
	Bayantsogt	146,0	9,8	11,3	8,547	10,084	10,091
	Bayanchandmana	582,7	94,4	100,0	36,888	44,962	47,037
	Bornuur	1.153,6	99,7	100,0	96,713	115,878	118,821
	Jargalant	1.858,6	99,4	100,0	134,377	157,485	156,946
	Sumber	544,3	99,2	100,0	36,171	43,200	44,215
	Ugtaal	149,0	9,5	9,1	8,903	10,489	10,501
	Tseel	255,6	15,4	13,0	12,973	15,174	15,074
	Erdene	57,4	0,7	0,0			
Darkhan-Uul	Darkhan	101,9	100,0	100,0	75,228	91,968	97,131
	Orkhon	216,5	47,9	45,9	15,392	19,236	20,808
	Khongor	2.554,1	99,9	100,0	103,995	123,114	124,246
	Shariin gol	96,3	100,0	100,0	37,064	42,343	42,239
Ulaanbaatar	Bayanzurkh	1,2	0,1	0,0			
	Songinokhairkhan	840,4	69,0	93,2	52,226	64,338	73,363
	Sukhbaatar	0,2	0,1	0,0			
	Chingeltei	1,2	1,3	0,0			
Total river basin		17.697,0			1,014,765	1,221,914	1,267,911

11. Eroo Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	1.67	1.97	3.40	5.22	100% surface water	• Irrigation of wheat fields in lower part of the basin and vegetables
Mining	3.91	0.67	1.20	2.11	100% groundwater	• Gold mines in upper part of the basin, iron mine near Eroo soum
Livestock	0.51	0.54	0.78	0.97	45% groundwater 55% surface water	• From surface water; springs and groundwater supply points
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	50% groundwater 50% surface water	• Small demand for industries and transport
Drinking water	0.02	0.03	0.04	0.07	75% groundwater 25% surface water	• Surface water use is expected to reduce to 10% in 2021
Energy	0.00	0.00	0.00	0.00		• No power stations
Other	0.00	0.00	0.00	0.00		• No tourism water demand
Total Demand	6.22	3.33	5.58	8.56	Medium scenario	
			4.25	5.46	Low scenario	
			7.14	15.06	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	196.2	112.1	
Groundwater	Pot.	Expl.	
Granular aquifers	239	0.6	Small deposit Sudut Shuvuut
Total Resources	435	112.8	Conclusion: Water resources exceed demand by far

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Eroo River	1,022	586	843	483	178.8	102.5	Outflow to Orkhon River Basin
Khuder River	99	55	82	46	17.4	9.7	Outflow to Russia
Minj River							No data available
Total Resources	1121	641	925	529	196.2	112.1	

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: pollution of heavy metals in Eroo river
Groundwater	• no quality issues reported
Vegetation	• Pasture: 16% of the basin area; condition relatively stable • Forests: 71% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases
Ecology and biodiversity	• The upstream part of the basin is located in the forested Khan Khentii SPA. which is important as wildlife habitat

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 34 rural area boreholes	1.2
	Local surveys to identify resources for 11 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 34 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Mineral springs are underused	Develop mineral spring at Eroo	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 15 pasture management herder groups	2.1
	Establishment of and support to 3 irrigation management groups	2.2
Irrigation area to be extended	Construction of 43 ha irrigated area (indicative area)	2.2
	Renovation of 710 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Eroo, Khuder and Minj rivers by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 86 rural area boreholes	1.2
	Local surveys to identify resources for 16 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 86 rural area boreholes	1.2
	Construction of 3 ponds for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 30 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 490 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Eroo, Khuder and Minj rivers by implementing state or local protection	4.1

Data by aimag:

Eroo River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Selenge	15,401.6	69.1
Tov	5,290.5	23.7
Khentii	1567.0	7.0
Darkhan-Uul	20.9	0.1
Total river basin area	22,280.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Selenge	215,123	256,989	263,632
Tov	0	0	0
Khentii	0	0	0
Darkhan-Uul	2,113	2,640	2,856
Total river basin area	217,236	259,630	266,488

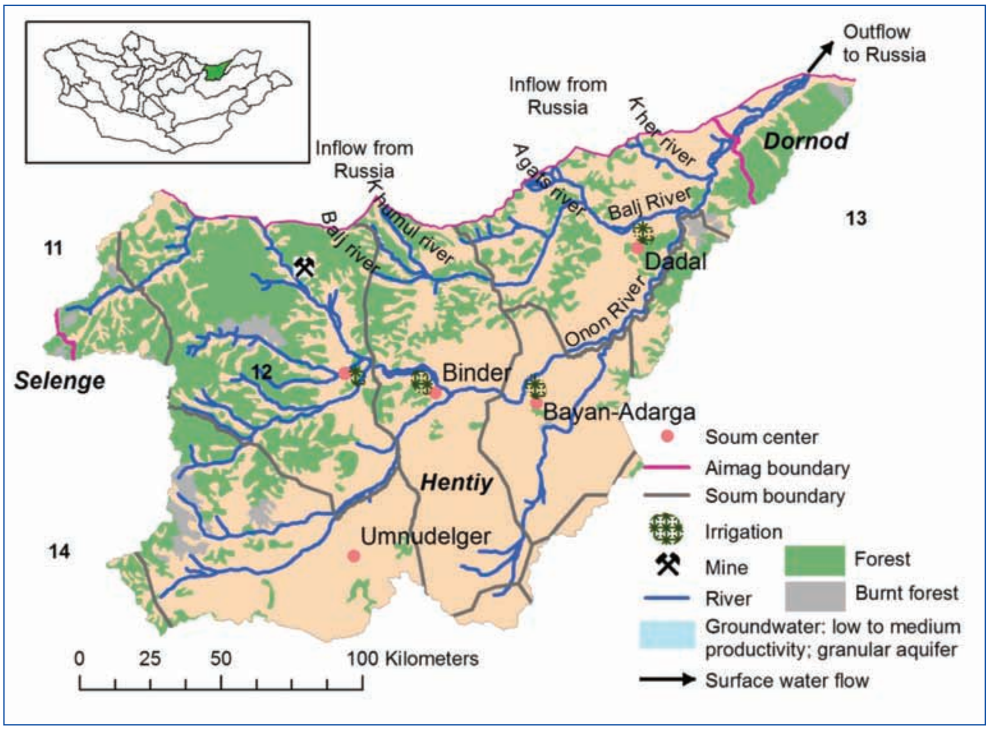
Eroo River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Selenge	7,568	2,245	9,813	7,570	2,245	9,815	7,862	2,332	10,194
Tov	0	0	0	0	0	0	0	0	0
Khentii	0	0	0	0	0	0	0	0	0
Darkhan-Uul	0	43	43	0	45	45	0	48	48
Total river basin area	7,568	2,288	9,856	7,570	2,291	9,861	7,862	2,380	10,243

Data by soum:

Eroo River basin population										
Aimag	Soum	2010		2015			2021			
		urban	rural	total	urban	rural	total	urban	rural	total
Selenge	Altanbulag	0	625	183	0	625	1,674	0	649	114
	Eruu	5,449	925	1,095	5,450	925	972	5,661	961	52
	Javkhlant	0	452	1,089	0	452	901	0	469	213
	Mandal	0	218	2,505	0	218	2,099	0	227	1,155
	Khuder	2,119	0	1,157	2,120	0	59	2,201	0	590
	Shaamar	0	25	72	0	25	693	0	26	637
Darkhan-Uul	Orkhon	0	43	1,473	0	45	949	0	48	765
Total river basin		7,568	2,288	134	7,570	2,291	524	7,862	2,380	1,025

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Selenge	Altanbulag	1.743,9	71,5	63,5	21,794	26,853	28,529
	Eruu	8.270,1	98,6	100,0	62,571	76,050	79,678
	Javkhlant	550,1	46,3	44,8	36,611	42,747	42,507
	Mandal	2.061,4	42,7	13,3	13,426	17,059	18,753
	Khuder	2.649,9	100,0	100,0	76,959	89,764	89,370
	Shaamar	126,2	19,9	17,7	3,762	4,515	4,796
Tov	Batsumber	17,0	0,7	0,0			
	Mungunmorit	2.549,5	38,1	0,0			
	Erdene	2.724,1	33,6	0,0			
Khentii	Barshireet	189,3	2,7	0,0			
	Umnudelger	1.377,8	12,6	0,0			
Darkhan-Uul	Orkhon	18,3	4,1	6,3	2,113	2,640	2,856
	Khongor	2,5	0,1	0,0			
Total river basin		22.280,0			217,236	259,630	266,488

12. Onon Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	1.31	1.38	1.83	2.23	45% groundwater 55% surface water	From surface water; springs and groundwater supply points
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	50% groundwater 50% surface water	Small demand for industries and transport
Drinking water	0.03	0.04	0.05	0.09	60% groundwater 40% surface water	Surface water use is expected to reduce to 15% in 2021
Mining	0.00	0.04	0.07	0.13	100% groundwater	Gold mines in upper part of the basin
Energy	0.00	0.00	0.00	0.00		No power stations
Irrigation	0.00	0.00	0.00	0.00		WWF estimated 0.3 Mm3/year water use by non-engineered irrigation at Omnodelger soum.
Other	0.04	0.05	0.09	0.23		Tourism water demand
Total Demand	1.48	1.62	2.20	2.88	Medium scenario	
			2.06	2.63	Low scenario	
			2.42	3.05	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	259.0	230.8	
Groundwater	Pot.	Expl.	
Granular aquifers	344	0.6	Small deposit at Gurvan Bayan
Total Resources	603	231.3	Conclusion: Water resources exceed demand by far

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Onon River	1480	1319	1221	1088	259.0	230.8	Outflow to Russia

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers and lakes: no quality issues reported
Groundwater	• no quality issues reported
Vegetation	• Pasture: 56% of the basin area; condition is generally better than in other parts of Mongolia although due to overgrazing, top soil structure has been lost in 5000 ha • Forests: 33% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases
Ecology and biodiversity	Permanent freshwater lakes in the Khurkh-Khuiten Valley in Binder Soum are a Ramsar site. They are important for migratory waterfowl and support many endemic plants. The upstream north-western part of the basin is located in the forested Khan Khentii SPA. The central northern part of the basin is located in the Onon-Balj NP.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 23 rural area boreholes	1.2
	Local surveys to identify resources for 11 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 23 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Waste water treatment inadequate, not working or not available	Construction of high-tech WWTP in tourist camps near Onon and Balj rivers	1.3
Mineral springs are underused	Develop mineral spring at Onon	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 12 pasture management herder groups	2.1
	Establishment of and support to 3 irrigation management groups	2.2
Irrigation area to be extended	Construction of 20 ha irrigated area (indicative area)	2.2
	Renovation of 19 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Onon River by implementing state or local protection	4.1
River valleys are damaged due to mining	Make inventory, clean and reconstruct damaged and polluted river valleys in upper part of the Onon River	4.4

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 58 rural area boreholes	1.2
	Local surveys to identify resources for 11 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 58 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 23 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 45 ha irrigated area (indicative area)	2.2
	Renovation of 10 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Onon River by implementing state or local protection	4.1

Data by aimag:

Onon River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Khentii	27,050.9	95.8
Dornod	1,123.0	4.0
Tov	67.2	0.2
Total river basin area	28,241.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Khentii	478,201	558,645	572,303
Dornod	6,786	8,528	9,190
Tov	0	0	0
Total river basin area	484,987	567,173	581,492

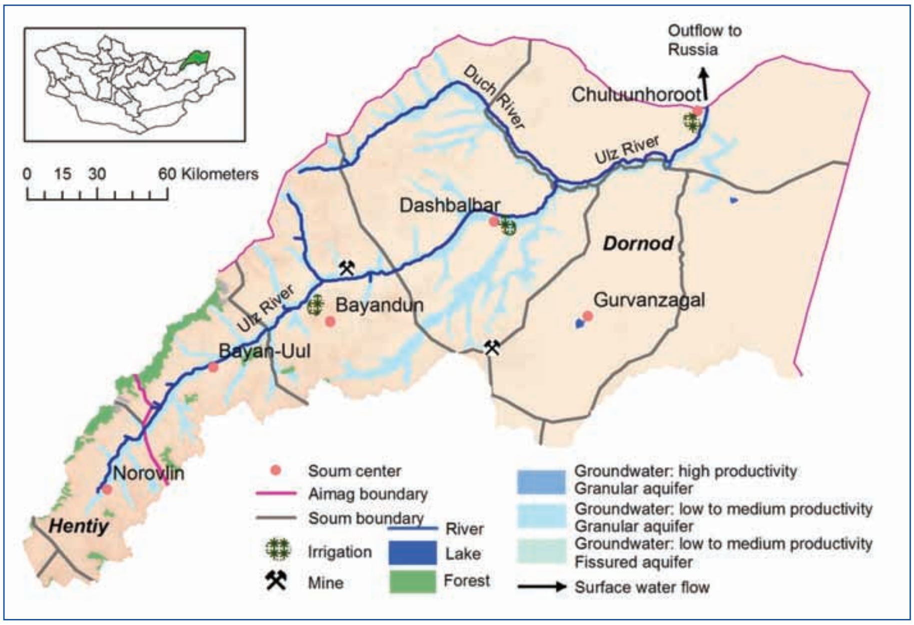
Onon River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Khentii	5,043	7,525	12,568	5,044	7,526	12,570	5,212	7,769	12,981
Dornod	0	183	183	0	181	181	0	187	187
Tov	0	0	0	0	0	0	0	0	0
Total river basin area	5,043	7,708	12,751	5,044	7,707	12,752	5,212	7,956	13,168

Data by soum:

Onon River basin population										
Aimag	Soum	2010		2015			2021			
		urban	rural	total	urban	rural	total	urban	rural	total
Dornod	Bayan-Uul	0	183	0	0	181	0	0	187	1,409
Khentii	Barshireet	1,027	1,095	0	1,027	1,095	0	1,061	1,132	1,085
	Bayan-adraga	1,323	1,089	0	1,323	1,089	0	1,367	1,125	1,317
	Binder	1,248	2,505	0	1,248	2,506	0	1,290	2,589	576
	Dadal	1,445	1,157	0	1,445	1,157	0	1,493	1,196	589
	Norivlin	0	72	7,708	0	72	7,871	0	75	569
	Umnudelger	0	1,473	0	0	1,473	0	0	1,522	945
	Kherlen	0	134	0	0	133	0	0	130	1,201
Total river basin		5,043	7,708	0	5,044	7,707	0	5,212	7,956	884

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Dornod	Bayan-Uul	1.123,0	19,8	10,5	6,786	8,528	9,190
Tov	Mungunmorit	67,2	0,0	0,0			
Khentii	Barnorov	225,7	4,5	0,0			
	Barshireet	6.824,1	97,0	100,0	48,822	65,434	75,609
	Bayan-adraga	2.864,4	94,0	100,0	67,443	81,350	83,988
	Binder	5.389,1	99,5	100,0	123,567	141,666	145,784
	Dadal	4.674,7	96,2	100,0	25,487	35,941	43,555
	Norivlin	618,4	11,2	5,9	5,035	6,145	6,404
	Umnudelger	5.980,8	54,5	64,6	193,461	212,381	202,139
	Kherlen	259,2	6,8	7,5	14,386	15,728	14,824
	Tsenkhermandal	214,3	6,7	0,0			
Total river basin		28.241,0			484,987	567,173	581,492

13. Ulz Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm^3/year					
Mining	2.99	3.43	12.11	16.03	100% groundwater	• Gold mines at Bayandun, metal and uranium at Dashbalbar
Livestock	1.43	1.29	1.88	2.29	50% groundwater 50% surface water	• From surface water; springs and groundwater supply points
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	50% groundwater 50% surface water	• Small demand for industries and transport
Drinking water	0.03	0.04	0.06	0.10	70% groundwater 30% surface water	• Surface water use is expected to reduce to 10% in 2021
Energy	0.00	0.00	0.00	0.00		• No power stations
Irrigation	0.00	0.00	0.00	0.00		• No engineered irrigation
Other	0.00	0.00	0.00	0.00		• No tourism water demand
Total Demand	4.56	4.89	14.21	18.62	Medium scenario	
			7.72	9.68	Low scenario	
			16.36	25.57	High scenario	

Water Resources	Mm^3/year		Remarks
Surface water	50%	10%	
Possible use	22.7	3.8	
Groundwater	Pot.	Expl.	
Granular aquifers	320	26.4	Major deposits in Ulz River aquifer
Total Resources	343	30.2	Conclusion: Water resources exceed demand by sufficient margin; additional groundwater resources required in future for mines

Surface water resources Mm^3/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Ulz River	130	22	107	18	22.7	3.8	Closed basin; outflow to Turey Lakes in Russia

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers and lakes: no quality issues reported
Groundwater	• no quality issues reported
Vegetation	• Pasture: 90% of the basin area; condition relatively stable • Forests: 2% of the basin area;
Ecology and biodiversity	• Mongol Daguur SPA consisting of wetlands, rivers and lakes in Chuluunkhoroot Soum is a Ramsar site. It supports a high species diversity with many endemic or rare plants. • Loss of habitat in lakes due to increased use by humans and livestock

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 2 soum centers (Bayanuul, Dashbalbar)	1.2
	Local surveys to identify resources for 19 rural area boreholes	1.2
	Local surveys to identify resources for 8 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2

Issues in the river basin	Measures until 2015	Chall.
Water supply infrastructure is inadequate	Construction of water supply in 2 soum centers (Bayanuul, Dashbalbar)	1.2
	Construction of 19 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 2 soum centers (Bayanuul, Dashbalbar)	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 9 pasture management herder groups	2.1
	Establishment of and support to 1 irrigation management group	2.2
Irrigation area to be extended	Construction of 70 ha irrigated area (indicative area)	2.2
	Renovation of 22 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Ulz River by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 47 rural area boreholes	1.2
	Local surveys to identify resources for 12 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Mardai, Gurvanbulag and Dornod mines	3.2
Water supply infrastructure is inadequate	Construction of 47 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
	Construction of water supply for Mardai, Gurvanbulag and Dornod mines including waste water treatment, storage and water reuse	3.2
Organisation of water supply O&M to be improved	Establishment of and support to 18 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 230 ha irrigated area (indicative area)	2.2
	Renovation of 44 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Ulz River by implementing state or local protection	4.1

Data by aimag:

Ulz River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Dornod	35,041.6	92.3
Khentii	2,919.4	7.7
	37,961.0	100.0
Total river basin area		

River basin livestock numbers			
Aimag	2010	2015	2021
Dornod	429,907	522,929	541,280
Khentii	36,522	44,575	46,458
Total river basin area	466,429	567,504	587,739

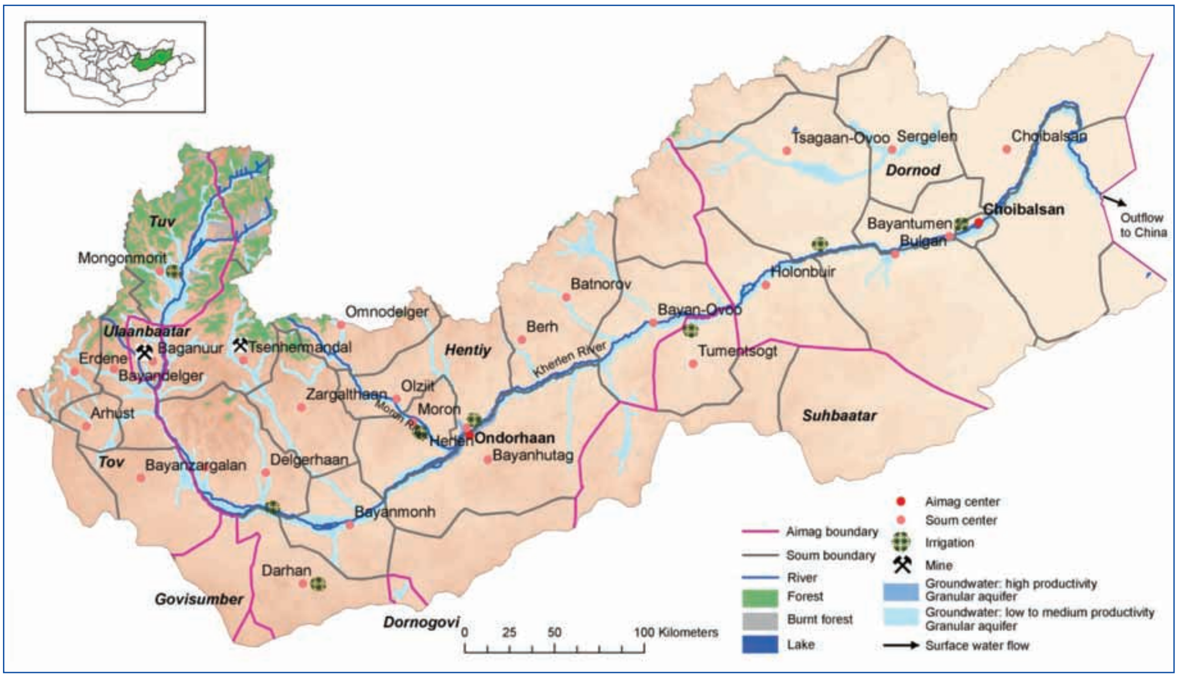
Ulz River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Dornod	6,158	7,347	13,505	6,098	7,276	13,374	6,298	7,514	13,811
Khentii	1,069	524	1,593	1,069	524	1,594	1,105	542	1,647
Total river basin area	7,227	7,871	15,098	7,168	7,800	14,967	7,403	8,055	15,458

Data by soum:

Ulz River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Dornod	Bayandun	1,211	1,674	2,885	1,199	1,658	2,857	1,238	1,712	2,950
	Bayan-Uul	2,654	972	3,626	2,628	963	3,591	2,714	994	3,708
	Gurvanzagal	453	901	1,354	449	892	1,341	463	921	1,385
	Dashbalbar	1,158	2,099	3,257	1,147	2,079	3,225	1,184	2,147	3,331
	Sergelen	0	59	59	0	59	59	0	61	61
	Choibalsan	0	693	693	0	686	686	0	708	708
	Chuluunkhoroot	682	949	1,631	675	940	1,615	697	971	1,668
Khentii	Norivlin	1,069	524	1,593	1,069	524	1,594	1,105	542	1,647
Total river basin		7,227	7,871	15,098	7,168	7,800	14,967	7,403	8,055	15,458

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Dornod	Bayandun	5.682,2	89,8	88,7	90,669	110,281	114,341
	Bayan-Uul	3.005,6	52,8	55,7	35,998	45,241	48,749
	Gurvanzagal	5.355,9	100,0	100,0	57,817	71,456	74,979
	Dashbalbar	8.891,2	100,0	100,0	157,187	188,805	192,463
	Sergelen	271,1	6,4	7,2	5,862	7,156	7,384
	Choibalsan	5.300,4	51,3	52,4	34,999	42,789	44,493
	Chuluunkhoroot	6.535,3	100,0	100,0	47,375	57,201	58,871
Khentii	Barnorov	176,2	3,5	0,0			
	Bayan-adraga	180,4	5,9	0,0			
	Dadal	185,3	3,8	0,0			
	Norivlin	2.377,4	42,9	42,8	36,522	44,575	46,458
Total river basin		37.961,0			466,429	567,504	587,739

14. Kherlen Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Mining	5.72	6.71	8.65	11.64	100% groundwater	Coal mine at Baganuur, gold mines at Tsenkhermandal
Livestock	7.19	6.49	7.16	7.68	50% groundwater 50% surface water	From surface water; springs and groundwater supply points
Irrigation	4.59	5.42	9.33	14.33	100% surface water	Vegetables and wheat
Energy	2.97	3.18	4.25	6.03	100% groundwater	Power station at Choibalsan
Drinking water	1.38	1.59	2.39	2.83	93% groundwater 7% surface water	Main demand at Ondorkhaan and Choibalsan; Surface water use is expected to reduce to 3% in 2021
Industry, transport, roads, construction	0.12	0.19	0.26	0.35	30% groundwater 70% surface water	Manufacturing industries at Choibalsan and Ondorkhaan
Other	0.05	0.06	0.11	0.26	100% groundwater	Tourism and green area water demand
Total Demand	22.02	23.65	32.14	43.12	Medium scenario	
			24.92	29.27	Low scenario	
			40.10	69.21	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	59.5	28.4	
Groundwater	Pot.	Expl.	
Granular aquifers	721	43.9	Several main groundwater deposits
Total Resources	781	72.3	Conclusion: Water resources exceed demand by sufficient margin

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Kherlen River	567	271	507	242	59.5	28.4	Outflow to China

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers and lakes: no quality issues reported; some pollution from domestic waste water possible downstream of Undurkhaan and Choibalsan; locally increase in turbidity possible due to trampling of river banks by livestock.
Groundwater	• no quality issues reported
Vegetation	• Pasture: 88% of the basin area; condition relatively stable except near urban centres • Forests: 3% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• The upstream part of the basin is located in the forested Khan Khentii SPA. • The lower part of the basin contains national reserves fro the protection of the gazelles.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in Undurkhaan and Choibalsan	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Baganuur for industrial water supply	3.1
	Local surveys to identify resources for 86 rural area boreholes	1.2
	Local surveys to identify resources for 37 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Baganuur	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Construction of 4 ponds for livestock water supply	2.1
	Construct separate water supply for industries at Choibalsan and Undurkhaan using industrial water sources or reused water	3.1
	Construction of water supply for Baganuur mine including waste water treatment, storage and water reuse	3.2
	Extension of water supply distribution system in Berkh soum	1.2
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Undurkhaan and Baganuur	1.1
	Construction of high-tech WWTP in tourist camps along Kherlen river	1.3
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Water supply and/or sanitation at army camp below standard	Installation of water supply, water treatment and sanitation at Delgerkhaan soum of Khentii aimag	1.1
Water supply infrastructure is inadequate	Construction of 86 rural area boreholes	1.2
Mineral springs are underused	Develop mineral spring at Avragatoson of Khentii aimag	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 43 pasture management herder groups	2.1
	Establishment of and support to 9 irrigation management groups	2.2
Irrigation area to be extended	Construction of 1311 ha irrigated area (indicative area)	2.2
	Renovation of 666 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Kherlen River by implementing state or local protection	4.1
	Regulate gold mining in upper part of Kherlen river	
Environmental flow to be maintained	Determine environmental flow and study effect on river flow regime due to planned dams in Kherlen River including dam for Kherlen-Gobi water transfer	4.3
Groundwater levels may be affected by mine dewatering	Monitoring of groundwater levels and regulation of groundwater abstraction and dewatering at Baganuur coal mine	4.3

Issues in the river basin	Measures in period 2016-2021	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in Baganuur	1.1
Water resources are not adequate	Local surveys to identify resources for 216 rural area boreholes	1.2
	Local surveys to identify resources for 42 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Undurkhaan and Choibalsan	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Construction of 216 rural area boreholes	1.2
	Construction of 7 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Choibalsan and Undurkhaan using industrial water sources or reused water	3.1
	Construction of water supply for Baganuur mine including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Choibalsan	1.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 87 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 1337 ha irrigated area (indicative area)	2.2
	Renovation of 1169 ha irrigated area (indicative area)	2.2
Groundwater levels may be affected by mine dewatering	Monitoring of groundwater levels and regulation of groundwater abstraction and dewatering at Baganuur coal mine	4.3
Runoff forming area needs better protection	Protect the watersheds of the Kherlen River by implementing state or local protection	4.1

Data by aimag:

Kherlen River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Khentii	43,866.9	40.7
Dornod	37,974.2	35.2
Tov	11,983.7	11.1
Sukhbaatar	11,370.9	10.5
Gobi-Sumber	1,608.5	1.5
Ulaanbaatar	605.9	0.6
Dornogobi	496.0	0.5
Total river basin area	107,906.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Khentii	1,518,020	1,615,646	1,495,254
Dornod	516,471	622,688	643,188
Tov	358,084	412,994	409,282
Sukhbaatar	214,396	184,643	163,408
Gobi-Sumber	48,095	50,420	45,291
Ulaanbaatar	83,393	97,614	97,067
Dornogobi	9,375	6,975	6,009
Total river basin area	2,747,834	2,990,979	2,859,498

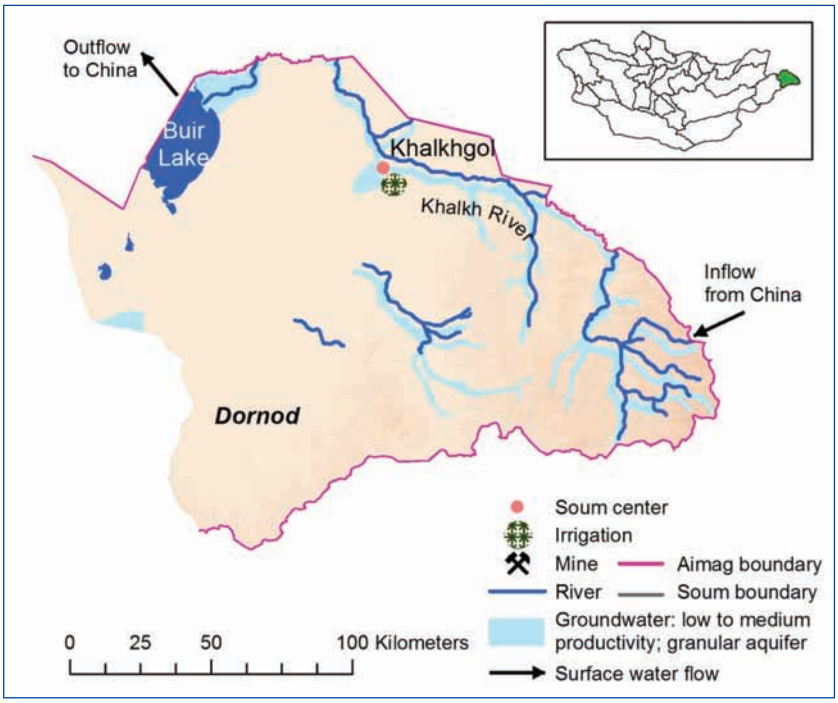
Kherlen River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Khentii	39,390	14,442	53,832	39,400	14,437	53,837	40,709	14,831	55,540
Dornod	46,790	8,182	54,972	46,336	8,109	54,445	47,852	8,315	56,167
Tov	4,280	4,765	9,045	4,217	4,695	8,912	4,325	4,815	9,140
Sukhbaatar	1,070	3,811	4,881	1,070	3,812	4,882	1,104	3,933	5,037
Gobi-Sumber	0	624	624	0	645	645	0	686	686
Ulaanbaatar	26,905	0	26,905	31,611	0	31,611	35,525	0	35,525
Dornogobi	0	166	166	0	177	177	0	188	188
Total river basin area	118,435	31,990	150,425	122,634	31,875	154,510	129,515	32,768	162,283

Data by soum:

Kherlen River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Dornogobi	Dalanjargalan	0	114	114	0	122	122	0	129	129
	Ikh-khet	0	52	52	0	55	55	0	59	59
Dornod	Bayandun	0	213	213	0	211	211	0	218	218
	Bayantumen	882	1,155	2,037	873	1,150	2,023	902	1,128	2,030
	Bayan-Uul	0	590	590	0	584	584	0	603	603
		1,065	637	1,702	1,055	631	1,686	1,089	652	1,741
	Sergelen	1,311	765	2,076	1,298	757	2,056	1,341	782	2,123
	Khulunbuir	690	1,025	1,715	683	1,015	1,698	706	1,048	1,754
	Kherlen	40,283	698	40,981	39,892	691	40,583	41,198	714	41,911
	Tsagaan-Ovoo	1,202	2,470	3,672	1,190	2,446	3,636	1,229	2,526	3,755
	Choibalsan	1,357	629	1,986	1,344	623	1,967	1,388	644	2,031
Sukhbaatar	Munkh-khaan	0	1,409	1,409	0	1,409	1,409	0	1,454	1,454
	Sukhbaatar	0	1,085	1,085	0	1,085	1,085	0	1,120	1,120
	Tumentsogt	1,070	1,317	2,387	1,070	1,317	2,388	1,104	1,359	2,463
	Arkhust	682	576	1,258	672	568	1,240	689	582	1,271
	Bayan	0	589	589	0	581	581	0	596	596
	Bayandelger	677	569	1,246	667	561	1,228	684	575	1,260
	Bayanjargalan	580	945	1,525	572	931	1,503	586	955	1,541
	Mungunmorit	882	1,201	2,083	869	1,183	2,052	891	1,214	2,105
Tov	Erdene	1,459	884	2,343	1,438	871	2,309	1,474	893	2,367
Khentii	Barnorov	4,044	1,977	6,021	4,045	1,977	6,023	4,179	2,043	6,223
	Bayanmunkh	909	661	1,570	909	661	1,570	939	683	1,623
	Bayanovoo	761	941	1,702	761	941	1,702	786	972	1,759
	Bayankhutag	517	1,579	2,096	517	1,579	2,097	534	1,632	2,166
	Galshir	0	649	649	0	650	650	0	671	671
	Darkhan	9,432	1,110	10,542	9,434	1,110	10,544	9,748	1,147	10,894
	Delgerkhaan	1,411	1,020	2,431	1,411	1,020	2,432	1,458	1,054	2,512
	Jargaltkhaan	622	1,356	1,978	622	1,356	1,978	643	1,401	2,044
	Murun	640	1,214	1,854	640	1,214	1,854	661	1,255	1,916
	Norivlin	0	628	628	0	629	629	0	649	649
	Umnudelger	2,939	807	3,746	2,940	807	3,747	3,037	834	3,872
	Kherlen	17,272	1,647	18,919	17,276	1,640	18,916	17,850	1,608	19,459
	Tsenkhermandal	843	852	1,695	843	852	1,695	871	881	1,752
Ulaanbaatar	Baganuur	26,905	0	26,905	31,611	0	31,611	35,525	0	35,525
Gobi-Sumber	Gobi-sumber	0	624	624	0	645	645	0	686	686
Total river basin		118,435	31,990	150,425	122,634	31,875	154,510	129,515	32,768	162,283

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Dornogobi	Dalanjargalan	245,2	6,1	6,1	5,025	3,797	3,360
	Ikh-khet	250,8	6,0	6,0	4,350	3,177	2,649
Dornod	Bayandun	639,8	10,2	11,3	11,551	14,049	14,567
	Bayantumen	8.465,5	99,8	100,0	77,892	96,110	100,764
	Bayan-Uul	1.546,2	27,4	33,8	21,844	27,453	29,582
	Bulgan	6.799,0	95,3	95,0	61,838	76,023	79,393
	Matad	972,0	4,2	0,0			
	Sergelen	3.930,3	93,6	92,8	75,559	92,235	95,178
	Khulunbuir	3.812,0	100,0	100,0	60,594	75,133	79,084
	Kherlen	287,4	100,0	100,0	74,447	81,126	79,809
	Tsagaan-Ovoo	6.533,8	100,0	100,0	100,953	121,687	124,394
	Choibalsan	4.988,1	48,7	47,6	31,793	38,870	40,417
Sukhbaatar	Munkh-khaan	3.716,8	50,0	46,5	86,996	61,834	54,840
	Sukhbaatar	5.485,6	42,7	43,3	69,172	68,216	60,668
	Tumentsogt	2.168,4	100,0	100,0	58,227	54,593	47,900
Tov	Arkhust	823,8	100,0	100,0	30,927	33,335	31,141
	Bayan	1.117,5	37,8	36,2	19,247	20,345	18,863
	Bayandelger	1.882,7	86,9	92,6	98,356	115,512	114,871
	Bayanjargalan	2.747,1	95,3	95,0	88,242	95,205	88,349
	Mungunmorit	4.042,5	60,5	100,0	64,946	81,551	87,965
	Sergelen	147,7	3,9	0,0			
	Erdene	1.222,4	15,1	37,9	56,366	67,046	68,093
Khentii	Barnorov	4.591,6	92,0	100,0	196,956	214,559	205,813
	Barshireet	21,0	0,3	0,0			
	Bayan-adraga	3,0	0,1	0,0			
	Bayanmunkh	2.546,6	100,0	100,0	82,030	82,400	72,543
	Bayanovoo	3.387,3	100,0	100,0	74,017	74,223	65,880
	Bayankhutag	6.035,1	100,0	100,0	188,448	195,470	175,367
	Binder	26,9	0,5	0,0			
	Galshir	2.816,1	42,1	41,6	65,873	66,057	58,086
	Darkhan	2.909,1	64,5	62,9	94,044	96,170	84,918
	Delgerkhaan	3.832,5	100,0	100,0	127,353	136,302	124,925
	Jargaltkhaan	2.859,5	100,0	100,0	128,591	131,614	117,027
	Murun	2.221,3	100,0	100,0	114,723	115,830	102,883
	Norivlin	2.521,6	45,9	51,3	43,775	53,428	55,685
	Umnudelger	3.592,3	32,9	35,4	106,015	116,382	110,770
	Kherlen	3.534,3	93,2	92,5	177,431	193,977	182,824
	Tsenkhermandal	2.968,7	93,3	100,0	118,765	139,234	138,534
Ulaanbaatar	Baganuur	605,2	100,0	100,0	83,393	97,614	97,067
	Nalaikh	0,7	0,1	0,0			
Gobi-Sumber	Bayantal	1,8	0,2	0,0			
	Gobi-sumber	1.606,7	42,9	41,9	48,095	50,420	45,291
Total river basin			107.906,0		2,747,834	2,990,979	2,859,498

15. Buir Lake - Khalkh Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	0.47	0.56	0.96	1.47	100% surface water	• Large irrigation projects planned along Khalkh river which will use groundwater
Livestock	0.19	0.21	0.33	0.43	60% groundwater 40% surface water	• From surface water; springs and groundwater supply points
Drinking water	0.01	0.01	0.01	0.02	86% groundwater 14% surface water	• Surface water use is expected to reduce to 5% in 2021
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	100% groundwater	• Small demand for industries and transport
Energy	0.00	0.00	0.00	0.00		• No power stations
Mining	0.00	0.00	0.00	0.00		• No mining
Other	0.01	0.01	0.02	0.03	100% groundwater	• Green area water demand
Total Demand	0.78	0.91	1.48	2.15	Medium scenario	
			1.19	1.57	Low scenario	
			1.69	2.68	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	102.3	54.9	
Groundwater	Pot.	Expl.	
Granular aquifers	198	1.1	Small deposit at Tamsag Bulag
Total Resources	300	56.0	Conclusion: Water resources exceed demand by far

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Khalkh River	1023	549	920	494	102.3	54.9	Inflow from and outflow to China

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported • Lakes: no quality issues reported
Groundwater	• no quality issues reported
Vegetation	• Pasture: 90% of the basin area; condition relatively stable • No forests in the basin area;
Ecology and biodiversity	• Freshwater Buir Lake is a Ramsar site which straddles the border with China. It regulates the Khalkh River water regime featuring flora and fauna characteristic of the arid steppe. • The Nomrog SPA in the south-east of the basin is established to protect the specific ecosystem of Khyangan, and the wildlife and biodiversity species of Manjuur. • The Eastern Steppe SPA in the south-west of the basin is established for the protection of the gazelle.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Khalkhgol)	1.2
	Local surveys to identify resources for 10 rural area boreholes	1.2
	Local surveys to identify resources for 4 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of water supply in1 soum center (Khalkhgol)	1.2
	Construction of 10 rural area boreholes	1.2
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 1 soum center (Khalkhgol)	1.2
Water supply and/or sanitation at border post below standard	Investigate water resources and improve water supply at border posts: Kharkhonit in Khalkh-Gol soum, Avdarant in Sumber soum of Dornod aimag	1.1
Organisation of water supply O&M to be improved	Establishment of and support to 5 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 50 ha irrigated area (indicative area)	2.2
	Renovation of 116 ha irrigated area (indicative area)	2.2
Loss of habitat in lakes due to increased use	No control on commercial fishing in Buir Lake	4.3
Drop in lake level of Buir Lake	Create special protected areas to protect and restore rivers and lakes with changing ecological conditions	4.4

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 26 rural area boreholes	1.2
	Local surveys to identify resources for 7 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 26 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 10 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 70 ha irrigated area (indicative area)	2.2
	Renovation of 131 ha irrigated area (indicative area)	2.2

Data by soum:

Buir Lake - Khalkh River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Dornod	23,756.0	100.0
Total river basin area	23,756.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Dornod	55,268	72,302	81,175
Total river basin area	55,268	72,302	81,175

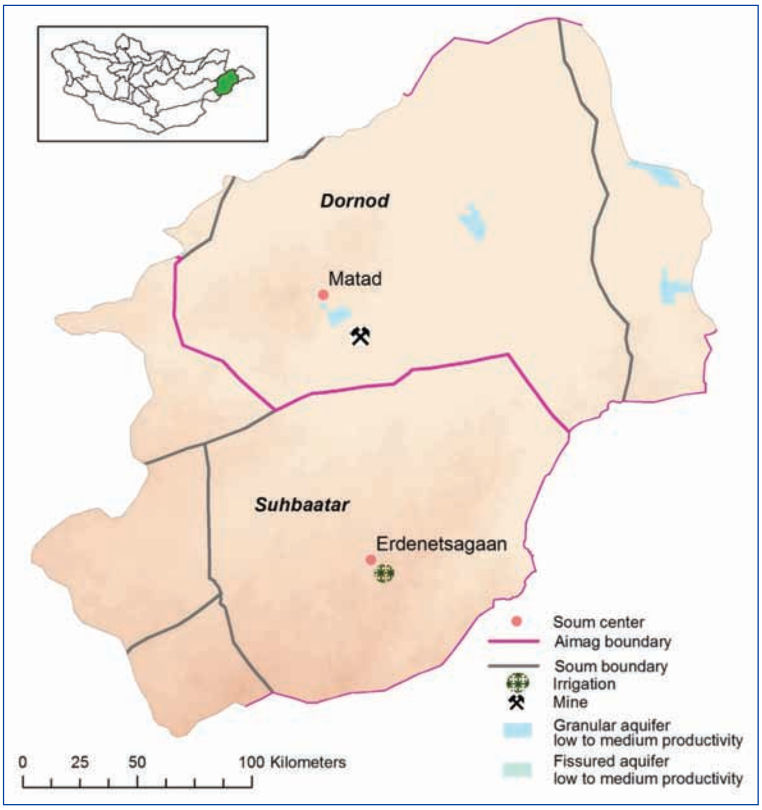
Buir Lake - Khalkh River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Dornod	1,835	1,208	3,043	1,817	1,196	3,013	1,877	1,235	3,112
Total river basin area	1,835	1,208	3,043	1,817	1,196	3,013	1,877	1,235	3,112

Data by aimag:

Buir Lake - Khalkh River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
	Khalkhgol	1,835	1,208	3,043	1,817	1,196	3,013	1,877	1,235	3,112
Total river basin		1,835	1,208	3,043	1,817	1,196	3,013	1,877	1,235	3,112

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin		Livestock numbers		
						2010	2015	2021
Dornod	Khalkhgol	23.756,0	82,7	83,3		55,268	72,302	81,175
Total river basin		23.756,0				55,268	72,302	81,175

16. Menengiin Tal Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	1.23	1.35	1.19	1.18	100% groundwater	• Mainly from shallow and deep wells
Mining	0.20	0.86	0.01	0.02	100% groundwater	• Oil at Matad soum but no demand included in future
Drinking water	0.02	0.03	0.04	0.07	100% groundwater	
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	100% groundwater	• Small demand for industries and transport
Energy	0.00	0.00	0.00	0.00		• No power stations
Irrigation	0.00	0.00	0.00	0.00		• No irrigation
Other	0.01	0.01	0.02	0.03	100% groundwater	• Green area water demand
Total Demand	1.57	2.37	1.42	1.50	Medium scenario	
			1.34	1.40	Low scenario	
			1.63	1.73	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	0	0.0	No surface water available except at springs and temporary rivers and lakes
Groundwater	Pot.	Expl.	
Granular/fissured aquifers	168	0.1	Small deposit at Matad soum; shallow groundwater resources not included in exploitable resources
Total Resources	168	0.1	Conclusion: exploitable groundwater resources to be increased to cover demand

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no permanent rivers • Lakes: seasonal shallow lakes only
Groundwater	• No quality issues reported
Vegetation	• Pasture: 95% of the basin area; condition relatively stable • No forests in the basin area; • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• The Eastern Steppe SPA in the south-east of the basin is established for the protection of the gazelle. • Loss of habitat in lakes due to increased use by humans and livestock

Issues in the river basin	Measures until 2015	Chall.
Water resources are not adequate	Local surveys to identify resources for 29 rural area boreholes	1.2
	Local surveys to identify resources for 14 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 29 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Water supply and/or sanitation at border post below standard	Investigate water resources and improve water supply at border post at Kholboo Zalaa in Erdenetsagaan soum of Sukhbaatar aimag; Arbulag in Matad soum of Dornod aimag	1.1
Organisation of water supply O&M to be improved	Establishment of and support to 19 pasture management herder groups	2.1
	Establishment of and support to 2 irrigation management groups	2.2
Irrigation area to be extended	Construction of 23 ha irrigated area (indicative area)	2.2
	Renovation of 10 ha irrigated area (indicative area)	2.2

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Erdenetsagaan)	1.2
	Local surveys to identify resources for 72 rural area boreholes	1.2
	Local surveys to identify resources for 16 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of water supply in1 soum center (Erdenetsagaan)	1.2
	Construction of 72 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 1 soum center (Erdenetsagaan)	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 37 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 2 ha irrigated area (indicative area)	2.2
	Renovation of 10 ha irrigated area (indicative area)	2.2

Data by aimag:

Menengiin Tal River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Dornod	27,561.2	51.0
Sukhbaatar	26,520.8	49.0
Total river basin area	54,082.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Dornod	104,850	132,951	143,843
Sukhbaatar	348,326	305,468	285,573
Total river basin area	453,176	438,418	429,416

Menengiin Tal River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Dornod	809	1,961	2,770	801	1,942	2,743	827	2,005	2,833
Sukhbaatar	2,889	5,810	8,699	2,890	5,812	8,701	2,981	5,996	8,978
Total river basin area	3,698	7,771	11,469	3,691	7,753	11,444	3,809	8,001	11,810

Data by soum:

Menengiin Tal River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Dornod	Bulgan	0	34	34	0	33	33	0	34	34
	Matad	809	1,685	2,494	801	1,669	2,470	827	1,723	2,551
	Khalkhgol	0	242	242	0	240	240	0	248	248
Sukhbaatar	Asgat	0	653	653	0	653	653	0	674	674
	Dariganga	0	974	974	0	974	974	0	1,005	1,005
	Sukhbaatar	0	589	589	0	589	589	0	608	608
	Erdenetsagaan	2,889	3,594	6,483	2,890	3,595	6,485	2,981	3,709	6,690
Total river basin		3,698	7,771	11,469	3,691	7,753	11,444	3,809	8,001	11,810

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Dornod	Bayantumen	17,0	0,2	0,0			
	Bulgan	336,3	4,7	5,0	3,255	4,001	4,179
	Matad	22.238,3	95,8	100,0	90,515	114,455	123,390
	Khalkhgol	4.969,6	17,3	16,7	11,080	14,495	16,274
Sukhbaatar	Asgat	4.201,5	57,6	57,7	55,354	41,155	60,826
	Dariganga	2.092,6	43,0	42,8	57,439	39,878	33,293
	Sukhbaatar	3.015,3	23,4	23,5	37,541	37,023	32,926
	Erdenetsagaan	17.211,4	100,0	100,0	197,991	187,412	158,528
Total river basin		54.082,0			453,176	438,418	429,416

17. Umard Goviin Guveet-Khalkhiin Dundad Tal Basin

Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	9.36	7.83	6.83	6.74	100% groundwater	• Mainly from shallow and deep wells
Drinking water	1.91	2.10	2.90	3.46	100% groundwater	• Main demand in aimag centers
Mining	0.81	0.36	3.49	3.98	100% groundwater	• Coal at Shivee Gobi, uranium at Nyalga, Metal at Tumurtei, fluorspar at Bor Ondor
Irrigation	0.62	0.73	1.25	1.92	100% groundwater	• Small irrigation projects distributed over the basin
Industry, transport, roads, construction	0.45	0.62	0.86	1.24	100% groundwater	• Demand from concentrator at Tumurtei and industries at aimag centers
Energy	0.16	0.33	0.44	0.62	100% groundwater	• Energy plants at aimag centers
Other	0.05	0.06	0.11	0.26	100% groundwater	• Green area water demand
Total Demand	13.36	12.03	15.87	18.23	Medium scenario	
			13.23	14.37	Low scenario	
			19.51	26.14	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	0	0.0	No surface water available except at springs and temporary rivers and lakes
Groundwater	Pot.	Expl.	
Granular/fissured aquifers	433	46.7	Many deposits distributed in the basin
Total Resources	433	46.7	Conclusion: groundwater resources are sufficient to cover the demand

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no permanent rivers • Lakes: seasonal shallow lakes only
Groundwater	• High mineralization due to low recharge
Vegetation	• Pasture: 99% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests (saxaul): <1% of the basin area; • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• The basin has two NR for the protection of the argali and gazelle

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in aimag centers	1.1
Water resources are not adequate	Surveys to identify new or verify existing water resources for drinking water and industrial water supply in Mandalgobi, Choir and Bor Undur	1.1 3.1
	Local surveys to identify resources for 2 soum centers (Airag, Ikhet)	1.2
	Local surveys to identify resources for 148 rural area boreholes	1.2
	Local surveys to identify resources for 68 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Shivee Ovoo mine	3.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Choir, Sainshand and Bor Undur for drinking water and industrial water supply	1.1 3.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Extension of water supply distribution system in Shivee Govi soum	1.1
	Construction of water supply in2 soum centers (Airag, Ikhet)	1.2
	Construction of 148 rural area boreholes	1.2
	Construction of 6 ponds for livestock water supply	2.1
	Construct separate water supply for industries at Sainshand using industrial water sources or reused water	3.1
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP centers Baruun Urt, Mandalgobi and Choir and Bor Undur	1.1
	Construction of small WWTP at 2 soum centers (Airag, Ikhet)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Mineral springs are underused	Develop mineral spring at Khalzan-Uul springs of Dornogovi aimag	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 88 pasture management herder groups	2.1
	Establishment of and support to 11 irrigation management group	2.2
Irrigation area to be extended	Construction of 167 ha irrigated area (indicative area)	2.2
	Renovation of 59 ha irrigated area (indicative area)	2.2
Groundwater levels may be affected by mine dewatering	Monitoring of groundwater levels and regulation of groundwater abstraction and dewatering at mines	4.3

Issues in the river basin	Measures in period 2016-2021	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in Bor Undur and Zamiin Uud	1.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Baruun Urt, Sainshand and urban area of Bor Undur	1.1
	Local surveys to identify resources for 5 soum centers (Erdenedalai, Govi-Ugtaal, Gurvansaikhan of Dundgovi aimag, Munkhaan of Sukhbaatar aimag, Buren of Tuv aimag)	1.2
	Local surveys to identify resources for 371 rural area boreholes	1.2
	Local surveys to identify resources for 89 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Tumurtein mine	3.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources Baruun Urt, Mandalgobi, Sainshand	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in all urban areas	1.1
	Construction of water supply in 5 soum centers (Erdenedalai, Govi-Ugtaal, Gurvansaikhan of Dundgovi aimag, Munkhaan of Sukhbaatar aimag, Buren of Tuv aimag)	1.2
	Construction of 371 rural area boreholes	1.2
	Construction of 14 ponds for livestock water supply	2.1
	Construct separate water supply for industries at Sainshand using industrial water sources or reused water	3.1
	Construction of water supply for Shivee Ovoo and Tumurtein mines including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Sainshand	1.1
	Construction of small WWTP at 5 soum centers (Erdenedalai, Govi-Ugtaal, Gurvansaikhan of Dundgovi aimag, Munkhaan of Sukhbaatar aimag, Buren of Tuv aimag)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 176 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 193 ha irrigated area (indicative area)	2.2
	Renovation of 70 ha irrigated area (indicative area)	2.2
Groundwater levels may be affected by mine dewatering	Monitoring of groundwater levels and regulation of groundwater abstraction and dewatering at mines	4.3

Data by aimag:

Umard Goviin Guveet-Khalkhiin Dundad Tal Basin River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Dundgobi	69,227.6	38.3
Dornogobi	40,919.3	22.7
Sukhbaatar	26,226.4	14.5
Tov	19,329.8	10.7
Uvurkhangai	8,966.1	5.0
Umnugobi	6,314.2	3.5
Khentii	5,483.3	3.0
Gobi-Sumber	3,932.8	2.2
Ulaanbaatar	155.5	0.1
Total river basin area	180,555.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Dundgobi	1,078,720	1,056,735	1,011,577
Dornogobi	506,723	384,226	368,467
Sukhbaatar	859,948	747,046	844,406
Tov	517,109	581,444	558,260
Uvurkhangai	351,383	397,773	381,155
Umnugobi	31,472	35,003	33,820
Khentii	147,945	149,457	131,630
Gobi-Sumber	105,128	106,324	105,594
Ulaanbaatar	10,774	12,821	12,980
Total river basin area	3,609,201	3,470,829	3,447,889

Umard Goviin Guveet-Khalkhiin Dundad Tal Basin River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Dundgobi	19,215	24,351	43,566	18,745	23,818	42,563	19,006	24,046	43,052
Dornogobi	26,840	7,143	33,983	28,636	7,621	36,257	30,459	8,107	38,566
Sukhbaatar	18,751	11,933	30,684	18,756	11,936	30,692	19,351	12,315	31,666
Tov	2,047	8,381	10,428	2,017	8,258	10,275	2,068	8,468	10,537
Uvurkhangai	2,521	8,889	11,410	2,497	8,803	11,300	2,575	9,078	11,653
Umnugobi	591	1,008	1,599	591	1,008	1,599	610	1,040	1,650
Khentii	584	1,566	2,150	584	1,566	2,151	604	1,618	2,222
Gobi-Sumber	12,081	1,803	13,884	12,481	1,862	14,344	13,276	1,981	15,257
Ulaanbaatar	3,647	0	3,647	4,285	0	4,285	4,815	0	4,815
Total river basin area	86,277	65,074	151,351	88,591	64,873	153,465	92,764	66,653	159,418

Data by soum:

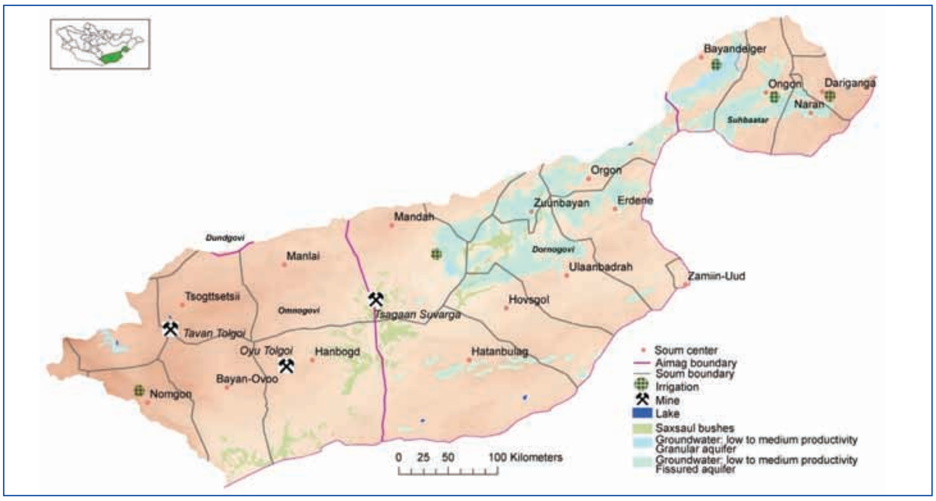
Umard Goviin Guveet-Khalkhiin Dundad Tal Basin River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Dornogobi	Airag	2,560	1,039	3,599	2,731	1,109	3,840	2,905	1,179	4,084
	Altanshiree	368	935	1,303	393	998	1,390	418	1,061	1,479
	Dalanjargalan	713	1,754	2,467	761	1,871	2,632	809	1,991	2,800
	Delgerekh	405	1,392	1,797	432	1,485	1,917	460	1,580	2,039
	Ikh-khet	1,279	813	2,092	1,365	868	2,232	1,451	923	2,374
	Mandakh	0	172	172	0	184	184	0	196	196
	Urgun	0	382	382	0	408	408	0	434	434
	Saikhandulaan	368	656	1,024	393	699	1,092	418	744	1,162
	Sainshand	21,147	0	21,147	22,562	0	22,562	23,998	0	23,998
Dundgobi	Adaatsag	539	2,549	3,088	526	2,487	3,012	533	2,521	3,054
	Bayanjargalan	469	708	1,177	458	691	1,148	464	700	1,164
	Gobi-Ugtaal	750	848	1,598	732	827	1,559	742	839	1,581
	Gurvansaikhan	452	1,820	2,272	441	1,775	2,216	447	1,800	2,247
	Delgerkhangai	824	649	1,473	804	633	1,437	815	642	1,457
	Delgertsogt	457	1,256	1,713	446	1,225	1,671	452	1,242	1,694
	Deren	559	1,654	2,213	545	1,614	2,159	553	1,636	2,189
	Luus	712	1,335	2,047	695	1,302	1,997	704	1,320	2,025
	Ulziit	428	1,961	2,389	418	1,913	2,331	423	1,940	2,363
	Undurshil	780	768	1,548	761	749	1,510	772	760	1,531
	Saintsagaan	10,320	3,189	13,509	10,067	3,174	13,241	10,208	3,114	13,321
	Saikhanovoo	0	1,101	1,101	0	1,074	1,074	0	1,089	1,089
	Khuld	926	1,348	2,274	903	1,315	2,218	916	1,333	2,249
	Tsagaandelger	345	678	1,023	337	661	998	341	671	1,012
	Erdenedalai	1,654	4,487	6,141	1,614	4,377	5,991	1,636	4,438	6,074
	Manlai	0	99	99	0	99	99	0	102	102
	Khankhongor	0	116	116	0	116	116	0	120	120
Umnugobi	Tsogt-Ovoo	591	792	1,383	591	792	1,383	610	817	1,427

Umard Goviin Guveet-Khalkhiin Dundad Tal Basin River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Sukhbaatar	Asgat	666	334	1,000	666	334	1,000	687	345	1,032
	Baruun-Urt	14,297	2,437	16,734	14,301	2,438	16,738	14,755	2,515	17,269
	Bayandelger	0	1,148	1,148	0	1,148	1,148	0	1,185	1,185
	Munkh-khaan	1,184	1,621	2,805	1,184	1,621	2,806	1,222	1,673	2,895
	Sukhbaatar	638	832	1,470	638	832	1,470	658	859	1,517
	Tuvshinshiree	630	2,431	3,061	630	2,432	3,062	650	2,509	3,159
	Uulbayan	755	2,111	2,866	755	2,112	2,867	779	2,179	2,958
	Khalzan	581	1,019	1,600	581	1,019	1,600	600	1,052	1,651
	Altanbulag	0	115	115	0	113	113	0	116	116
	Bayan	383	1,039	1,422	377	1,023	1,401	387	1,050	1,437
	Bayanjargalan	0	50	50	0	49	49	0	50	50
	Bayan-Unjuul	0	758	758	0	747	747	0	766	766
	Bayantsagaan	405	1,507	1,912	399	1,485	1,884	409	1,523	1,932
	Buren	572	1,998	2,570	564	1,969	2,533	578	2,019	2,597
	Delgerkhaan	687	990	1,677	677	975	1,652	694	1,000	1,695
	Sergelen	0	1,065	1,065	0	1,050	1,050	0	1,076	1,076
Tov	Erdenesant	0	858	858	0	846	846	0	867	867
Khentii	Galshir	584	912	1,496	584	912	1,496	604	942	1,546
	Darkhan	0	654	654	0	655	655	0	676	676
Ulaanbaatar	Bagakhangai	3,647	0	3,647	4,285	0	4,285	4,815	0	4,815
Gobi-Sumber	Bayantal	398	466	864	411	481	893	437	512	949
	Gobi-sumber	9,207	866	10,073	9,512	894	10,407	10,118	951	11,069
	Shivee-gobi	2,476	471	2,947	2,558	487	3,045	2,721	518	3,239
Uvurkhangai	Bayangol	0	524	524	0	519	519	0	535	535
	Bayan-Undur	1,855	2,024	3,879	1,837	2,005	3,842	1,894	2,067	3,962
	Burd	0	165	165	0	163	163	0	168	168
	Zuil	0	1,368	1,368	0	1,355	1,355	0	1,397	1,397
	Z-Bayan-Ulaan	0	656	656	0	650	650	0	670	670
	Ulziit	0	1,384	1,384	0	1,370	1,370	0	1,413	1,413
	Sant	666	2,768	3,434	660	2,741	3,401	680	2,827	3,507
Total river basin		86,277	65,074	151,351	88,591	64,873	153,465	92,764	66,653	159,418

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Dornogobi	Airag	7.481,9	100,0	100,0	68,008	37,050	34,057
	Altanshiree	7.229,3	100,0	100,0	69,918	47,893	58,448
	Dalanjargalan	3.780,8	93,9	93,9	77,358	58,455	51,721
	Delgerekh	4.838,9	100,0	100,0	127,110	135,567	126,294
	Ikh-khet	3.936,3	94,0	94,0	68,148	49,775	41,497
	Mandakh	1.964,4	15,5	15,9	10,312	7,551	10,304
	Urgun	4.240,1	50,4	50,7	34,182	16,379	13,527
	Saikhandulaan	7.262,8	75,8	75,7	47,965	30,236	31,883
	Sainshand	184,7	8,0	7,1	3,722	1,319	735
Dundgobi	Adaatsag	3.335,8	100,0	100,0	88,999	90,534	78,888
	Bayanjargalan	3.182,4	100,0	100,0	62,272	42,956	52,310
	Gobi-Ugtaal	2.706,3	100,0	100,0	76,532	62,055	96,475
	Gurvansaikhan	5.458,1	100,0	100,0	101,908	106,822	95,642
	Delgerkhangai	2.576,8	41,7	41,6	13,031	14,594	14,011
	Delgertsogt	2.532,4	100,0	100,0	51,327	52,096	45,582
	Deren	3.574,8	100,0	100,0	68,031	69,182	61,111
	Luus	3.150,5	100,0	100,0	53,853	56,258	50,845
	Ulziit	15.343,9	99,5	100,0	85,413	87,939	76,833
	Undurshil	4.847,8	100,0	100,0	73,678	46,021	50,932
	Saintsagaan	3.352,1	100,0	100,0	110,054	111,962	98,175
	Saikhanovoo	2.380,9	58,4	58,6	20,518	22,668	21,011
	Khuld	6.025,2	99,4	100,0	71,869	80,518	76,255
	Tsagaandelger	3.448,9	100,0	100,0	42,816	43,575	38,573
	Erdenedalai	7.311,7	100,0	100,0	158,419	169,554	154,933
Umnugobi	Manlai	707,0	5,7	5,7	4,117	4,606	4,429
	Khankhongor	619,4	6,0	6,3	3,924	4,260	3,935
	Tsogt-Ovoo	4.965,9	75,9	76,0	23,431	26,137	25,455
	Tsogt-tsetsii	21,8	0,3	0,0			

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Sukhbaatar	Asgat	2.156,1	29,6	29,5	28,301	21,041	31,098
	Baruun-Urt	60,0	100,0	100,0	181,351	177,492	155,019
	Bayandelger	2.595,0	34,1	34,0	91,460	96,388	131,307
	Munkh-khaan	3.723,0	50,0	53,5	100,093	71,142	63,096
	Ongon	105,0	1,5	0,0			
	Sukhbaatar	4.362,4	33,9	33,2	53,037	52,304	46,517
	Tuvshinshiree	4.423,1	100,0	100,0	171,570	171,218	214,602
	Uulbayan	4.975,2	100,0	100,0	145,321	93,218	112,299
	Khalzan	3.826,5	100,0	100,0	88,815	64,243	90,468
Tov	Altanbulag	339,8	6,0	5,6	7,456	8,795	8,802
	Bayan	1.841,9	62,2	63,8	33,921	35,857	33,245
	Bayanjargalan	135,7	4,7	5,0	4,644	5,011	4,650
	Bayan-Unjuul	2.549,6	53,2	53,9	82,846	95,457	92,833
	Bayantsagaan	5.878,1	100,0	100,0	72,970	77,275	71,295
	Buren	2.993,1	79,8	81,5	138,766	159,183	154,052
	Delgerkhaan	2.164,7	99,9	100,0	60,853	69,935	67,908
	Sergelen	2.545,6	67,1	71,2	44,798	47,555	44,601
	Erdenesant	881,4	26,0	28,4	70,854	82,376	80,874
Khentii	Galshir	3.879,5	57,9	58,4	92,475	92,734	81,543
	Darkhan	1.603,8	35,5	37,1	55,469	56,723	50,087
Ulaanbaatar	Bagakhangai	155,5	100,0	100,0	10,774	12,821	12,980
Gobi-Sumber	Bayantal	889,7	99,8	100,0	17,922	20,246	19,270
	Gobi-sumber	2.142,1	57,1	58,1	66,690	69,914	62,802
	Shivee-gobi	901,0	100,0	100,0	20,516	16,164	23,522
Uvurkhangai	Bayangol	507,8	14,5	14,5	14,199	15,919	15,000
	Bayan-Undur	3.013,2	85,6	84,1	137,136	158,430	154,415
	Burd	168,9	6,4	6,6	12,015	13,836	13,403
	Zuil	969,1	49,3	57,4	53,343	56,845	52,223
	Z-Bayan-Ulaan	459,8	18,3	19,3	11,861	13,720	13,448
	Ulziit	1.236,1	62,7	63,5	55,731	64,755	63,438
	Sant	2.611,2	99,6	100,0	67,098	74,268	69,230
Total river basin		180.555,0			3,609,201	3,470,829	3,447,889

18. Galba-Uush-Doloodiin Govi Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	3.92	4.09	3.93	4.12	100% groundwater	Mainly from shallow and deep wells
Mining	0.00	0.51	21.73	36.86	100% groundwater	Oyu Tolgoi, Tavan Tolgoi, Tsagaan Suvarga and other mines
Irrigation	0.21	0.25	0.43	0.67	100% groundwater	Small irrigation projects distributed over the basin
Drinking water	0.10	0.14	0.25	0.49	100% groundwater	Domestic water demand at mines included in mine water demand estimate
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	100% groundwater	Nominal demand from transport
Energy	0.00	0.00	0.00	0.00	100% groundwater	power stations (18 mW) at Ukhaa khudag
Other	0.05	0.06	0.11	0.26	100% groundwater	Tourism and green area water demand
Total Demand	4.38	5.17	26.60	42.59	Medium scenario	
			15.40	23.63	Low scenario	
			32.34	52.29	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	0	0.0	No surface water except at springs and temporary rivers and lakes
Groundwater	Pot.	Expl.	
Granular / fissured aquifers	352	59.0	Many deposits distributed in the basin
Total Resources	352	59.0	Conclusion: Groundwater resources exceed demand but need further exploration to cover increasing mining demand

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no permanent rivers • Lakes: seasonal shallow lakes only
Groundwater	• High mineralization due to low recharge; too high natural concentrations of Cyanide and Arsenic reported
Vegetation	• Pasture: 98% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests (saxaul): 2% of the basin area; • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	The two areas of the Small Gobi SPA in the south are established to protect rare wildlife. Brackish shallow Ganga Lake and surrounding wetlands at Dariganga Soum is a Ramsar site. It supports many water birds.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources at Tsogtsetsii	1.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Zamiin Uud for drinking water and industrial water supply	1.1 3.1
	Local surveys to identify resources for 2 soum centers (Manlai, Zuunbayan)	1.2
	Local surveys to identify resources for 66 rural area boreholes	1.2
	Local surveys to identify resources for 29 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Tsagaan Suvarga, Oyu Tolgoi and Tavan Tolgoi mines, including thermal power plants	3.2

Issues in the river basin	Measures until 2015	Chall.
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Khanbogd and Zamiin Uud	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in urban areas	1.1
	Construction of water supply in 2 soum centers (Manlai, Zuunbayan)	1.2
	Construction of 66 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construction of water supply for Tsagaan Suvarga, Oyu Tolgoi and Tavan Tolgoi mines including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network at Khanbogd	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Khanbogd and Zamiin Uud	1.1
	Construction of small WWTP at 2 soum centers (Manlai, Zuunbayan)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Water supply and/or sanitation at border post below standard	Investigate water resources and improve water supply at border posts: Ingensevstei, Uushig, Sainsuuj in Ulaanbadrakh soum, Uzuur-Us in Erdene soum, Khukhbulag in Urgun soum and Khetsuu-Uul in Khatanbulag soum of Dornogovi aimag; Tsagaan-Ovoo in Bayandelger soum, Bayantukhum, Lamt in Dariganga soum, Kholboo Zalaa in Erdenetsagaan soum of Sukhbaatar aimag; Buduun Mod in Bayan-Ovoo soum of Umnogovi aimag	1.1
Organisation of water supply O&M to be improved	Establishment of and support to 32 pasture management herder groups	2.1
	Establishment of and support to 4 irrigation management groups	2.2
Irrigation area to be extended	Construction of 40 ha irrigated area (indicative area)	2.2
	Renovation of 98 ha irrigated area (indicative area)	2.2
Groundwater levels may be affected by mine dewatering	Monitoring of groundwater levels and regulation of groundwater abstraction and dewatering at mines	4.3

Issues in the river basin	Measures in period 2016-2021	Chall.
Water sources are vulnerable to pollution	Protection of water sources in urban areas	1.1
Water resources are not adequate	Surveys to identify new water resources at Khanbogd	1.1
	Local surveys to identify resources for 1 soum center (Ongon)	1.2
	Local surveys to identify resources for 166 rural area boreholes	1.2
	Local surveys to identify resources for 40 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Oyu Tolgoi mines	3.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Tsogtsetsii	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in urban areas	1.1
	Construction of water supply in 1 soum center (Ongon)	1.2
	Construction of 166 rural area boreholes	1.2
	Construction of 6 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construction of water supply for Tsagaan Suvarga, Oyu Tolgoi and Tavan Tolgoi mines including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in all urban areas	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Tsogtsetsii	1.1
	Construction of small WWTP at 1 soum center (Ongon)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 64 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 34 ha irrigated area (indicative area)	2.2
	Renovation of 118 ha irrigated area (indicative area)	2.2
Groundwater levels may be affected by mine dewatering	Monitoring of groundwater levels and regulation of groundwater abstraction and dewatering at mines	4.3

Data by aimag:

Galba-Uush-Doloodiin Govi River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Dornogobi	68,370.1	48.1
Umnugobi	54,794.2	38.5
Sukhbaatar	19,045.5	13.4
Dundgobi	77.2	0.1
Total river basin area	142,287.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Dornogobi	540,680	470,084	446,884
Umnugobi	296,505	328,492	314,101
Sukhbaatar	557,121	552,806	592,835
Dundgobi	0	0	0
Total river basin area	1,394,306	1,351,382	1,353,820

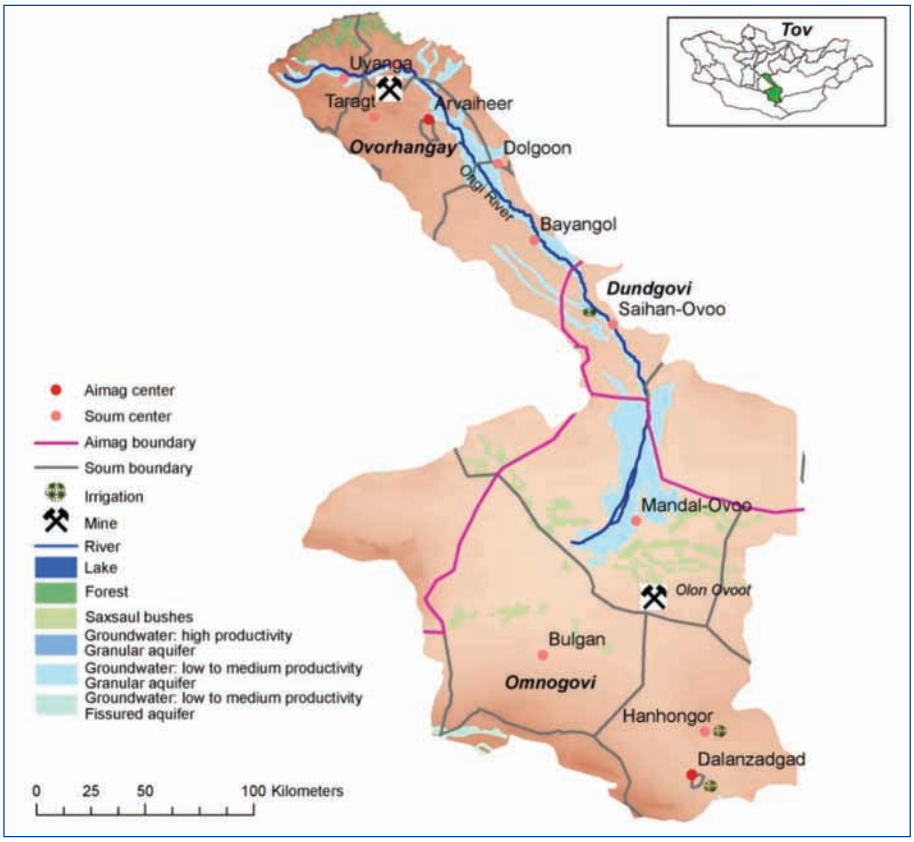
Galba-Uush-Doloodiin Govi River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Dornogobi	18,447	7,176	25,623	19,681	7,656	27,337	20,934	8,143	29,078
Umnugobi	4,966	8,028	12,994	18,981	8,030	27,011	37,044	8,285	45,329
Sukhbaatar	3,395	7,193	10,588	3,396	7,194	10,590	3,504	7,423	10,926
Dundgobi	0	0	0	0	0	0	0	0	0
Total river basin area	26,808	22,396	49,204	42,059	22,880	64,939	61,482	23,851	85,333

Data by soum:

Galba-Uush-Doloodiin Govi River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Dornogobi	Zamiin-Uud	13,799	0	13,799	14,722	0	14,722	15,660	0	15,660
	Mandakh	424	912	1,336	452	973	1,425	481	1,035	1,516
	Urgun	1,121	372	1,493	1,196	397	1,593	1,272	422	1,694
	Saikhandulaan	0	210	210	0	225	225	0	239	239
	Sainshand	0	0	0	0	0	0	0	0	0
	Ulaanbadrakh	360	1,182	1,542	384	1,261	1,645	409	1,341	1,750
	Khatanbulag	584	2,512	3,096	623	2,680	3,303	663	2,851	3,513
	Khuvsgul	385	1,180	1,565	411	1,259	1,670	437	1,339	1,776
	Erdene	1,774	808	2,582	1,893	862	2,755	2,013	917	2,930
Umnugobi	Bayanovoo	641	959	1,600	641	959	1,600	662	990	1,651
	Manlai	700	1,642	2,342	700	1,642	2,342	722	1,694	2,417
	Nomgon	640	533	1,173	640	533	1,173	660	550	1,210
	Khanbogd	1,455	2,067	3,522	10,000	2,068	12,067	20,000	2,133	22,133
	Khankhongor	0	835	835	0	836	836	0	862	862
	Khurmen	0	83	83	0	83	83	0	86	86
	Tsogt-Ovoo	0	73	73	0	73	73	0	75	75
	Tsogt-tsetsii	1,530	1,836	3,366	7,000	1,836	8,837	15,000	1,895	16,895
Sukhbaatar	Asgat	0	145	145	0	145	145	0	150	150
	Bayandelger	1,214	2,229	3,443	1,214	2,229	3,444	1,253	2,300	3,553
	Dariganga	607	1,302	1,909	607	1,302	1,909	626	1,344	1,970
	Naran	345	1,148	1,493	345	1,148	1,493	356	1,185	1,541
	Ongon	1,229	2,369	3,598	1,229	2,370	3,599	1,268	2,445	3,713
Total river basin		26,808	22,396	49,204	42,059	22,880	64,939	61,482	23,851	85,333

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Dornogobi	Zamiin-Uud	485,5	100,0	100,0	19,921	22,776	22,215
	Mandakh	10.722,9	84,5	84,1	54,545	39,941	54,501
	Urgun	4.178,3	49,6	49,3	33,239	15,927	13,154
	Saikhandulaan	2.321,8	24,2	24,3	15,397	9,706	10,235
	Sainshand	2.127,0	92,0	92,9	48,696	17,261	9,620
	Ulaanbadrakh	11.716,6	100,0	100,0	86,978	95,121	88,966
	Khatanbulag	18.734,1	100,0	100,0	148,972	165,480	155,815
	Khuvsgul	8.438,6	100,0	100,0	72,320	69,908	58,515
	Erdene	9.645,4	100,0	100,0	60,612	33,965	33,865
Dundgobi	Ulziit	77,2	0,5	0,0			
Umnugobi	Bayanovoo	10.801,8	96,7	100,0	46,611	51,025	47,856
	Manlai	11.712,6	94,3	94,3	68,107	76,198	73,279
	Nomgon	4.319,8	23,4	24,7	17,254	17,557	14,948
	Khanbogd	14.976,1	100,0	100,0	96,084	108,357	107,408
	Khankhongor	4.465,7	43,2	45,2	28,153	30,566	28,233
	Khurmen	810,2	6,4	6,7	4,084	4,358	3,973
	Tsogt-Ovoo	445,5	6,8	7,0	2,158	2,407	2,345
	Tsogt-tsetsii	7.262,6	99,7	100,0	34,054	38,023	36,060
Sukhbaatar	Asgat	933,6	12,8	12,8	12,280	9,130	13,493
	Bayandelger	5.021,5	65,9	66,0	177,541	187,106	254,891
	Dariganga	2.773,7	57,0	57,2	76,764	53,295	44,494
	Naran	3.414,0	100,0	100,0	105,855	117,360	114,117
	Ongon	6.902,7	98,5	100,0	184,682	185,916	165,839
Total river basin		142.287,0			1,394,306	1,351,382	1,353,820

19. Ongi Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	2.84	1.49	1.88	2.14	65% groundwater 35% surface water	• From surface water; springs and groundwater supply points
Mining	1.01	1.22	1.55	2.07	50% groundwater 50% surface water	• Gold mines in upper part of basin and at Olon Ovoot
Irrigation	0.74	0.87	1.50	2.30	80% surface water 20% groundwater	• Small irrigation projects along Ongi river
Energy	0.81	0.92	1.23	1.74	100% groundwater	• Power stations at Dalanzadgad
Drinking water	0.62	0.70	1.08	1.35	95% groundwater 5% surface water	• Main demand at Arvakheer; Surface water use is expected to reduce to 2% in 2021
Industry, transport, roads, construction	0.07	0.07	0.09	0.12	100% groundwater	• Small industries at Arvakheer
Other	0.03	0.03	0.05	0.12	100% groundwater	• Tourism and green area water demand
Total Demand	6.12	5.30	7.37	9.85	Medium scenario	
			5.99	7.15	Low scenario	
			8.98	14.93	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	1.0	0.3	
Groundwater	Pot.	Expl.	
Granular / fissured aquifer	294	5.8	Deposits at Arvakheer and in southern part of the basin
Total Resources	295	6.1	Conclusion: Water resources not enough to cover demand; further exploration of groundwater resources are required

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Ongi River	25.7	8.0	24.7	7.7	1.0	0.3	Closed basin, runoff decreases in downstream direction; Ongi river discharges into Ulaan Lake in some years;

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: pollution from mining activities but concentrations are low • Lakes: Ulaan lake has dried up
Groundwater	• High mineralization due to low recharge in southern part of the basin
Vegetation	• Pasture: 96% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests: Cedar, Larch 1%, Saxaul: 3% of the basin area; • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• The Gobi Gurvan Saikhan NP in the south of the basin contains mountains and steppe significant as tourist destination

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in Arvakheer and Dalanzadgad	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Dalanzadgad for drinking water and industrial water supply	1.1 3.1
	Local surveys to identify resources for 28 rural area boreholes	1.2
	Local surveys to identify resources for 14 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Olon Ovoot mine	3.2
Water supply infrastructure is inadequate	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in aimag centers	1.1
	Construction of 28 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construction of water supply for Olon Ovoot mine including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag centers	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP in Dalanzadgad	1.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 23 pasture management herder groups	2.1
	Establishment of and support to 2 irrigation management groups	2.2
Irrigation area to be extended	Construction of 101 ha irrigated area (indicative area)	2.2
	Renovation of 50 ha irrigated area (indicative area)	2.2
Risk of disasters by flooding	Rehabilitate, construct and maintain flood protection facilities at Arvakheer	4.5
Runoff forming area needs better protection	Protect the watersheds of the Ongi River by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Bayangol)	1.2
	Local surveys to identify resources for 69 rural area boreholes	1.2
	Local surveys to identify resources for 19 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Olon Ovoot mine	3.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources in Dalanzadgad	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in aimag centers	1.1
	Construction of water supply in 1 soum center (Bayangol)	1.2
	Construction of 69 rural area boreholes	1.2
	Construction of 3 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construction of water supply for Olon Ovoot mine including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag centers	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP in Arvakheer	1.1
	Construction of small WWTP at 1 soum center (Bayangol)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 46 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 321 ha irrigated area (indicative area)	2.2
	Renovation of 183 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Ongi River by implementing state or local protection	4.1

Data by aimag:

Ongi River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Umnugobi	21,688.5	54.6
Uvurkhangai	12,701.1	32.0
Dundgobi	5,334.4	13.4
Total river basin area	39,724.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Umnugobi	183,254	200,538	188,619
Uvurkhangai	336,091	378,143	359,917
Dundgobi	32,789	36,502	34,513
Total river basin area	552,134	615,183	583,050

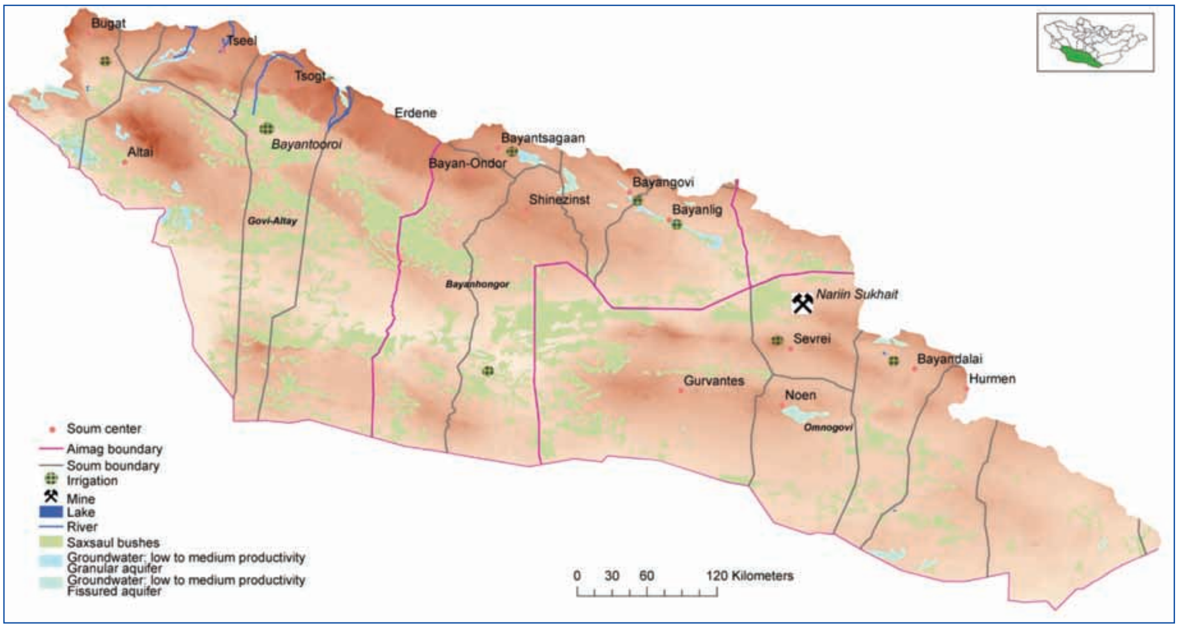
Ongi River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Umnugobi	19,992	4,634	24,626	19,997	4,635	24,632	20,632	4,782	25,414
Uvurkhangai	30,805	13,855	44,660	30,506	13,721	44,227	31,459	14,149	45,609
Dundgobi	658	1,690	2,348	642	1,648	2,290	651	1,671	2,322
Total river basin area	51,455	20,178	71,633	51,145	20,003	71,148	52,742	20,602	73,344

Data by soum:

Ongi River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Dundgobi	Delgerkhangai	0	912	912	0	889	889	0	902	902
	Saikhanovoo	658	778	1,436	642	759	1,401	651	769	1,420
Umnugobi	Bayandalai	0	187	187	0	187	187	0	193	193
	Bulgan	863	1,462	2,325	863	1,462	2,326	891	1,509	2,399
	Dalanzadgad	17,907	839	18,746	17,911	839	18,751	18,480	866	19,346
	Mandal-Ovoo	819	1,072	1,891	819	1,072	1,891	845	1,106	1,952
	Khankhongor	403	896	1,299	403	897	1,300	416	925	1,341
	Tsogt-Ovoo	0	177	177	0	177	177	0	183	183
Uvurkhangai	Arvaikheer	25,777	1,783	27,560	25,527	1,766	27,293	26,325	1,821	28,146
	Bayangol	809	2,667	3,476	801	2,641	3,442	826	2,724	3,550
	Bogd	0	1,646	1,646	0	1,630	1,630	0	1,681	1,681
	Z-Bayan-Ulaan	766	2,057	2,823	759	2,037	2,796	782	2,101	2,883
	Taragt	558	2,130	2,688	553	2,110	2,662	570	2,176	2,746
	Tugrug	0	304	304	0	301	301	0	311	311
	Uyanga	2,895	3,267	6,162	2,867	3,235	6,102	2,957	3,336	6,293
Total river basin		51,455	20,178	71,633	51,145	20,003	71,148	52,742	20,602	73,344

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Dundgobi	Delgerkhangai	3.602,2	58,3	58,4	18,294	20,487	19,669
	Saikhanovoo	1.695,8	41,6	41,4	14,495	16,015	14,844
	Khuld	36,4	0,6	0,0			
Umnugobi	Bayandalai	1.043,4	9,8	10,7	9,914	10,455	9,242
	Bulgan	7.454,0	100,0	100,0	55,485	60,679	56,283
	Dalanzadgad	23,2	100,0	100,0	34,705	36,679	32,579
	Mandal-Ovoo	6.468,8	99,8	100,0	47,700	54,082	54,526
	Sevrei	310,8	3,8	0,0			
	Khankhongor	5.243,9	50,8	48,5	30,208	32,798	30,294
	Khurmen	12,6	0,1	0,0			
	Tsogt-Ovoo	1.131,8	17,3	17,0	5,241	5,846	5,694
Uvurkhangai	Arvaikheer	49,2	100,0	100,0	53,643	59,664	55,758
	Bat-Ulzii	10,4	0,4	0,0			
	Bayangol	2.581,0	73,7	73,8	72,266	81,020	76,343
	Bogd	3.313,8	33,1	35,0	62,530	65,407	56,969
	Z-Bayan-Ulaan	1.512,4	60,2	60,5	37,182	43,008	42,155
	Sant	10,5	0,4	0,0			
	Taragt	2.777,7	79,1	78,5	43,395	49,104	46,695
	Tugrug	970,0	17,8	15,9	6,848	7,706	7,359
	Uyanga	1.443,1	47,4	48,3	60,226	72,234	74,638
	Khairkhandulaan	33,0	0,8	0,0			
Total river basin		39.724,0			552,134	615,183	583,050

20. Altain Uvur Gobi Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	3.91	2.96	3.36	3.47	100% groundwater	• Mainly from shallow and deep wells
Irrigation	2.45	2.89	4.97	7.64	100% groundwater	• Large old irrigation systems near Bayantooroi
Mining	0.05	0.06	1.70	3.40	100% groundwater	• Coal mine at Nariin Sukhait
Drinking water	0.09	0.11	0.14	0.22	100% groundwater	• Main demand at Arvakheer; Surface water use is expected to reduce to 2% in 2021
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	100% groundwater	• Nominal demand from transport
Energy	0.00	0.00	0.00	0.00		• No power stations
Other	0.03	0.03	0.05	0.12	100% groundwater	• Tourism and green area water demand
Total Demand	6.61	6.17	10.39	15.05	Medium scenario	
			8.04	10.34	Low scenario	
			12.64	19.73	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	0	0.0	No surface water except at springs and temporary rivers and lakes
Groundwater	Pot.	Expl.	
Granular/fissured aquifers	337	65.5	Many deposits especially in central and eastern part of basin
Total Resources	337	65.5	Conclusion: Water resources exceed demand by sufficient margin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported • Lakes: ……….
Groundwater	• High mineralization due to low recharge in many parts of the basin
Vegetation	• Pasture: 87% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests (saxaul): 15% of the basin area; • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• The areas of the Small Gobi SPA in the south-east and of the Great Gobi SPA in the south-west are established to protect rare wildlife (wild ass, Gobi bear, ibex, argali, o.a.). • The Gobi Gurvan Saikhan NP contains mountains and steppe significant as tourist destination. • Loss of habitat in lakes due to increased use by humans and livestock

Issues in the river basin	Measures until 2015	Chall.
Water resources are not adequate	Local surveys to identify resources for 2 soum centers (Bayantsagaan, Gurvantes)	1.2
	Local surveys to identify resources for 109 rural area boreholes	1.2
	Local surveys to identify resources for 52 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Nariin Sukhait mine	3.2
Water supply infrastructure is inadequate	Construction of water supply in 2 soum centers (Bayantsagaan, Gurvantes)	1.2
	Construction of 109 rural area boreholes	1.2
	Construction of 4 ponds for livestock water supply	2.1
	Rehabilitation of 4 ponds for livestock water supply	2.1
	Construction of water supply for Nariin Sukhait mine including waste water treatment, storage and water reuse	3.2
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 2 soum centers (Bayantsagaan, Gurvantes)	1.2
Water supply and/or sanitation at army camp below standard	Improve water supply and water treatment at Bayanlig army camp of Bayankhongor aimag	1.1
Water supply and/or sanitation at border post below standard	Investigate water resources and improve water supply at border posts in Khuvd in Gurvantes soum, Jaalshand in Nomgon soum of Umnogovi aimag; Urgustui in Altai soum, unit 171 in Erdene soum of Govi-Altai aimag; Khatan Suudal in Shinejinst soum of Bayankhongor aimag	1.1
Organisation of water supply O&M to be improved	Establishment of and support to 72 pasture management herder groups	2.1
	Establishment of and support to 5 irrigation management groups	2.2
Irrigation area to be extended	Construction of 96 ha irrigated area (indicative area)	2.2
	Renovation of 226 ha irrigated area (indicative area)	2.2
Groundwater levels may be affected by mine dewatering	Monitoring of groundwater levels and regulation of groundwater abstraction and dewatering at mines	4.3

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Altai)	1.2
	Local surveys to identify resources for 273 rural area boreholes	1.2
	Local surveys to identify resources for 62 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Nariin Sukhait mine	3.2
Water supply infrastructure is inadequate	Construction of water supply in 1 soum center (Altai)	1.2
	Construction of 273 rural area boreholes	1.2
	Construction of 9 ponds for livestock water supply	2.1
	Rehabilitation of 4 ponds for livestock water supply	2.1
	Construction of water supply for Nariin Sukhait mine including waste water treatment, storage and water reuse	3.2
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 1 soum center (Altai)	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 143 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 300 ha irrigated area (indicative area)	2.2
	Renovation of 456 ha irrigated area (indicative area)	2.2
Groundwater levels may be affected by mine dewatering	Monitoring of groundwater levels and regulation of groundwater abstraction and dewatering at mines	4.3

Data by aimag:

Altain Uvur Gobi River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Umnugobi	85,713.6	38.8
Gobi-Altai	77,159.3	34.9
Bayankhongor	53,839.8	24.3
Uvurkhangai	4,443.2	2.0
Total river basin area	221,156.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Umnugobi	499,097	515,470	445,296
Gobi-Altai	374,328	389,594	337,403
Bayankhongor	354,952	364,904	314,454
Uvurkhangai	70,749	74,003	64,456
Total river basin area	1,299,126	1,343,970	1,161,609

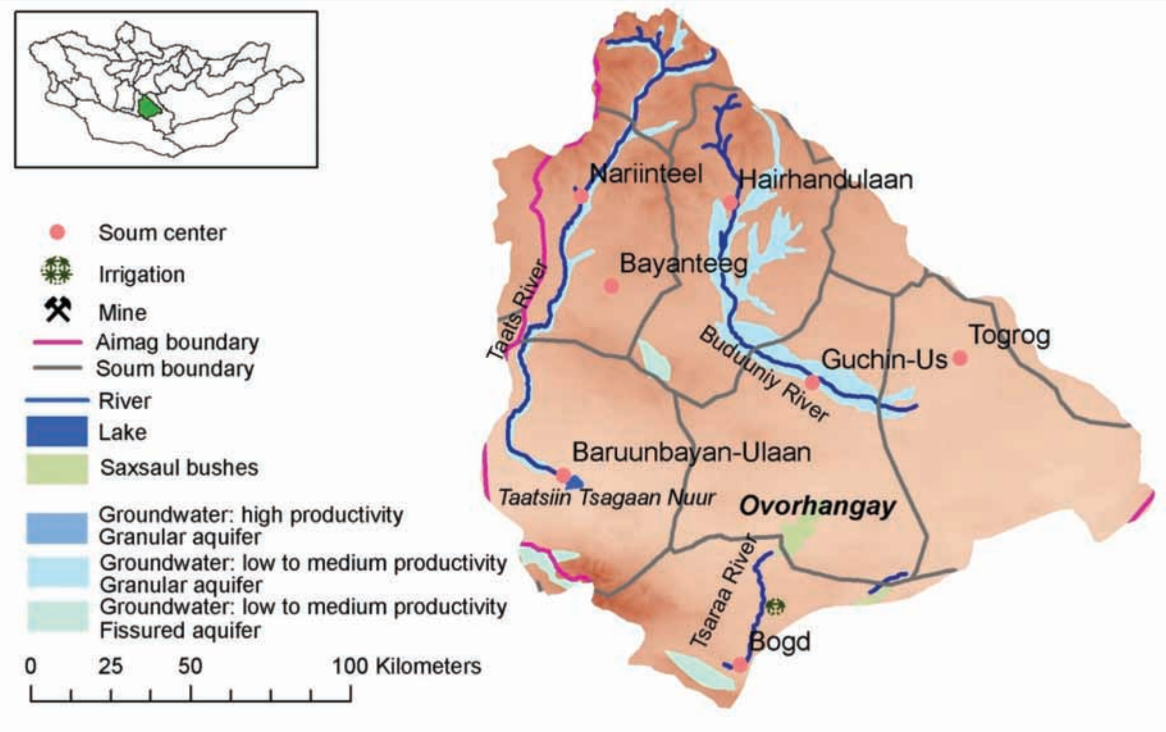
Altain Uvur Gobi River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Umnugobi	4,493	8,595	13,088	4,494	8,597	13,091	4,637	8,870	13,507
Gobi-Altai	2,645	9,053	11,698	2,672	9,146	11,818	2,735	9,363	12,098
Bayankhongor	2,609	8,623	11,232	2,571	8,497	11,068	2,648	8,751	11,399
Uvurkhangai	0	1,862	1,862	0	1,844	1,844	0	1,902	1,902
Total river basin area	9,747	28,134	37,881	9,737	28,084	37,821	10,020	28,885	38,905

Data by soum:

Aimag	Soum	Altain Uvur Gobi River basin population								
		2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bayankhongor	Bayangovi	655	1,967	2,622	645	1,939	2,584	665	1,997	2,661
	Bayanlig	583	1,640	2,223	574	1,616	2,190	592	1,664	2,256
	Bayan-Undur	554	1,941	2,495	546	1,913	2,458	562	1,970	2,532
	Bayantsagaan	569	1,080	1,649	561	1,064	1,625	577	1,096	1,674
	Shinejinst	248	1,995	2,243	244	1,966	2,210	252	2,025	2,276
Gobi-Altai	Altai	506	1,570	2,076	511	1,586	2,097	523	1,624	2,147
	Bugat	340	1,119	1,459	343	1,131	1,474	352	1,157	1,509
	Tugrug	0	363	363	0	367	367	0	376	376
	Tsogt	1,162	2,424	3,586	1,174	2,449	3,623	1,202	2,507	3,709
	Tseel	282	1,569	1,851	285	1,585	1,870	292	1,622	1,914
	Erdene	355	2,008	2,363	359	2,029	2,387	367	2,077	2,444
Umnugobi	Bayandalai	544	1,562	2,106	544	1,562	2,106	561	1,612	2,173
	Gurvantes	2,495	1,748	4,243	2,496	1,748	4,244	2,575	1,804	4,379
	Noyon	385	930	1,315	385	930	1,315	397	960	1,357
	Nomgon	0	1,624	1,624	0	1,625	1,625	0	1,676	1,676
	Sevrei	555	1,571	2,126	555	1,571	2,127	573	1,621	2,194
	Khurmen	514	1,160	1,674	514	1,160	1,674	530	1,197	1,727
Uvurkhangai	Bogd	0	1,862	1,862	0	1,844	1,844	0	1,902	1,902
Total river basin		9,747	28,134	37,881	9,737	28,084	37,821	10,020	28,885	38,905

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Bayankhongor	Bayangovi	4.582,7	94,2	93,6	79,170	80,729	68,200
	Bayanlig	11.753,6	94,5	95,0	99,780	104,811	94,454
	Bayan-Undur	17.805,0	99,9	100,0	73,678	74,947	63,279
	Bayantsagaan	2.294,4	39,6	38,9	32,564	33,720	28,937
	Bogd	169,3	4,1	0,0			
	Shinejinst	17.234,7	100,0	100,0	69,760	70,696	59,583
Gobi-Altai	Altai	21.254,2	100,0	100,0	38,382	39,313	33,422
	Biger	7,9	0,2	0,0			
	Bugat	6.506,7	61,8	62,8	36,376	38,394	33,794
	Tugrug	1.247,9	21,9	24,6	18,544	20,092	18,400
	Tsogt	16.953,2	96,9	100,0	119,191	124,948	109,269
	Tseel	5.361,5	90,8	91,3	65,444	67,998	58,691
	Erdene	25.828,0	98,5	100,0	96,391	98,848	83,828
Umnugobi	Bayandalai	9.995,5	90,2	89,3	82,743	87,253	77,135
	Bayanovoo	383,1	3,3	0,0			
	Gurvantes	29.157,3	100,0	100,0	101,201	102,340	86,111
	Noyon	10.989,5	100,0	100,0	116,852	119,001	100,153
	Nomgon	14.697,7	76,6	75,3	52,599	53,525	45,569
	Sevrei	8.188,5	96,2	100,0	88,834	92,662	81,002
	Khurmen	12.302,0	93,5	93,3	56,868	60,689	55,326
Uvurkhangai	B-Bayan-Ulaan	4,1	0,1	0,0			
	Bogd	4.439,1	42,6	39,6	70,749	74,003	64,456
Total river basin			221.156,0		1,299,126	1,343,970	1,161,609

21. Taats Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	2.00	1.32	1.65	1.81	65% groundwater 35% surface water	From surface water; springs and groundwater supply points
Irrigation	0.22	0.26	0.44	0.68	80% surface water 20% groundwater	Small irrigation projects along the Taats and Buduunly rivers
Drinking water	0.05	0.06	0.08	0.14	58% groundwater 42% surface water	Surface water use is expected to reduce to 20% in 2021
Industry, transport, roads, construction	0.05	0.06	0.08	0.10	100% groundwater	Nominal demand from transport
Energy	0.00	0.00	0.00	0.00	100% groundwater	No power stations
Mining	0.00	0.00	0.00	0.00	50% groundwater 50% surface water	No mining
Other	0.03	0.03	0.05	0.12	100% groundwater	Tourism and green area water demand
Total Demand	2.34	1.72	2.30	2.85	Medium scenario	
			2.09	2.48	Low scenario	
			2.77	3.46	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	0.9	0.3	Based on runoff Taats river only
Groundwater	Pot.	Expl.	
Granular/fissured aquifers	61	0.5	Only three deposits explored
Total Resources	62	0.8	Conclusion: groundwater resources need further exploration to cover the demand

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Taats River	22	7	20.8	6.6	0.9	0.3	Closed basins; runoff decreases in downstream direction; Taats river discharges in some years into Taatsiin Tsagaan Lake

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported • Lakes: Taatsiin Tsagaan has dried up
Groundwater	• High mineralization due to low recharge in southern part of the basin

Vegetation	• Pasture: 99% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests (saxaul): 1% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• Saline Taatsiin Tsagaan Lake is part of the Valley of Lakes Ramsar site. It is important for migratory water fowl. It also provides water for livestock in a dry arid region.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 30 rural area boreholes	1.2
	Local surveys to identify resources for 17 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 30 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 31 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 118 ha irrigated area (indicative area)	2.2
	Renovation of 72 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Taats River by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 2 soum centers (Khairkhandulaan, Guchin-Us)	1.2
	Local surveys to identify resources for 74 rural area boreholes	1.2
	Local surveys to identify resources for 22 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of water supply in 2 soum centers (Khairkhandulaan, Guchin-Us)	1.2
	Construction of 74 rural area boreholes	1.2
	Construction of 3 ponds for livestock water supply	2.1
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 2 soum centers (Khairkhandulaan, Guchin-Us)	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 62 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 70 ha irrigated area (indicative area)	2.2
	Renovation of 68 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Taats River by implementing state or local protection	4.1

Data by aimag:

Taats River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Uvurkhangai	24,537.6	96.5
Bayankhongor	874.5	3.4
Umnugobi	13.0	0.1
Total river basin area	25,425.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Uvurkhangai	617,662	679,564	630,312
Bayankhongor	32,723	35,665	32,834
Umnugobi	0	0	0
Total river basin area	650,385	715,229	663,146

Taats River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Uvurkhangai	4,339	15,865	20,204	4,297	15,711	20,008	4,431	16,202	20,634
Bayankhongor	0	604	604	0	595	595	0	613	613
Umnugobi	0	0	0	0	0	0	0	0	0
Total river basin area	4,339	16,470	20,809	4,297	16,307	20,604	4,431	16,816	21,247

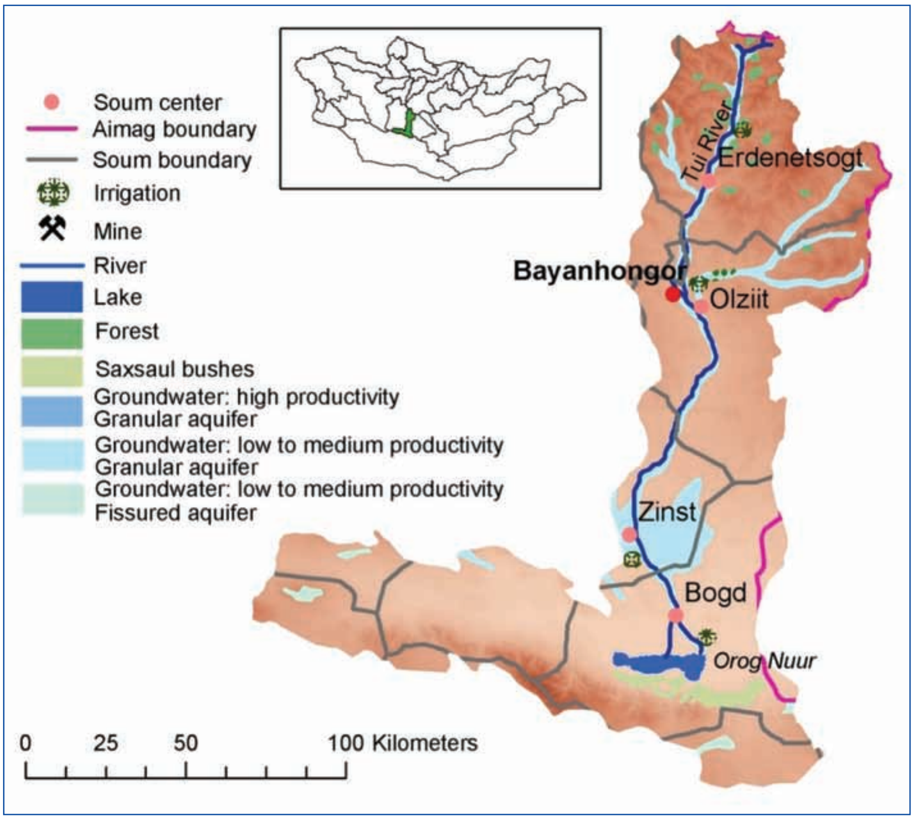
Data by soum:

Taats River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bayankhongor	Bogd	0	145	145	0	143	143	0	147	147
	Ulziit	0	459	459	0	452	452	0	466	466

Taats River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Uvurkhangai	B-Bayan-Ulaan	595	2,043	2,638	589	2,023	2,612	608	2,086	2,694
	Bayangol	0	423	423	0	419	419	0	432	432
	Bogd	660	1,195	1,855	654	1,183	1,837	674	1,220	1,894
	Guchin us	710	1,528	2,238	703	1,513	2,216	725	1,560	2,286
	Nariin teel	780	2,939	3,719	772	2,910	3,683	797	3,001	3,798
	Taragt	0	584	584	0	578	578	0	596	596
	Tugrug	852	1,610	2,462	844	1,594	2,438	870	1,644	2,514
	Uyanga	0	2,814	2,814	0	2,787	2,787	0	2,874	2,874
	Khairkhandulaan	742	2,731	3,473	735	2,705	3,439	758	2,789	3,547
Total river basin		4,339	16,470	20,809	4,297	16,307	20,604	4,431	16,816	21,247

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	2015	2021
Bayankhongor	Bogd	250,0	6,3	6,5	7,991	8,402	7,422
	Ulziit	624,5	15,8	15,7	24,732	27,262	25,412
Umnugobi	Mandal-Ovoo	13,0	0,2	0,0			
Uvurkhangai	B-Bayan-Ulaan	3.754,8	95,0	100,0	105,856	113,885	102,855
	Bayangol	413,2	11,8	11,7	11,457	12,845	12,103
	Bogd	2.432,3	24,3	25,4	45,379	47,467	41,343
	Guchin us	4.763,3	100,0	100,0	86,172	94,986	88,175
	Nariin teel	2.687,0	99,6	100,0	146,605	159,900	146,598
	Taragt	733,8	20,9	21,5	11,885	13,449	12,789
	Tugrug	4.478,7	82,2	84,1	36,223	40,761	38,923
	Uyanga	1.181,1	38,8	41,6	51,872	62,214	64,285
	Khairkhandulaan	4.093,4	99,2	100,0	122,213	134,057	123,241
Total river basin		25.425,0			650,385	715,229	663,146

22. Orog Lake - Tui Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	1.87	2.21	3.80	5.83	100% surface water	• Small irrigation projects along the Tui river and tributaries
Livestock	1.31	1.22	1.65	1.94	65% groundwater 35% surface water	• From surface water; springs and groundwater supply points
Drinking water	0.42	0.47	0.72	0.90	93% groundwater 7% surface water	• Main demand at Bayankhongor; surface water use is expected to reduce to 3% in 2021
Energy	0.11	0.12	0.16	0.23	100% groundwater	• Energy plant at Bayankhongor
Industry, transport, roads, construction	0.60	0.06	0.08	0.11	100% groundwater	• Light industries at Bayankhongor
Mining	0.00	0.00	0.00	0.00		• No mining
Other	0.03	0.03	0.05	0.12	100% groundwater	• Tourism and green area water demand
Total Demand	4.34	4.11	6.46	9.13	Medium scenario	
			5.30	6.73	Low scenario	
			7.61	11.75	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	2.6	0.9	
Groundwater	Pot.	Expl.	
Granular/fissured aquifer	33	5.9	Four deposits
Total Resources	36	6.7	Conclusion: Water resources not enough to cover future irrigation water demand

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Tui River	66	22	63.1	20.8	2.6	0.9	Closed basin, runoff decreases in downstream direction; Tui river discharges some years into Orog Lake

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues • Lakes: Orog Lake has dried up in 2005-2007
Groundwater	• High mineralization due to low recharge in southern part of the basin
Vegetation	• Pasture: 98% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests: Larch 1%, Saxaul: 2% of the basin area; • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• Shallow saline Orog Lake is part of the Valley of Lakes Ramsar site. It is important for migratory water fowl. It also provides water for livestock in a dry arid region.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in Bayankhongor aimag center	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Bayankhongor aimag center for drinking water and industrial water supply	1.1 3.1
	Local surveys to identify resources for 1 soum center (Bogd)	1.2
	Local surveys to identify resources for 11 rural area boreholes	1.2
	Local surveys to identify resources for 5 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks	1.1
	Construction of water supply in 1 soum center (Bogd)	1.2
	Construction of 11 rural area boreholes	1.2
	Construction of reservoirs for irrigation water supply	2.2
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag center	1.1
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 1 soum center (Bogd)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Mineral springs are underused	Develop mineral spring at Shargaljuut of Bayankhongor aimag	1.3
Organisation of water supply O&M to be improved	Establishment of and support to 8 pasture management herder groups	2.1
	Establishment of and support to 1 irrigation management group	2.2
Irrigation area to be extended	Construction of 100 ha irrigated area (indicative area)	2.2
	Renovation of 95 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Tui River by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 27 rural area boreholes	1.2
	Local surveys to identify resources for 6 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in aimag center	1.1
	Construction of 27 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag center	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP in aimag center	1.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 17 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 280 ha irrigated area (indicative area)	2.2
	Renovation of 120 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Tui River by implementing state or local protection	4.1

Data by aimag:

Orog Lake - Tui River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Bayankhongor	15,508.2	98.6
Uvurkhangai	220.5	1.4
Arkhangai	6.3	0.0
Total river basin area	15,735.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Bayankhongor	528,236	589,291	561,616
Uvurkhangai	0	0	0
Arkhangai	0	0	0
Total river basin area	528,236	589,291	561,616

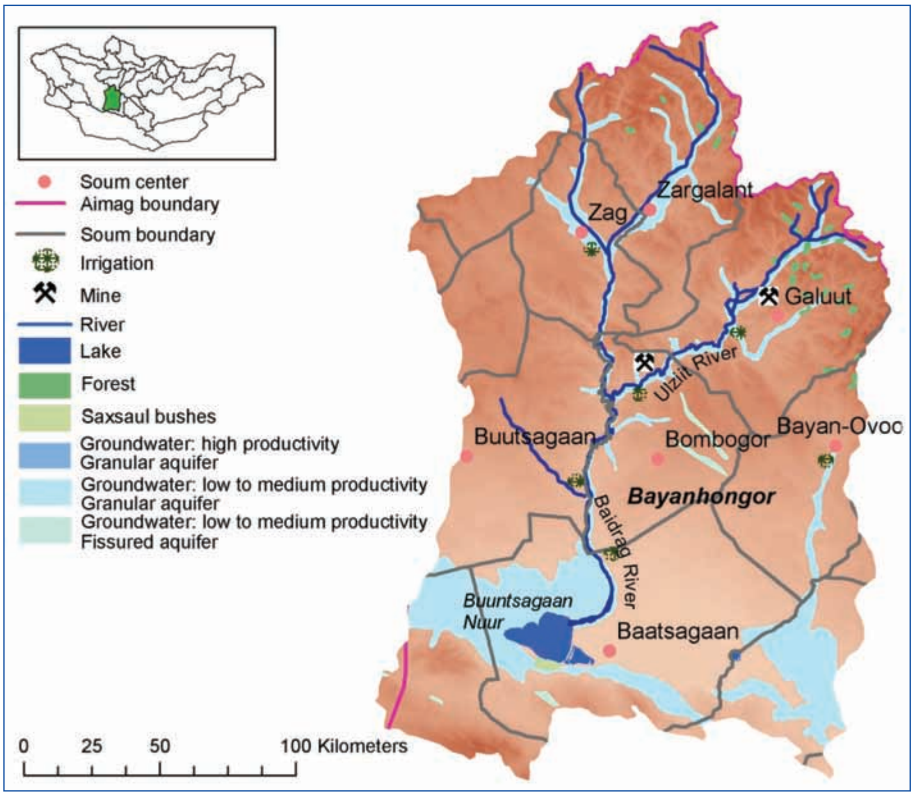
Orog Lake - Tui River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Bayankhongor	29,342	9,961	39,303	28,912	9,815	38,727	29,777	10,108	39,885
Uvurkhangai	0	0	0	0	0	0	0	0	0
Arkhangai	0	0	0	0	0	0	0	0	0
Total river basin area	29,342	9,961	39,303	28,912	9,815	38,727	29,777	10,108	39,885

Data by soum:

Orog Lake - Tui River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bayankhongor	Baatsagaan	0	219	219	0	216	216	0	222	222
	Bayangovi	0	135	135	0	133	133	0	137	137
	Bayanlig	0	86	86	0	85	85	0	88	88
	Bayan-Ovoo	0	286	286	0	282	282	0	290	290
	Bayankhongor	26,770	826	27,596	26,378	814	27,192	27,167	838	28,005
	Bayantsagaan	0	347	347	0	342	342	0	352	352
	Bogd	661	2,086	2,747	651	2,055	2,707	671	2,117	2,788
	Jinst	344	974	1,318	339	960	1,299	349	989	1,338
	Ulziit	618	2,466	3,084	609	2,430	3,039	627	2,502	3,129
	Erdenetsogt	949	2,535	3,484	935	2,498	3,433	963	2,573	3,536
Total river basin		29,342	9,961	39,303	28,912	9,815	38,727	29,777	10,108	39,885

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Arkhangai	Tsenkher	6,3	0,2	0,0			
Bayankhongor	Baatsagaan	568,7	7,6	7,6	9,913	10,372	9,077
	Bayangovi	272,0	5,8	6,4	5,413	5,520	4,663
	Bayanlig	659,5	5,5	5,0	5,252	5,516	4,971
	Bayan-Ovoo	329,1	10,2	10,9	10,685	11,969	11,278
	Bayankhongor	64,4	100,0	100,0	107,639	123,373	121,637
	Bayantsagaan	675,9	12,1	12,5	10,464	10,835	9,299
	Bogd	3.516,3	88,3	93,5	114,948	120,863	106,768
	Galuut	15,2	0,3	0,0			
	Jinst	3.013,0	58,1	58,0	50,213	51,990	44,718
	Ulziit	3.166,0	79,8	84,3	132,799	146,383	136,447
	Erdenetsogt	3.227,9	79,1	79,1	80,911	102,469	112,757
Uvurkhangai	B-Bayan-Ulaan	194,4	4,9	0,0			
	Nariin teel	10,8	0,4	0,0			
	Uyanga	15,3	0,5	0,0			
Total river basin		15.735,0			528,236	589,291	561,616

23. Buuntsagaan Lake – Baidrag Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	2.18	1.68	2.16	2.44	65% groundwater 35% surface water	• From surface water; springs and groundwater supply points
Irrigation	1.36	1.61	2.76	4.24	100% surface water	• Old and new systems along the Baidrag river
Mining	3.64	1.04	1.72	3.13	100% surface water	• Gold mines along the Ulziit River
Drinking water	0.05	0.07	0.09	0.16	58% groundwater 42% surface water	• Surface water use is expected to reduce to 20% in 2021
Industry, transport, roads, construction	0.05	0.06	0.08	0.10	100% groundwater	• Nominal demand from transport
Energy	0.00	0.00	0.00	0.00		• No power stations
Other	0.03	0.03	0.05	0.12	100% groundwater	• Tourism and green area water demand
Total Demand	7.30	4.49	6.86	10.18	Medium scenario	
			5.50	6.80	Low scenario	
			9.08	19.17	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	22.7	12.9	
Groundwater	Pot.	Expl.	
Granular/fissured aquifers	174	2.9	Eight deposits
Total Resources	197	15.9	Conclusion: Water resources are sufficient except in dry year under 2021 high scenario demand

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Baidrag river	303	173	280.5	159.7	22.7	12.9	Closed basin, runoff decreases in downstream direction; Baidrag river discharges into Boontsagaan Lake

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: pollution from mining activities but concentrations are low • Lakes: Boontsagaan Lake water level dropped by 5 meter since 1999
Groundwater	• High mineralization due to low recharge in southern part of the basin
Vegetation	• Pasture: 97% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests: 1% of the basin area • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• Shallow saline Boontsagaan Lake and Adgiin Tsagaan Lake are part of the Valley of Lakes Ramsar site. It is important for migratory water fowl. It also provides water for livestock in a dry arid region. • The Ulziit river has it's sources in the Khangai Nuruu NP in the north of the basin

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 25 rural area boreholes	1.2
	Local surveys to identify resources for 3 soum centers (Jargalant, Buutsagaan, Zag of Bayankhongor aimag)	1.2
	Local surveys to identify resources for 13 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 25 rural area boreholes	1.2
	Construction of water supply in 3 soum centers (Jargalant, Buutsagaan, Zag of Bayankhongor aimag)	1.2
	Construction of 1 pond for livestock water supply	2.1
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 3 soum centers (Jargalant, Buutsagaan, Zag of Bayankhongor aimag)	1.2
Irrigation area to be extended	Construction of 100 ha irrigated area (indicative area)	2.2
	Renovation of 200 ha irrigated area (indicative area)	2.2
Organisation of water supply O&M to be improved	Establishment of and support to 19 pasture management herder groups	2.1
	Establishment of and support to 1 irrigation management group	2.2
Runoff forming area needs better protection	Protect the watersheds of the Baidrag River by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 63 rural area boreholes	1.2
	Local surveys to identify resources for 14 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 63 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
		2.1
Organisation of water supply O&M to be improved	Establishment of and support to 39 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 120 ha irrigated area (indicative area)	2.2
	Renovation of 210 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Baidrag River by implementing state or local protection	4.1

Data by aimag:

Buuntsagaan Lake – Baidrag River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Bayankhongor	35,393.8	99.4
Gobi-Altai	160.6	0.5
Arkhangai	67.7	0.2
Total river basin area	35,622.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Bayankhongor	808,676	891,932	835,045
Gobi-Altai	0	0	0
Arkhangai	0	0	0
Total river basin area	808,676	891,932	835,045

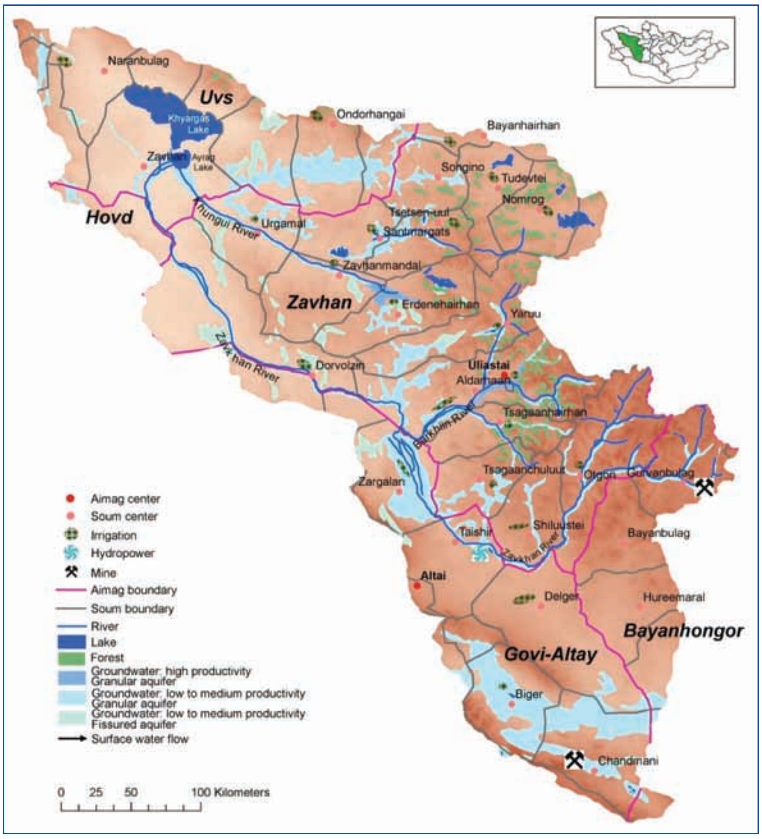
Buuntsagaan Lake – Baidrag River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Bayankhongor	4,381	18,719	23,100	4,317	18,445	22,762	4,446	18,996	23,442
Gobi-Altai	0	0	0	0	0	0	0	0	0
Arkhangai	0	0	0	0	0	0	0	0	0
Total river basin area	4,381	18,719	23,100	4,317	18,445	22,762	4,446	18,996	23,442

Data by soum:

Buuntsagaan Lake – Baidrag River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bayankhongor	Baatsagaan	359	2,665	3,024	354	2,626	2,980	364	2,704	3,069
	Bayanbulag	0	137	137	0	135	135	0	139	139
	Bayan-Ovoo	843	2,339	3,182	831	2,305	3,135	855	2,374	3,229
	Bayantsagaan	0	1,080	1,080	0	1,064	1,064	0	1,096	1,096
	Bumbugur	674	2,093	2,767	664	2,062	2,726	684	2,124	2,808
	Buutsagaan	690	1,894	2,584	680	1,866	2,546	700	1,922	2,622
	Galuut	629	3,233	3,862	620	3,186	3,805	638	3,281	3,919
	Gurvanbulag	0	408	408	0	402	402	0	414	414
	Jargalant	617	2,300	2,917	608	2,266	2,874	626	2,334	2,960
	Jinst	0	706	706	0	695	695	0	716	716
	Zag	569	1,447	2,016	561	1,426	1,986	577	1,468	2,046
	Khureemaral	0	418	418	0	412	412	0	424	424
Total river basin		4,381	18,719	23,100	4,317	18,445	22,762	4,446	18,996	23,442

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Arkhangai	Ikhtamir	24,5	0,5	0,0			
	Khangai	27,4	0,7	0,0			
	Chuluut	15,8	0,4	0,0			
Bayankhongor	Baatsagaan	6.910,5	92,4	92,4	120,517	126,103	110,358
	Bayanbulag	290,2	9,1	9,5	5,235	5,721	5,345
	Bayan-Ovoo	2.896,0	89,8	89,1	87,338	97,838	92,193
	Bayantsagaan	2.132,9	38,2	38,9	32,564	33,720	28,937
	Bogd	51,7	1,3	0,0			
	Bumbugur	3.047,6	100,0	100,0	102,211	106,631	92,412
	Buutsagaan	3.779,2	69,6	69,0	96,525	102,286	90,576
	Galuut	5.049,2	99,5	100,0	141,842	167,641	169,646
	Gurvanbulag	964,8	21,5	20,8	12,916	15,748	16,398
	Jargalant	4.104,3	97,8	100,0	79,386	97,542	103,351
	Jinst	2.171,8	41,9	42,0	36,361	37,648	32,382
	Zag	2.581,2	100,0	100,0	68,316	72,881	67,248
	Ulziit	174,5	4,4	0,0			
	Khureemaral	1.227,5	28,1	27,7	25,465	28,173	26,198
	Erdenetsogt	12,2	0,3	0,0			
Gobi-Altai	Chandmana	160,6	3,4	0,0			
Total river basin		35.622,0			808,676	891,932	835,045

24. Khyargas Lake - Zavkhan Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	9.30	10.99	18.90	29.02	100% surface water	• Old and new systems at various locations in the river basin
Livestock	7.78	4.27	5.30	5.80	65% groundwater 35% surface water	• From surface water; springs and groundwater supply points
Drinking water	0.63	0.72	1.05	1.35	90% groundwater 10% surface water	• Major demand at aimag centers; Surface water use is expected to reduce to 5% in 2021
Energy	0.28	0.29	0.39	0.55	100% groundwater	• Energy plants at aimag centers
Mining	0.31	0.05	0.09	0.16	100% groundwater	• Small gold and coal mines
Industry, transport, roads, construction	0.13	0.18	0.24	0.32	100% groundwater	• Light industries at aimag centers
Other	0.03	0.03	0.05	0.12	100% groundwater	• Tourism and green area water demand
Total Demand	18.46	16.52	26.02	37.33	Medium scenario	
			20.60	26.03	Low scenario	
			31.17	50.47	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	45	22.8	
Groundwater	Pot.	Expl.	
Granular/fissured aquifers	892	10.0	2 large and 7 small deposits
Total Resources	937	32.9	Conclusion: Water resources need exploration to cover the increase in demand from irrigation

Surface water resources Mm³/year	Total resource 50%	Total resource 10%	Ecol. resource 50%	Ecol. resource 10%	Possible use 50%	Possible use 10%	Remarks
Zavkhan river	527	294	487.3	272.4	39.5	22.1	Zavkhan river and Khungui river discharge into Ayrag Lake and Khyargas Lake
Khungui river	72	10	66.5	9.3	5.4	0.8	
Jigj river	21	10	19.7	9.0	1.6	0.7	Undurkhangai soum
Total Resources	620	314	573	291	46.5	23.6	Closed basin

Hydropower	Taishir dam operational since 2008 with 11 MW capacity

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues ; flow regime changed after building of Taishir Dam • Lakes: mineralization higher in closed lakes
Groundwater	• High mineralization due to low recharge in dry parts of the basin
Vegetation	• Pasture: 92% of the basin area; condition is deteriorating due to increased livestock numbers especially near urban centers and due to decrease of soil moisture content caused by climate change • Forests: 2% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases • Vegetation degradation is a continuing process due to grazing practices and climate change effects • Vegetation near water bodies is affected negatively by overuse and trampling
Ecology and biodiversity	• Shallow freshwater Ayrag Lake in the Khyargas Lake NP is a Ramsar site. It is an exceptionally important breeding and resting site for a variety of waterbirds and the only remaining place in Mongolia where the Dalmatian Pelican regularly comes to breed. • Loss of habitat in lakes due to increased use by humans and livestock

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in Uliastai aimag center	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 115 rural area boreholes	1.2
	Construction of pipeline from Taishir Dam for Altai water supply	1.1
	Local surveys to identify resources for 1 soum center (Gurvanbulag)	1.2
	Local surveys to identify resources for 57 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources at Uliastai	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in aimag centers	1.1
	Construction of water supply in 1 soum center (Gurvanbulag)	1.2
	Construction of 115 rural area boreholes	1.2
	Construction of 5 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Uliastai using industrial water sources or reused water	3.1
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag centers	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Uliastai	1.1
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Water supply and/or sanitation at army camp below standard	Improve water supply and water treatment at Songino army camp of Zavkhan aimag	1.1
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 1 soum center (Gurvanbulag)	1.2
	Construction of high-tech WWTP in tourist camps near Khyargas and Khar-Us Lakes	1.3
Mineral springs are underused	Develop mineral spring at Marz of Zavkhan aimag	1.3
	Rehabilitation of 1 pond	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 72 pasture management herder groups	2.1
	Establishment of and support to 4 irrigation management groups	2.2
Irrigation area to be extended	Construction of 211 ha irrigated area (indicative area)	2.2
	Renovation of 1805 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Zavkhan, Khungui and Jigi Rivers by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 5 soum centers (Biger of Govi-Altai aimag, Naranbulag of Uvs aimag, Shiluustei, Zavkhanmandal, Tudevtei of Zavkhan aimag)	1.2
	Local surveys to identify resources for 288 rural area boreholes	1.2
	Local surveys to identify resources for 72 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in aimag centers	1.1
	Construction of water supply in 5 soum centers (Biger of Govi-Altai aimag, Naranbulag of Uvs aimag, Shiluustei, Zavkhanmandal, Tudevtei of Zavkhan aimag)	1.2
	Construction of 288 rural area boreholes	1.2
	Construction of 11 ponds for livestock water supply	2.1
	Rehabilitation of 1 pond	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Uliastai using industrial water sources or reused water	3.1
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag centers	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP at Altai	1.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 5 soum centers (Biger of Govi-Altai aimag, Naranbulag of Uvs aimag, Shiluustei, Zavkhanmandal, Tudevtei of Zavkhan aimag)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 144 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 380 ha irrigated area (indicative area)	2.2
	Renovation of 2520 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Zavkhan, Khungui and Jigi Rivers by implementing state or local protection	4.1

Data by aimag:

Khyargas Lake - Zavkhan River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Zavkhan	59,320.9	48.5
Gobi-Altai	26,866.6	22.0
Uvs	22,677.7	18.5
Bayankhongor	11,791.9	9.6
Khovd	1,648.0	1.3
Arkhangai	9.9	0.0
Total river basin area	122,315.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Zavkhan	1,120,612	1,261,524	1,198,021
Gobi-Altai	370,606	397,079	356,230
Uvs	422,482	458,757	467,149
Bayankhongor	217,004	242,365	229,650
Khovd	26,391	28,461	26,065
Arkhangai	0	0	0
Total river basin area	2,157,094	2,388,186	2,277,115

Khyargas Lake - Zavkhan River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Zavkhan	22,182	22,858	45,040	21,530	22,211	43,742	21,768	22,426	44,195
Gobi-Altai	19,694	9,091	28,785	19,896	9,185	29,081	20,367	9,402	29,770
Uvs	2,738	9,814	12,552	2,766	9,915	12,681	2,827	10,131	12,958
Bayankhongor	879	5,070	5,949	866	4,995	5,862	892	5,145	6,037
Khovd	0	990	990	0	995	995	0	1,023	1,023
Arkhangai	0	0	0	0	0	0	0	0	0
Total river basin area	45,493	47,822	93,315	45,059	47,301	92,360	45,854	48,128	93,982

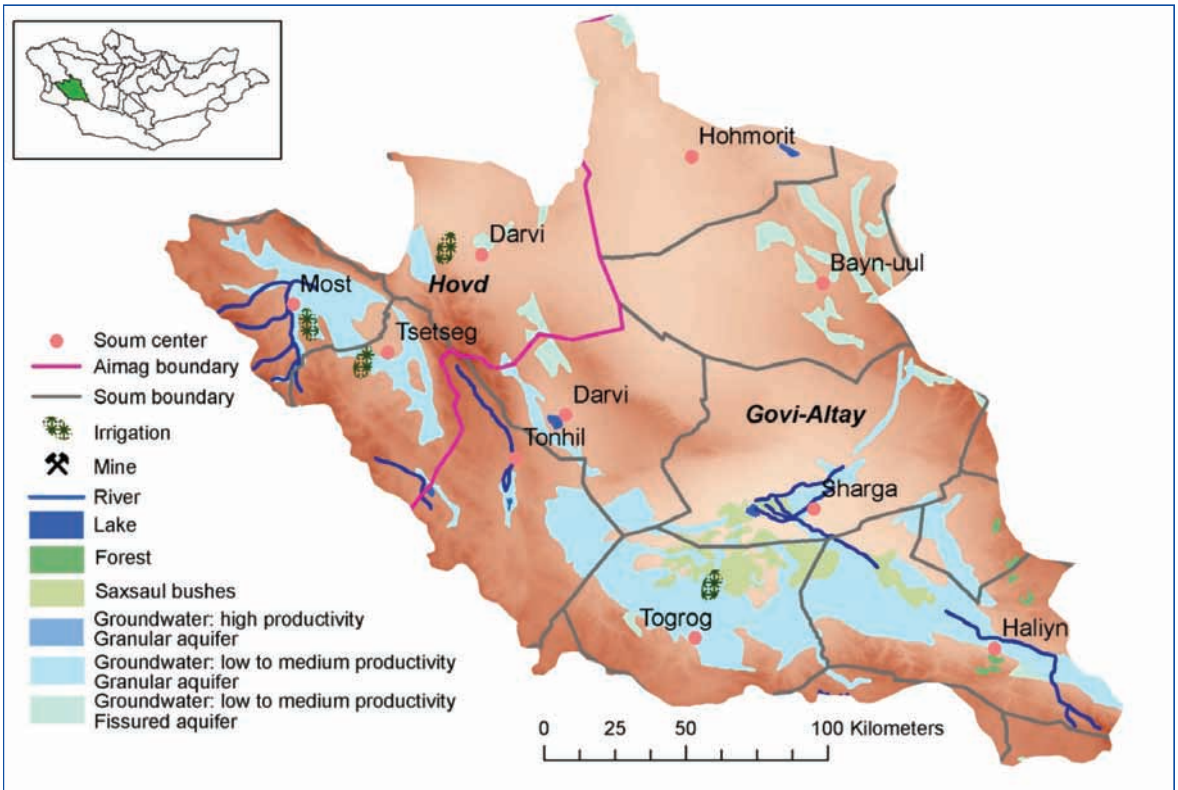
Data by soum:

Khyargas Lake - Zavkhan River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bayankhongor	Bayanbulag	321	1,307	1,628	316	1,288	1,604	326	1,326	1,652
	Bayantsagaan	0	269	269	0	265	265	0	273	273
	Buutsagaan	0	851	851	0	838	838	0	864	864
	Gurvanbulag	293	1,552	1,845	289	1,530	1,818	297	1,575	1,873
	Khureemaral	265	1,090	1,355	261	1,074	1,335	269	1,106	1,375
Gobi-Altai	Bayan-Uul	0	288	288	0	291	291	0	298	298
	Biger	603	1,627	2,230	609	1,644	2,253	624	1,683	2,306
	Delger	1,176	1,875	3,051	1,188	1,894	3,082	1,216	1,939	3,155
	Esunbulag	16,830	522	17,352	17,003	527	17,530	17,405	540	17,945
	Jargalan	246	1,512	1,758	249	1,528	1,776	254	1,564	1,818
	Taishir	348	1,093	1,441	352	1,104	1,456	360	1,130	1,490
	Khaliun	0	298	298	0	301	301	0	308	308
	Khukhmorit	0	227	227	0	229	229	0	234	234
	Chandmana	491	1,650	2,141	496	1,667	2,163	508	1,706	2,214
	Zavkhan	609	1,144	1,753	615	1,156	1,771	629	1,181	1,810
	Zuunkhangai	0	986	986	0	996	996	0	1,017	1,017
	Malchin	0	523	523	0	528	528	0	540	540
	Naranbulag	1,124	1,878	3,002	1,136	1,897	3,032	1,160	1,938	3,099
	Ulgii	0	993	993	0	1,003	1,003	0	1,025	1,025
	Umnugobi	0	573	573	0	579	579	0	591	591
	Undurkhangai	1,005	1,694	2,699	1,015	1,712	2,727	1,038	1,749	2,787
	Kharkhiraa	0	238	238	0	240	240	0	245	245
	Khyargas	0	690	690	0	697	697	0	712	712
Uvs	Tsagaankhairkhan	0	1,096	1,096	0	1,107	1,107	0	1,132	1,132
Khovd	Durgun	0	990	990	0	995	995	0	1,023	1,023

Khyargas Lake - Zavkhan River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Zavkhan	Aldarkhaan	602	2,322	2,924	584	2,254	2,838	591	2,279	2,869
	Bayankhairkhan	500	467	967	485	453	939	491	458	949
	Durvuljin	465	1,463	1,928	451	1,420	1,871	456	1,436	1,892
	Zavkhanmandal	333	737	1,070	323	715	1,039	327	723	1,050
	Numrug	348	1,578	1,926	338	1,532	1,869	342	1,549	1,890
	Otgon	466	2,741	3,207	452	2,660	3,113	457	2,690	3,147
	Santmargats	428	1,236	1,664	415	1,200	1,615	420	1,213	1,633
	Songino	420	1,217	1,637	408	1,181	1,589	412	1,194	1,606
	Tudevtei	598	1,276	1,874	580	1,239	1,819	587	1,252	1,839
	Telmen	0	553	553	0	537	537	0	543	543
	Uliastai	14,691	1,010	15,701	14,260	1,005	15,265	14,417	986	15,403
	Urgamal	333	921	1,254	323	894	1,217	327	904	1,231
	Tsagaankhairkhan	428	1,002	1,430	415	973	1,388	420	983	1,403
	Tsagaanchuluut	244	1,183	1,427	237	1,148	1,385	239	1,161	1,400
	Tsetsen-Uul	1,143	662	1,805	1,109	643	1,752	1,122	650	1,771
	Shiluustei	330	1,760	2,090	320	1,708	2,029	324	1,727	2,051
	Erdenekhairkhan	332	1,231	1,563	322	1,195	1,517	326	1,208	1,534
	Yaruu	521	1,498	2,019	506	1,454	1,960	511	1,470	1,982
Total river basin		45,493	47,822	93,315	45,059	47,301	92,360	45,854	48,128	93,982

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Arkhangai	Tsakhir	9,9	0,3	0,0			
Bayankhongor	Bayanbulag	2.894,0	90,9	90,5	49,873	54,503	50,920
	Bayan-Undur	17,1	0,1	0,0			
	Bayantsagaan	563,0	10,1	9,7	8,120	8,408	7,216
	Buutsagaan	1.647,8	30,4	31,0	43,366	45,955	40,694
	Gurvanbulag	3.471,7	77,5	79,2	49,179	59,963	62,440
	Jargalant	62,8	1,5	0,0			
	Khureemaral	3.135,4	71,9	72,3	66,465	73,536	68,381
Gobi-Altai	Bayan-Uul	721,7	12,2	12,2	9,614	10,457	9,550
	Biger	3.795,4	99,8	100,0	69,906	74,552	66,877
	Delger	6.534,9	100,0	100,0	95,017	101,535	90,595
	Esunbulag	1.268,8	54,1	54,1	32,724	34,956	31,225
	Jargalan	3.669,8	98,6	100,0	48,837	52,880	48,026
	Taishir	3.737,1	94,9	94,8	30,768	33,121	29,785
	Khaliun	514,1	9,9	14,2	14,964	16,028	14,429
	Khukhmorit	1.579,1	24,7	12,4	5,323	5,966	5,683
	Tsogt	84,2	0,5	0,0			
	Chandmana	4.554,1	96,6	100,0	63,453	67,583	60,061
	Sharga	29,0	0,5	0,0			
	Erdene	378,4	1,5	0,0			
Uvs	Zavkhan	7.047,3	100,0	100,0	47,731	52,306	49,033
	Zuunkhangai	1.305,3	48,6	53,8	43,549	50,147	48,868
	Malchin	1.310,9	32,2	30,5	28,626	20,497	26,187
	Naranbulag	3.075,3	58,2	56,3	59,770	65,020	88,240
	Ulgii	1.397,2	57,4	58,9	29,253	30,580	26,695
	Umnugobi	505,9	15,7	16,5	14,361	15,901	14,849
	Undurkhangai	3.277,8	69,6	75,3	76,600	87,429	84,545
	Tarialan	317,0	8,2	0,0			
	Kharkhiraa	0,0	0,0	10,3	12,090	14,304	14,510
	Khyargas	1.200,4	36,5	38,5	39,841	44,843	42,475
	Tsagaankhairkhan	3.240,5	78,6	82,6	70,662	77,730	71,746
Khovd	Durgun	1.648,0	39,4	43,5	26,391	28,461	26,065
Zavkhan	Aldarkhaan	7.126,2	98,6	100,0	92,850	103,100	96,602
	Bayankhairkhan	839,0	32,1	35,9	30,268	34,872	33,944
	Durvuljin	7.279,4	98,8	100,0	90,320	99,564	92,197
	Zavkhanmandal	3.657,8	100,0	100,0	58,670	61,471	54,197
	Ider	14,9	0,4	0,0			
	Numrug	3.137,1	95,3	95,0	51,136	61,079	61,706
	Otgon	5.652,5	99,4	100,0	103,232	119,860	117,884
	Santmargats	2.430,7	100,0	100,0	98,839	111,256	105,433
	Songino	2.458,6	100,0	100,0	44,936	51,820	50,446
	Tudevtei	2.691,9	99,7	100,0	58,705	69,155	68,706
	Telmen	822,1	23,5	24,2	21,741	25,787	25,851
	Uliastai	43,7	100,0	100,0	57,268	63,233	58,822
	Urgamal	3.559,6	100,0	100,0	68,572	75,655	70,183
	Tsagaankhairkhan	2.646,3	100,0	100,0	37,080	38,271	33,435
	Tsagaanchuluut	2.617,4	100,0	100,0	35,364	39,448	36,930
	Tsetsen-Uul	2.467,4	100,0	100,0	79,779	89,422	84,321
	Shiluustei	3.075,2	100,0	100,0	40,881	45,395	42,398
	Erdenekhairkhan	4.220,1	100,0	100,0	86,441	97,560	92,474
	Yaruu	4.580,9	91,6	91,3	64,531	74,576	72,493
Total river basin		122.315,0			2,157,094	2,388,186	2,277,115

25. Khuisiin Govi - Tsetseg Lake Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	4.99	5.90	10.14	15.58	100% surface water	Old and new systems at various locations in the river basin
Livestock	2.40	1.53	1.93	2.13	100% groundwater	From springs and groundwater supply points
Drinking water	0.05	0.06	0.08	0.14	67% groundwater 33% surface water	Surface water use is expected to reduce to 13% in 2021
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	100% groundwater	Nominal demand from transport
Energy	0.00	0.00	0.00	0.00		No power stations
Mining	0.00	0.00	0.00	0.00	100% surface water	No mining
Other	0.03	0.03	0.05	0.12	100% groundwater	Tourism and green area water demand
Total Demand	7.56	7.64	12.36	18.16	Medium scenario	
			9.56	12.32	Low scenario	
			14.79	24.49	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	0	0.0	Closed basin with some small rivers
Groundwater	Pot.	Expl.	
Granular/fissured aquifers	493	8.1	10 small to medium size deposits
Total Resources	493	8.1	Conclusion: Water resources need exploration to cover the increase in demand from irrigation

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers and lakes: no quality issues reported
Groundwater	• High mineralization due to low recharge in dry parts of the basin
Vegetation	• Pasture: 90% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests (saxaul): 2% of the basin area; • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• The Sharga-Mankhan NR is established for the protection of the Mongolian antelope.

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 25 rural area boreholes	1.2
	Local surveys to identify resources for 13 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 25 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
	Rehabilitation of 1 pond	2.1
Organisation of water supply O&M to be improved	Establishment of and support to 17 pasture management herder groups	2.1
	Establishment of and support to 5 irrigation management groups	2.2
Irrigation area to be extended	Construction of 157 ha irrigated area (indicative area)	2.2
	Renovation of 300 ha irrigated area (indicative area)	2.2

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 4 soum centers (Must of Khovd aimag, Tonkhil, Bayan-Uul, Tugrug of Govi-Altai aimag)	1.2
	Local surveys to identify resources for 62 rural area boreholes	1.2
	Local surveys to identify resources for 15 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of water supply in 4 soum centers (Must of Khovd aimag, Tonkhil, Bayan-Uul, Tugrug of Govi-Altai aimag)	1.2
	Construction of 62 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
	Rehabilitation of 2 ponds	2.1
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 4 soum centers (Must of Khovd aimag, Tonkhil, Bayan-Uul, Tugrug of Govi-Altai aimag)	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 33 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 230 ha irrigated area (indicative area)	2.2
	Renovation of 450 ha irrigated area (indicative area)	2.2

Data by aimag:

Khuisiin Govi - Tsetseg Lake River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Gobi-Altai	33,490.5	77.8
Khovd	9,533.5	22.2
Total river basin area	43,024.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Gobi-Altai	489,183	530,315	484,019
Khovd	240,413	272,169	260,884
Total river basin area	729,597	802,484	744,903

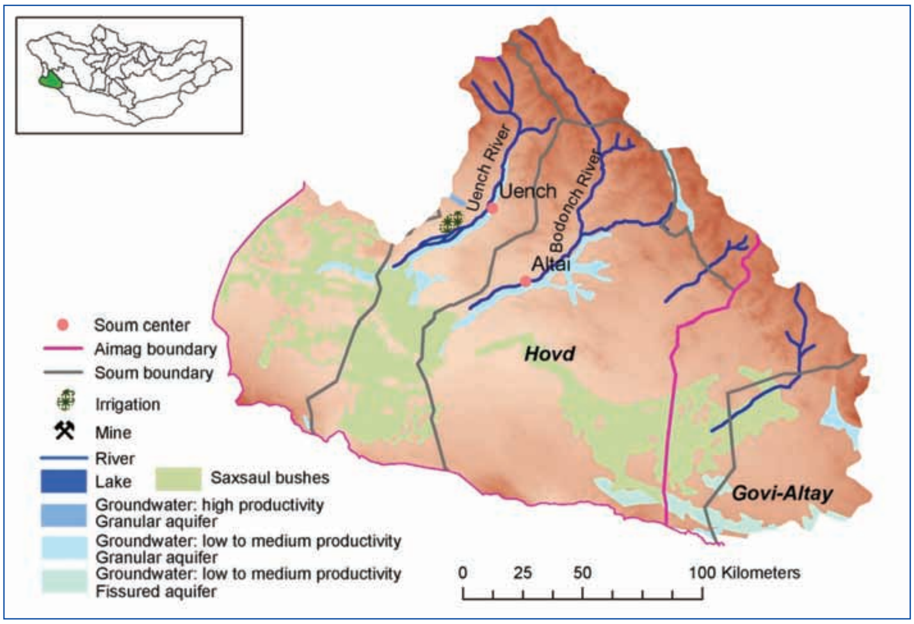
Khuisiin Govi - Tsetseg Lake River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Gobi-Altai	2,976	10,794	13,770	3,007	10,905	13,912	3,078	11,163	14,241
Khovd	1,914	4,809	6,723	1,924	4,834	6,758	1,979	4,972	6,951
Total river basin area	4,890	15,603	20,493	4,931	15,740	20,670	5,057	16,136	21,192

Data by soum:

Khuisiin Govi - Tsetseg Lake River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Gobi-Altai	Bayan-Uul	514	2,070	2,584	519	2,092	2,611	532	2,141	2,673
	Darvi	331	1,462	1,793	334	1,477	1,811	342	1,512	1,854
	Esunbulag	0	443	443	0	447	447	0	458	458
	Taishir	0	60	60	0	61	61	0	62	62
	Tonkhil	475	1,008	1,483	480	1,019	1,499	491	1,043	1,534
	Tugrug	550	1,114	1,664	556	1,125	1,681	569	1,152	1,721
	Khaliun	314	1,800	2,114	317	1,819	2,136	325	1,862	2,186
	Khukhmorit	372	1,208	1,580	376	1,221	1,597	385	1,250	1,634
	Tseel	0	149	149	0	151	151	0	155	155
	Sharga	420	1,479	1,899	424	1,494	1,919	434	1,530	1,964
Khovd	Darvi	568	1,542	2,110	571	1,550	2,121	587	1,594	2,182
	Must	804	1,929	2,733	808	1,940	2,748	831	1,995	2,826
	Tsetseg	542	1,338	1,880	545	1,345	1,890	560	1,383	1,944
Total river basin		4,890	15,603	20,493	4,931	15,740	20,670	5,057	16,136	21,192

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Gobi-Altai	Bayan-Uul	5.195,6	87,8	87,8	69,186	75,259	68,726
	Bugat	202,6	2,0	0,0			
	Darvi	3.597,8	100,0	100,0	87,138	94,707	86,410
	Esunbulag	1.076,9	45,9	45,9	27,764	29,658	26,492
	Jargalan	52,1	1,4	0,0			
	Taishir	200,9	5,1	5,2	1,688	1,817	1,634
	Tonkhil	3.671,4	47,8	53,9	59,160	65,273	60,332
	Tugrug	4.282,7	78,1	75,4	56,840	61,584	56,396
	Khaliun	4.681,0	90,1	85,8	90,418	96,846	87,186
	Khukhmorit	3.786,1	59,2	66,1	28,373	31,804	30,292
	Tsogt	437,8	2,6	0,0			
	Tseel	522,8	9,2	8,7	6,236	6,480	5,593
	Sharga	5.782,9	99,5	100,0	62,381	66,889	60,958
Khovd	Darvi	4.199,5	74,4	74,1	74,263	83,202	78,390
	Zereg	62,0	2,4	0,0			
	Mankhan	26,6	0,6	0,0			
	Must	2.796,3	68,6	73,0	100,185	114,600	111,479
	Tsetseg	2.449,2	68,8	68,6	65,965	74,367	71,014
Total river basin		43.024,0			729,597	802,484	744,903

26. Uench - Bodonch Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Livestock	1.23	0.67	0.85	0.94	80% groundwater 20% surface water	• From surface water; springs and groundwater supply points
Irrigation	0.35	0.42	0.72	1.10	100% surface water	• Old and new systems at various locations in the river basin
Drinking water	0.03	0.04	0.05	0.09	65% groundwater 35% surface water	• Surface water use is expected to reduce to 13% in 2021
Industry, transport, roads, construction	0.00	0.00	0.00	0.00		• No industries
Energy	0.00	0.00	0.00	0.00		• No power stations
Mining	0.00	0.00	0.00	0.00		• No mining
Other	0.01	0.01	0.02	0.03	100% groundwater	• Green area water demand
Total Demand	1.62	1.14	1.63	2.16	Medium scenario	
			1.40	1.71	Low scenario	
			1.94	2.70	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	2.7	1.1	
Groundwater	Pot.	Expl.	
Granular/fissured aquifers	237	11.3	2 large deposits at Boorchiin Gol in north-west of the basin
Total Resources	240	12.4	Conclusion: Water resources are sufficient but need exploration to cover the increase in demand from surface water

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Bodonch river	35	13	34.0	12.7	1.4	0.5	
Uench river	31	15	29.7	14.8	1.2	0.6	
Total resources	66	29	64	27	2.7	1.1	Closed basin

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers and lakes: no quality issues reported
Groundwater	• High mineralization due to low recharge in many parts of the basin
Vegetation	• Pasture: 78% of the basin area; condition is deteriorating due to increased livestock numbers and due to decrease of soil moisture content caused by climate change • Forests (saxaul): 18% of the basin area; • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• The area of the Great Gobi SPA in the south-east is established to protect rare wildlife (wild ass, Gobi bear, ibex, argali, o.a.).

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 27 rural area boreholes	1.2
	Local surveys to identify resources for 14 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 27 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
		2.1
Organisation of water supply O&M to be improved	Establishment of and support to 21 pasture management herder groups	2.1
	Establishment of and support to 2 irrigation management groups	2.2
Irrigation area to be extended	Construction of 10 ha irrigated area (indicative area)	2.2
	Renovation of 240 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Bodonch and Uench Rivers by implementing state or local protection	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 66 rural area boreholes	1.2
	Local surveys to identify resources for 20 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 66 rural area boreholes	1.2
	Construction of 3 ponds for livestock water supply	2.1
		2.1
Organisation of water supply O&M to be improved	Establishment of and support to 41 pasture management herder groups	2.1
Irrigation area to be extended	Renovation of 400 ha irrigated area (indicative area)	2.2

Data by aimag:

Uench - Bodonch River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Khovd	26,812.8	77.7
Gobi-Altai	7,673.1	22.2
Bayan-Ulgii	5.1	0.0
Total river basin area	34,491.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Khovd	237,776	266,277	253,505
Gobi-Altai	72,146	78,570	71,619
Bayan-Ulgii	0	0	0
Total river basin area	309,922	344,847	325,124

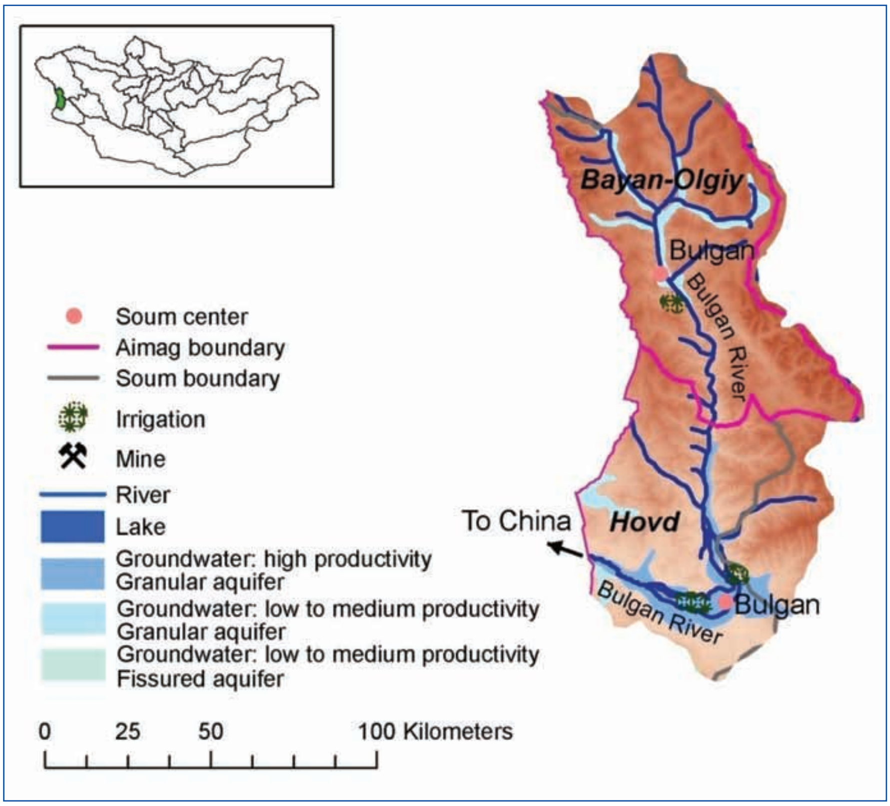
Uench - Bodonch River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Khovd	2,273	8,955	11,228	2,285	9,002	11,287	2,350	9,259	11,609
Gobi-Altai	0	1,525	1,525	0	1,541	1,541	0	1,578	1,578
Bayan-Ulgii	0	0	0	0	0	0	0	0	0
Total river basin area	2,273	10,480	12,753	2,285	10,543	12,828	2,350	10,837	13,187

Data by soum:

Uench - Bodonch River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Gobi-Altai	Bugat	0	663	663	0	670	670	0	686	686
	Tonkhil	0	863	863	0	871	871	0	892	892
Khovd	Altai	706	2,459	3,165	710	2,472	3,182	730	2,543	3,272
	Bulgan	0	2,734	2,734	0	2,749	2,749	0	2,827	2,827
	Must	0	714	714	0	717	717	0	738	738
	Uench	1,567	2,436	4,003	1,575	2,449	4,024	1,620	2,518	4,139
	Tsetseg	0	612	612	0	616	616	0	633	633
Total river basin		2,273	10,480	12,753	2,285	10,543	12,828	2,350	10,837	13,187

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	2015	2021
Bayan-Ulgii	Bulgan	5,1	0,1	0,0			
Gobi-Altai	Bugat	3.665,9	36,2	37,2	21,547	22,743	20,018
	Tonkhil	4.007,2	52,2	46,1	50,599	55,827	51,601
Khovd	Altai	13.464,2	100,0	100,0	60,816	67,453	63,312
	Bulgan	4.648,3	55,7	44,6	52,551	58,227	55,216
	Must	1.091,8	26,8	27,0	37,055	42,386	41,232
	Uench	6.498,3	85,5	81,9	57,160	64,171	61,239
	Tsetseg	1.110,1	31,2	31,4	30,194	34,040	32,505
Total river basin		34.491,0			309,922	344,847	325,124

27. Bulgan Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	1.34	1.59	2.73	4.20	100% surface water	Old and new systems along Bulgan river
Livestock	0.64	0.34	0.44	0.51	40% groundwater 60% surface water	From surface water; springs and groundwater supply points
Industry, transport, roads, construction	0.10	0.12	0.16	0.20	50% groundwater 50% surface water	Nominal demand from transport
Drinking water	0.03	0.04	0.05	0.09	50% groundwater 50% surface water	Surface water use is expected to reduce to 20% in 2021
Energy	0.00	0.00	0.00	0.00		No power stations
Mining	0.00	0.00	0.00	0.00		No mining
Other	0.01	0.01	0.02	0.03	100% groundwater	Green area water demand
Total Demand	2.12	2.10	3.40	5.03	Medium scenario	
			2.63	3.45	Low scenario	
			4.03	6.66	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	8.3	5.7	
Groundwater	Pot.	Expl.	
Granular aquifer	86	0.0	No groundwater deposits explored but there is a good potential
Total Resources	94	5.7	Conclusion: Water resources are sufficient but groundwater exploration required to cover future demand

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Bulgan River	207	142	199.1	136.2	8.3	5.7	Outflow to China

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported
Groundwater	• No quality issues reported
Vegetation	• Pasture: 96% of the basin area; • No forests in the basin area;
Ecology and biodiversity	• The lower part of the Bulgan river is a NR established to protect wildlife, notably the beaver

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 10 rural area boreholes	1.2
	Local surveys to identify resources for 6 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of 10 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Water supply and/or sanitation at army camp below standard	Improve water supply at Bulgan army camp of Khovd aimag	
Organisation of water supply O&M to be improved	Establishment of and support to 10 pasture management herder groups	2.1
	Establishment of and support to 2 irrigation management groups	2.2
Irrigation area to be extended	Renovation of 200 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Bulgan River by implementing state or local protection	4.1
Conservation of water resources	Conduct feasibility study of water harvesting reservoirs in Bulgan River	4.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Bulgan)	1.2
	Local surveys to identify resources for 25 rural area boreholes	1.2
	Local surveys to identify resources for 8 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction of water supply in 1 soum center (Bulgan)	1.2
	Construction of 25 rural area boreholes	1.2
	Construction of 1 pond for livestock water supply	2.1
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 1 soum center (Bulgan)	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 20 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 200 ha irrigated area (indicative area)	2.2
	Renovation of 300 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Bulgan River by implementing state or local protection	4.1

Data by aimag:

Bulgan River basin area		
Aimag	Area in river basin (km²)	% of river basin area
Bayan-Ulgii	5,135.6	50.6
Khovd	5,019.4	49.4
Total river basin area	10,155.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Bayan-Ulgii	59,033	57,219	54,281
Khovd	83,784	93,102	88,394
Total river basin area	142,817	150,321	142,675

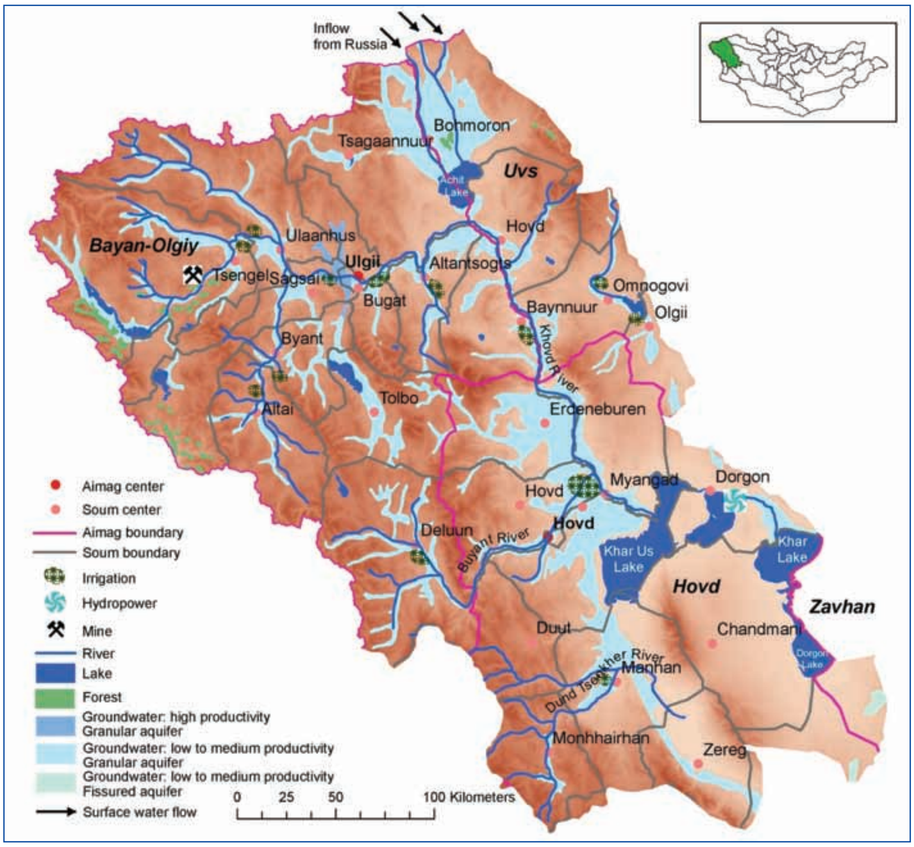
Bulgan River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Bayan-Ulgii	952	4,534	5,486	943	4,490	5,433	978	4,659	5,637
Khovd	3,135	4,044	7,179	3,151	4,065	7,217	3,241	4,181	7,423
Total river basin area	4,087	8,578	12,665	4,094	8,555	12,649	4,220	8,840	13,060

Data by soum:

Bulgan River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bayan-Ulgii	Bulgan	952	4,534	5,486	943	4,490	5,433	978	4,659	5,637
Khovd	Bulgan	3,135	3,397	6,532	3,151	3,414	6,566	3,241	3,512	6,753
	Munkh-khairkhan	0	109	109	0	110	110	0	113	113
	Uench	0	538	538	0	541	541	0	557	557
Total river basin		4,087	8,578	12,665	4,094	8,555	12,649	4,220	8,840	13,060

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers 2010	Livestock numbers 2015	Livestock numbers 2021
Bayan-Ulgii	Bulgan	5.031,5	98,9	100,0	59,033	57,219	54,281
	Deluun	104,2	1,8	0,0			
Khovd	Bulgan	3.700,8	44,3	55,4	65,277	72,326	68,587
	Duut	46,2	2,1	0,0			
	Munkh-khairkhan	169,2	6,4	7,1	5,874	6,594	6,273
	Uench	1.103,2	14,5	18,1	12,632	14,182	13,534
Total river basin		10.155,0			142,817	150,321	142,675

28. Khar Lake - Khovd Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	8.62	10.19	17.53	26.92	100% surface water	• Flooding of hayfields at Deluun; • Water shortage at Buyant and Khovd irrigation area;
Livestock	6.51	4.89	5.67	6.23	50% groundwater 50% surface water	• From surface water; springs and groundwater supply points
Drinking water	1.06	1.19	1.77	2.35	87% groundwater 13% surface water	• Well fields at Khovd and Ulgii have sufficient capacity • Surface water use is expected to reduce to 4% in 2021
Industry, transport, roads, construction	0.24	0.14	0.19	0.25	60% groundwater 40% surface water	• Small demand at aimag centers;
Energy	0.07	0.10	0.13	0.18	100% groundwater	• Energy plants at aimag centers
Mining	0.09	0.00	0.50	0.50	100% groundwater	• Tungsten mine at Ulaanhus
Other	0.05	0.10	0.11	0.26	100% groundwater	• Tourism and green area water demand
Total Demand	16.64	16.61	25.89	36.67	Medium scenario	
			20.60	25.99	Low scenario	
			30.94	48.75	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	115.8	80.8	
Groundwater	Pot.	Expl.	
Granular aquifers	684	12.7	Only 8 deposits in this large basin
Total Resources	800	93.5	Conclusion: Water resources exceed demand by sufficient margin

Surface water resources Mm^3/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Khovd River	2,254	1,570	2,141	1,492	112.7	78.5	Discharges into Khar Us Lake
Dund Tsenkher River	63	46	60.0	43.4	3.2	2.3	
Total Resources	2317	1616	2201	1535	115.8	80.8	Closed basin, no outflow

Hydropower	Durgun dam is operational since 2008 with 12 MW capacity

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues except near urban centers due to waste from domestic, industrial (wool and tannery factories) and livestock (ammonium, nitrogen, bacteriological pollution) • Lakes: mineralization higher in closed lakes; eutrophication increase due to increased phosphor concentrations and temperatures
Groundwater	• No quality issues except locally near industrial areas and waste dumps
Vegetation	• Pasture: 93% of the basin area; condition is deteriorating due to increased livestock numbers especially near urban centers and due to decrease of soil moisture content caused by climate change • Forests: 1% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases • Vegetation near water bodies is affected negatively by overuse and trampling • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• Khar Us Lake NP (containing shallow freshwater Khar Us Nuur, Khar Nuur and Durgun Lakes) is a Ramsar site. The vast reedbeds and extensive aquatic plant communities provide a suitable habitat for a large number of breeding and migratory waterbirds. • Shallow freshwater Achit Lake and surrounding wetlands is a Ramsar site. • The mountains of Altai Tavan Bogd, Siilkhem, Tsambagarav and Khokh Serkh are protected by NP's. • Loss of habitat downstream of Durgun HPP due to change in hydrological regime • Loss of habitat in lakes due to increased use by humans and livestock

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in Khovd and Ulgii aimag centers	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Surveys to identify new or verify existing water resources in Ulgii aimag center for drinking water and industrial water supply	1.1
	Local surveys to identify resources for 89 rural area boreholes	1.2
	Local surveys to identify resources for 54 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources in aimag centers	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in aimag centers	1.1
	Construction of 89 rural area boreholes	1.2
	Construction of 5 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Khovd and Ulgii using industrial water sources or reused water	3.1
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag centers	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP in Ulgii	1.1
	Construction of high-tech WWTP in tourist camps along Khovd and Buyant rivers	1.3
Water supply and/or sanitation at army camp below standard	Improve water supply at Ulaankhus army camp of Bayan-Ulgii aimag	1.1
Organisation of water supply O&M to be improved	Establishment of and support to 88 pasture management herder groups	2.1
	Establishment of and support to 11 irrigation management group	2.2
Irrigation area to be extended	Construction of 770 ha irrigated area (indicative area)	2.2
	Renovation of 2070 ha irrigated area (indicative area)	2.2
Hydropower capacity to be extended	Research and design of hydropower plant at Erdeneburen on Khovd River	3.3
Runoff forming area needs better protection	Protect the watersheds including glaciers of the Khovd and Dund Tsenkher Rivers by implementing state or local protection	4.1
Conservation of water resources	Conduct feasibility study and construct water harvesting reservoirs in Khovd region to store 70-80,000 Mm3	4.1

Issues derived from Khovd river basin water management plan:

Loss of habitat along Khovd and Buyant rivers	• Expand forests and implement forest management plans • Take under local protection important areas for biodiversity conservation	4.3
Damage to pasture and water sources by livestock	• Protect areas around sources of natural springs • Support and properly manage pastureland use practices near lakes • Reduce pressure on water resources and pastureland through improvement of livestock qualities	4.1
Wasteful use of water for watering town green areas and irrigation of hayfields	• Irrigate haymaking fields with schedules and introduce advanced technology • Renew and introduce advanced technologies into town green area irrigation systems	4.3
Wasteful use of groundwater in Khovd and Ulgii towns due to high losses in the central water supply network	• Install water meters among all water users • Introduce reuse technology in water treatment facilities in the towns • Improve water supply facility networks in Khovd and Ulgii towns	4.1 4.3
Deterioration of Khar and Durgun lakes and Teel river ecosystems due to Durgun HPP dam	• Have revisions made to the environmental impacts assessment of Durgun HPP and reduce its negative impacts • Change and renew the HPP fish pass channels	4.4
Pollution of water resources near urban centers due to improper human activities and due to grazing livestock within hygienic zones of rivers	• Improve waste management in urban areas • Demarcate conservation zones of rivers and enforce conservation regimes near urban areas	4.1
Pollution of surface water resources at Khovd and Ulgii urban centers due to outdated waste water treatment facilities	• Renew and update technologies and equipment/apparatus of water treatment plants	1.1
Inadequate participation by local communities in environmental conservation due to lack of knowledge and awareness on sustainable use of water, forest and other natural resources	Carry out efficient public awareness on water resource conservation, sustainable use, traditional practices and norms and standards on regular basis through enhancing with scientifically based knowledge, know-how and methodologies	5
Shortage of water for irrigation in lower part of the basin	Ensure fair access and sustainable use of water through establishment of engineering designed irrigation system in cultivation area (2400 ha) at Buyant river delta	2.2

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 5 soum centers (Deluun, Altantsugt, Buyant, Tsagaannuur of Bayan-Ulgii aimag, Umnogovi of Uvs aimag)	1.2
	Local surveys to identify resources for 223 rural area boreholes	1.2
	Local surveys to identify resources for 74 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources in aimag centers	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in aimag centers	1.1
	Construction of water supply in 5 soum centers (Deluun, Altantsugt, Buyant, Tsagaannuur of Bayan-Ulgii aimag, Umnogovi of Uvs aimag)	1.2
	Construction of 223 rural area boreholes	1.2
	Construction of 11 ponds for livestock water supply	2.1
	Construction of reservoirs for irrigation water supply	2.2
	Construct separate water supply for industries at Khovd and Ulgii using industrial water sources or reused water	3.1
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag centers	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP in Khovd aimag center	1.1
	Construction of small WWTP at 5 soum centers (Deluun, Altantsugt, Buyant, Tsagaannuur of Bayan-Ulgii aimag, Umnogovi of Uvs aimag)	1.2
Organisation of water supply O&M to be improved	Establishment of and support to 177 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 860 ha irrigated area (indicative area)	2.2
	Renovation of 2598 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Khovd and Dund Tsenkher Rivers by implementing state or local protection	4.1

Data by aimag:

Khar Lake - Khovd River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Bayan-Ulgii	42,026.6	47.3
Khovd	34,861.4	39.2
Uvs	10,930.0	12.3
Gobi-Altai	1,029.5	1.2
Zavkhan	88.4	0.1
Total river basin area	88,936.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Bayan-Ulgii	1,067,826	1,085,615	1,056,033
Khovd	1,050,736	1,156,823	1,134,189
Uvs	264,048	291,989	273,184
Gobi-Altai	9,229	10,345	9,853
Zavkhan	0	0	0
basin area	2,391,840	2,544,771	2,473,259

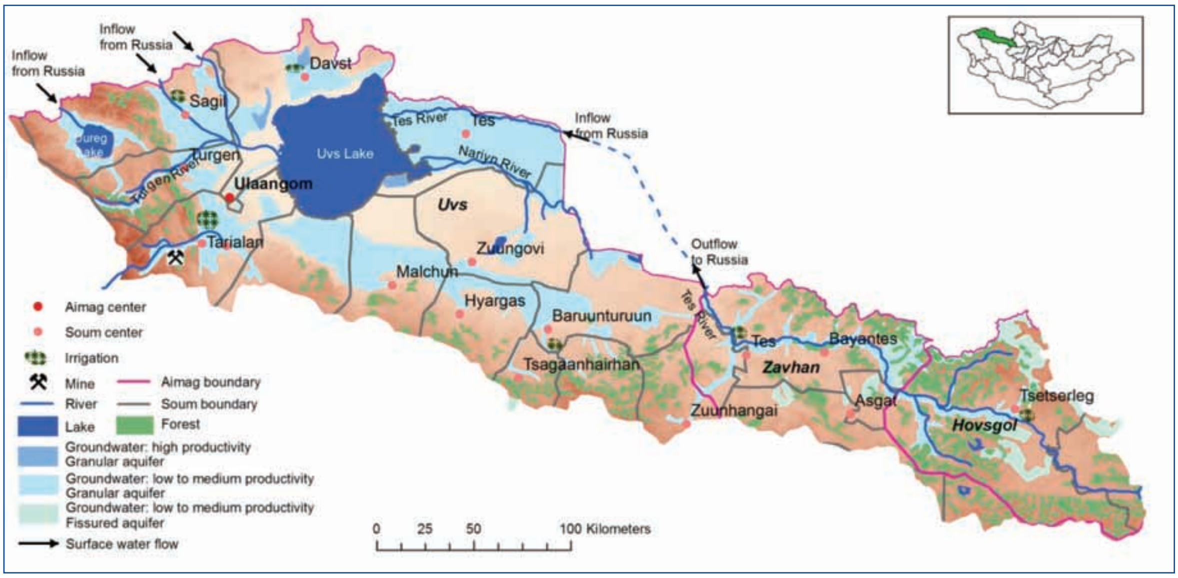
Khar Lake - Khovd River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Bayan-Ulgii	44,271	39,434	83,705	43,841	39,051	82,893	45,492	40,522	86,014
Khovd	35,951	20,133	56,084	36,140	20,239	56,379	37,172	20,817	57,989
Uvs	2,666	6,633	9,299	2,693	6,701	9,394	2,752	6,847	9,600
Gobi-Altai	0	393	393	0	397	397	0	406	406
Zavkhan	0	0	0	0	0	0	0	0	0
Total river basin area	82,888	66,593	149,481	82,675	66,389	149,063	85,416	68,593	154,009

Data by soum:

Khar Lake - Khovd River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Bayan-Ulgii	Tsagaannuur	1,353	0	1,353	1,340	0	1,340	1,390	0	1,390
	Altai	928	2,824	3,752	919	2,797	3,716	954	2,902	3,855
	Altantsugts	780	1,974	2,754	772	1,955	2,727	802	2,028	2,830
	Bayannuur	1,723	2,823	4,546	1,706	2,796	4,502	1,771	2,901	4,671
	Bugat	929	2,361	3,290	920	2,338	3,258	955	2,426	3,381
	Buyant	632	1,805	2,437	626	1,787	2,413	649	1,855	2,504
	Deluun	1,217	5,244	6,461	1,205	5,193	6,398	1,251	5,389	6,639
	Nogoonnuur	2,180	3,864	6,044	2,159	3,827	5,985	2,240	3,971	6,211
	Sagsai	1,319	3,420	4,739	1,306	3,387	4,693	1,355	3,514	4,870
	Tolbo	1,306	2,479	3,785	1,293	2,455	3,748	1,342	2,547	3,889
	Ulaankhus	1,106	6,212	7,318	1,095	6,152	7,247	1,137	6,383	7,520
	Tsengel	1,730	6,428	8,158	1,713	6,366	8,079	1,778	6,605	8,383
	Ulgii	29,068	0	29,068	28,786	0	28,786	29,870	0	29,870
Gobi-Altai	Khukhmorit	0	393	393	0	397	397	0	406	406
Uvs	Bukhmurun	809	1,217	2,026	817	1,229	2,047	835	1,256	2,091
	Ulgii	399	693	1,092	403	700	1,103	412	715	1,127
	Umnugobi	705	2,899	3,604	712	2,929	3,641	728	2,993	3,721
	Kharkhiraa	0	445	445	0	450	450	0	459	459
	Khovd	753	1,379	2,132	761	1,393	2,154	777	1,424	2,201
Khovd	Buyant	1,190	1,768	2,958	1,196	1,777	2,974	1,230	1,828	3,058
	Darvi	0	539	539	0	542	542	0	557	557
	Durgun	610	1,285	1,895	613	1,292	1,905	631	1,329	1,960
	Duut	1,912	131	2,043	1,922	132	2,054	1,977	135	2,112
	Jargalant	27,149	4	27,153	27,292	4	27,296	28,071	4	28,075
	Zereg	842	2,242	3,084	846	2,254	3,100	871	2,318	3,189
	Mankhan	1,230	2,771	4,001	1,236	2,786	4,022	1,272	2,865	4,137
	Munkh-khairkhan	703	1,426	2,129	707	1,434	2,140	727	1,474	2,201
	Myangad	680	2,822	3,502	684	2,837	3,520	703	2,918	3,621
	Khovd	430	2,759	3,189	432	2,773	3,206	445	2,853	3,297
	Chandmana	607	2,349	2,956	610	2,361	2,972	628	2,429	3,056
	Erdeneburen	598	2,037	2,635	601	2,048	2,649	618	2,106	2,724
Total river basin		82,888	66,593	149,481	82,675	66,389	149,063	85,416	68,593	154,009

Aimag	Soum	Area in river basin (km^2)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Bayan-Ulgii	Tsagaannuur	0,0	100,0	100,0	10,226	11,179	10,384
	Altai	3.280,4	100,0	100,0	105,123	123,132	123,078
	Altantsugts	1.848,9	100,0	100,0	40,322	40,521	34,476
	Bayannuur	2.406,1	100,0	100,0	79,979	83,077	73,153
	Bugat	2.098,8	100,0	100,0	50,307	56,790	54,321
	Bulgan	50,8	1,0	0,0			
	Buyant	1.888,7	100,0	100,0	67,146	69,496	61,954
	Deluun	5.679,1	98,2	100,0	145,026	107,918	150,250
	Nogoonnuur	5.415,4	100,0	100,0	98,557	107,734	99,373
	Sagsai	3.302,7	100,0	100,0	79,535	80,608	70,703
	Tolbo	3.048,3	100,0	100,0	85,398	62,170	51,480
	Ulaankhus	6.209,1	100,0	100,0	124,056	141,579	137,177
	Tsengel	6.692,0	100,0	100,0	165,730	186,303	177,344
	Ulgii	106,2	100,0	100,0	16,421	15,108	12,340
Gobi-Altai	Khukhmorit	1.029,5	16,1	21,5	9,229	10,345	9,853
Uvs	Bukhmurun	3.603,9	91,7	90,8	70,281	78,275	73,752
	Ulgii	1.037,2	42,6	41,1	20,412	21,339	18,628
	Umnugobi	2.717,3	84,3	83,5	72,678	80,470	75,144
	Sagil	4,0	0,1	0,0			
	Tarialan	618,7	16,0	0,0			
	Kharkhiraa	0,0	0,0	19,3	22,655	26,802	27,189
	Khovd	2.949,0	99,9	100,0	78,023	85,102	78,472
Khovd	Buyant	3.778,3	100,0	100,0	97,609	111,634	109,257
	Darvi	1.444,8	25,6	25,9	25,957	29,081	27,400
	Durgun	2.535,5	60,6	56,5	34,278	36,967	33,855
	Duut	2.152,0	97,9	100,0	65,809	71,549	66,147
	Jargalant	69,2	100,0	100,0	49,241	55,290	52,974
	Zereg	2.519,4	97,6	100,0	126,100	139,978	131,622
	Mankhan	4.400,2	99,4	100,0	184,073	200,829	184,400
	Munkh-khairkhan	2.472,5	93,6	92,9	76,865	86,281	82,079
	Must	187,5	4,6	0,0			
	Myangad	3.392,5	100,0	100,0	112,318	125,355	118,900
	Khovd	2.868,4	100,0	100,0	76,158	82,008	128,580
	Chandmana	6.194,2	100,0	100,0	115,382	128,449	121,042
	Erdeneburen	2.846,9	100,0	100,0	86,947	89,401	77,932
Zavkhan	Durvuljin	88,4	1,2	0,0			
Total river basin		88.936,0			2,391,840	2,544,771	2,473,259

29. Uvs Lake - Tes Basin



Water Demand by Sector	2008	2010	2015	2021	Water Source in 2010	Remarks
	Mm³/year					
Irrigation	9.85	11.64	20.04	30.77	100% surface water	Many old and new irrigation systems
Livestock	3.96	2.86	3.64	4.24	50% groundwater 50% surface water	From surface water; springs and groundwater supply points
Drinking water	0.48	0.53	0.81	1.06	90% groundwater 10% surface water	Main demand at Ulaangom Surface water use is expected to reduce to 4% in 2021
Industry, transport, roads, construction	0.11	0.17	0.22	0.30	65% groundwater 35% surface water	Light industry at Ulaangom
Energy	0.06	0.08	0.10	0.15	100% groundwater	Energy plant at Ulaangom
Mining	0.22	0.03	0.05	0.08	100% groundwater	Asgat silver mine, gold mine at Tarialan
Other	0.05	0.10	0.11	0.26	100% groundwater	Tourism and green area water demand
Total Demand	14.74	15.40	24.97	36.86	Medium scenario	
			19.39	25.16	Low scenario	
			29.76	49.58	High scenario	

Water Resources	Mm³/year		Remarks
Surface water	50%	10%	
Possible use	63.1	29.8	
Groundwater	Pot.	Expl.	
Granular / fissured aquifers	405	6.1	Deposits at Ulaangom and Malchin soum
Total Resources	469	36.3	Conclusion: exploration of surface water resources required to cover future irrigation water demand

Surface water resources Mm³/year	Total resource		Ecol. resource		Possible use		Remarks
	50%	10%	50%	10%	50%	10%	
Borshoo River	16	8	15.2	7.6	0.6	0.3	
Kharkhiraa River	119	39	114.2	37.1	4.8	1.5	
Turgen River	72	36	68.9	34.5	2.9	1.4	
Baruunturuun River	84	33	81.1	31.3	3.4	1.3	
Tes River	1,287	630	1,235.2	605.2	51.5	25.2	Outflow to and inflow from Russia
Total Resources	1,578	746	1514	716	63.1	29.8	Closed basin, no outflow

Water quality, vegetation, ecology and biodiversity	
Surface water	• Rivers: no quality issues reported • Lakes: mineralization higher in closed lakes
Groundwater	• No quality issues reported
Vegetation	• Pasture: 83% of the basin area; condition is deteriorating due to increased livestock numbers especially near urban centers and due to decrease of soil moisture content caused by climate change • Forests: 10% of the basin area; area and quality of forest is under pressure due to increased use of wood, forest fires and insects diseases • Vegetation near water bodies is affected negatively by overuse and trampling • Vegetation degradation is a continuing process due to grazing practices and climate change effects
Ecology and biodiversity	• Saline Uvs Lake and surrounding wetlands located in a desert-steppe landscape fringed by high mountain ranges is a Ramsar site and part of Uvs Lake NP. • The mountains of Turgen and Tsagaan Shuvuut and the dune area of Altan Els are part of the Uvs Lake NP. • Loss of habitat in lakes due to increased use by humans and livestock

Issues in the river basin	Measures until 2015	Chall.
Water sources are vulnerable to pollution	Protection of groundwater sources in Ulaangom aimag center	1.1
	Implementation of protection zones along surface water sources	4.1
Water resources are not adequate	Local surveys to identify resources for 1 soum center (Tsagaankhairhan of Uvs aimag)	1.2
	Local surveys to identify resources for 58 rural area boreholes	1.2
	Local surveys to identify resources for 26 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
	Local surveys to identify resources for Asgat mine	3.2
Water supply infrastructure is inadequate	Construction and renovation of water supply sources in aimag center	1.1
	Renovation and expansion of water supply network and increase of number of connected water supply kiosks in aimag center	1.1
	Construction of water supply in 1 soum center (Tsagaankhairhan of Uvs aimag)	1.2
	Construction of 58 rural area boreholes	1.2
	Construction of 2 ponds for livestock water supply	2.1
	Construct separate water supply for industries at Ulaangom using industrial water sources or reused water	3.1
	Construct water supply for Asgat mine including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag center	1.1
Waste water treatment inadequate, not working or not available	Construction and renovation of WWTP in aimag center	1.1
	Construction of small WWTP at 1 soum center (Tsagaankhairhan of Uvs aimag)	1.2
	Construction of high-tech WWTP in tourist camps along Kharkhiraa river and near Uvs Lake	1.3
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Water supply and/or sanitation at army camp below standard	Installation of water supply, water treatment and sanitation at Zuungovi soum of Uvs aimag	1.1
Organisation of water supply O&M to be improved	Establishment of and support to 41 pasture management herder groups	2.1
	Establishment of and support to 2 irrigation management groups	2.2
Irrigation area to be extended	Construction of 444 ha irrigated area (indicative area)	2.2
	Renovation of 1300 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Borshoo, Kharkhiraa, Turgen, Baruunturuun and Tes rivers by implementing state or local protection	4.1
Hydropower capacity to be extended	Research and design of hydropower plant at Turgen, Kharhiraa River	3.3

Issues in the river basin	Measures in period 2016-2021	Chall.
Water resources are not adequate	Local surveys to identify resources for 4 soum centers (Zuungovi, Baruunturuun, Sagil of Uvs aimag, Tes of Zavkhan aimag)	1.2
	Local surveys to identify resources for 145 rural area boreholes	1.2
	Local surveys to identify resources for 38 ponds	2.1
	Local surveys to identify resources for irrigated area (undefined area)	2.2
Water supply infrastructure is inadequate	Renovation and expansion of water supply network and increase of number of connected water supply kiosks	1.1
	Construction of water supply in 4 soum centers (Zuungovi, Baruunturuun, Sagil of Uvs aimag, Tes of Zavkhan aimag)	1.2
	Construction of 145 rural area boreholes	1.2
	Construction of 6 ponds for livestock water supply	2.1
	Construct separate water supply for industries at Ulaangom using industrial water sources or reused water	3.1
	Construct water supply for Asgat mine including waste water treatment, storage and water reuse	3.2
Sewerage network inadequate	Renovation and expansion of sewerage network in aimag center	1.1

Issues in the river basin	Measures in period 2016-2021	Chall.
Waste water treatment inadequate, not working or not available	Construction of small WWTP at 4 soum centers (Zuungovi, Baruunturuun, Sagil of Uvs aimag, Tes of Zavkhan aimag)	1.2
Sanitation facilities in ger areas below standard	Improve sanitation facilities and waste water disposal in ger areas of urban areas	4.2
Organisation of water supply O&M to be improved	Establishment of and support to 81 pasture management herder groups	2.1
Irrigation area to be extended	Construction of 850 ha irrigated area (indicative area)	2.2
	Renovation of 2352 ha irrigated area (indicative area)	2.2
Runoff forming area needs better protection	Protect the watersheds of the Borshoo, Kharkhiraa, Turgen, Baruunturuun and Tes rivers by implementing state or local protection	4.1

Data by aimag:

Uvs Nuur - Tes River basin area		
Aimag	Area in river basin (km^2)	% of river basin area
Uvs	37,359.9	68.9
Zavkhan	8,582.6	15.8
Khuvsgul	8,280.5	15.3
Total river basin area	54,223.0	100.0

River basin livestock numbers			
Aimag	2010	2015	2021
Uvs	932,781	1,022,354	1,079,385
Zavkhan	241,742	275,192	264,817
Khuvsgul	178,973	208,379	205,740
Total river basin area	1,353,496	1,505,925	1,549,943

Uvs Nuur - Tes River basin population									
Aimag	2010			2015			2021		
	urban	rural	total	urban	rural	total	urban	rural	total
Uvs	32,053	20,881	52,934	32,383	21,095	53,478	33,090	21,556	54,646
Zavkhan	3,437	4,474	7,911	3,336	4,342	7,679	3,373	4,390	7,763
Khuvsgul	1,347	3,920	5,267	1,334	3,882	5,216	1,384	4,028	5,411
Total river basin area	36,837	29,275	66,112	37,053	29,320	66,373	37,846	29,974	67,820

Data by soum:

Uvs Nuur - Tes River basin population										
Aimag	Soum	2010			2015			2021		
		urban	rural	total	urban	rural	total	urban	rural	total
Uvs	Baruunturuun	1,757	987	2,744	1,775	997	2,772	1,814	1,019	2,833
	Bukhmurun	0	123	123	0	125	125	0	127	127
	Davst	632	1,102	1,734	638	1,113	1,752	652	1,138	1,790
	Zuunkhangai	468	846	1,314	473	855	1,328	483	874	1,357
	Zuungobi	730	1,838	2,568	738	1,857	2,594	754	1,897	2,651
	Malchin	636	1,192	1,828	643	1,204	1,847	657	1,230	1,887
	Naranbulag	0	1,457	1,457	0	1,472	1,472	0	1,505	1,505
	Undurkhangai	0	556	556	0	561	561	0	574	574
	Sagil	596	1,698	2,294	602	1,715	2,318	615	1,753	2,368
	Tarialan	1,528	2,255	3,783	1,544	2,278	3,822	1,577	2,328	3,905
	Turgen	642	1,379	2,021	649	1,393	2,042	663	1,424	2,086
	Tes	716	4,491	5,207	723	4,537	5,261	739	4,636	5,375
	Kharkhiraa	22,907	1,623	24,530	23,143	1,640	24,783	23,648	1,676	25,324
	Khyargas	790	1,101	1,891	798	1,113	1,911	816	1,137	1,953
	Tsagaankhairkhan	651	231	882	658	233	891	672	238	910
Khuvsgul	Tsagaan-Uul	0	885	885	0	877	877	0	910	910
	Tsetserleg	1,347	3,035	4,382	1,334	3,006	4,339	1,384	3,118	4,502
Zavkhan	Asgat	420	474	894	408	460	868	412	465	877
	Bayantes	1,655	998	2,653	1,606	969	2,575	1,624	979	2,604
	Bayankhairkhan	0	834	834	0	809	809	0	818	818
	Numrug	0	83	83	0	81	81	0	82	82
	Telmen	0	350	350	0	340	340	0	343	343
	Tes	1,362	1,735	3,097	1,322	1,684	3,006	1,337	1,703	3,039
Total river basin		36,837	29,275	66,112	37,053	29,320	66,373	37,846	29,974	67,820

Aimag	Soum	Area in river basin (km²)	% of soum area in river basin	% of grassland area in river basin	Livestock numbers		
					2010	2015	2021
Uvs	Baruunturuun	3.263,4	100,0	100,0	32,028	38,600	39,822
	Bukhmurun	326,4	8,3	9,2	7,121	7,931	7,473
	Davst	6.635,4	100,0	100,0	62,587	65,952	58,888
	Zuunkhangai	1.381,5	51,4	46,2	37,397	43,063	41,965
	Zuungobi	4.068,9	100,0	100,0	52,517	65,040	85,581
	Malchin	2.762,3	67,8	69,5	65,229	46,706	59,672
	Naranbulag	2.210,3	41,8	43,7	46,393	50,468	68,492
	Undurkhangai	1.432,7	30,4	24,7	25,126	28,679	27,733
	Sagil	3.996,0	99,9	100,0	101,456	114,294	108,936
	Tarialan	2.932,3	75,8	100,0	66,092	51,634	73,714
	Turgen	2.147,8	100,0	100,0	63,914	71,677	67,775
	Tes	3.192,8	100,0	100,0	211,757	252,537	257,196
	Kharkhiraa	34,2	100,0	70,4	82,636	97,766	99,175
	Khovd	3,0	0,1	0,0			
	Khyargas	2.090,0	63,5	61,5	63,642	71,632	67,850
	Tsagaankhairkhan	882,9	21,4	17,4	14,885	16,374	15,113
Khuvsgul	Tsagaan-Uul	1.286,1	20,8	20,1	44,577	51,406	50,172
	Tsetserleg	6.994,4	93,7	93,5	134,396	156,973	155,568
Zavkhan	Asgat	578,2	100,0	100,0	25,916	29,888	29,194
	Bayantes	4.435,3	100,0	100,0	74,580	82,821	77,551
	Bayankhairkhan	1.776,1	67,9	64,1	54,043	62,265	60,607
	Tosontsengel	32,0	0,6	0,0			
	Ikhuul	3,8	0,1	0,0			
	Numrug	154,8	4,7	5,0	2,691	3,215	3,248
	Tudevtei	8,1	0,3	0,0			
	Telmen	661,7	18,9	15,3	13,745	16,303	16,344
	Tes	932,6	100,0	100,0	70,766	80,700	77,873
Total river basin		54.223,0			1,353,496	1,505,925	1,549,943

ANNEX 2. Methodological approach applied in developing the Integrated Water Management Plan of Mongolia

The planning methodology as applied for the development of the IWM Plan is presented in Figure A1.1. Basically it includes:

- a conceptual framework that describes the steps that have been followed in the analysis; and
- a computer modeling framework which generates the quantified information for the plan

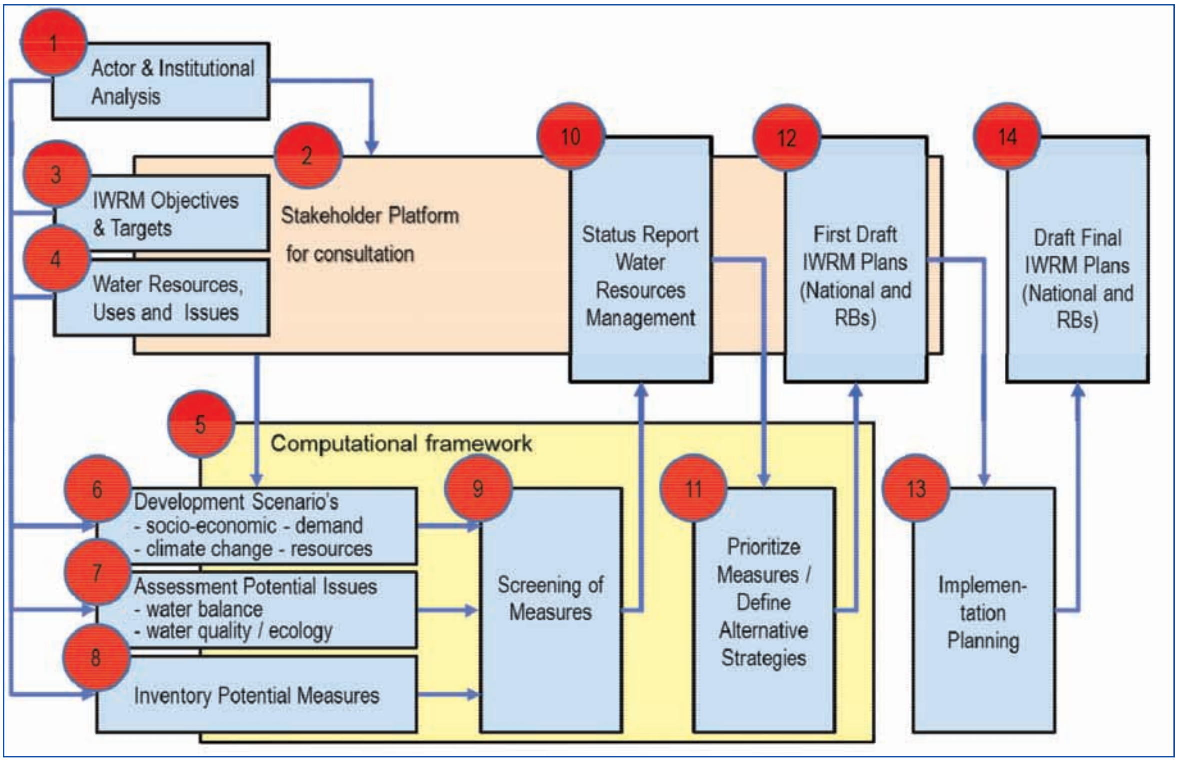


Figure A1.1 Planning methodology applied for IWM Plan

1.1 The conceptual framework

The conceptual framework includes 14 steps that relate to each other as illustrated in Figure A1.1. This conceptual framework follows the Integrated Water Resources Management (IWRM) approach.

Step 1 - Actor & Institution Analysis

The first step is to identify all actors, institutions and users who have a stake in the development and management of the water resources system, i.e. the stakeholders. Two main categories of stakeholders may be distinguished. The first main category is the users of the water (e.g. for domestic use, cooling, irrigation) who withdraw water and/or pollute the water. The users have a stake in water management because they depend on the supply of water or otherwise on the management of the water, but are not themselves involved in any of the management functions. The second category contains the institutions, agencies, organizations and people that are having an active role in one or more aspects of water management. In particular when they have a role in the decision making with respect to water management they are considered to be an 'actor' in water management. The actors involved are public organizations at national (ministries) and regional level (aimags, etc.), the private sector and NGO's.

Also included in this step is an analysis of what is called the institutional landscape to determine which actor is doing what in water management and how all these actors relate to each other. The analysis will determine whether all the necessary water management functions are carried out, whether there is overlapping, duplication or lapses and whether the resources (human, financial, equipment) available are adequate to carry out the functions as required.

Step 2 - Stakeholder Consultation

A stakeholder platform needs to be set up for regular consultation during the preparation of the IWM Plans. First of all the main actors need to be included in this stakeholder platform. For the preparation of the national; IWM Plan the National Water Committee was chosen as the platform for Stakeholder consultation. Although some disadvantages could be identified, the NWC has the advantage that it was already institutionalized and its membership was an almost perfect fit of the key actors in the water sector.

Depending on how advanced public consultation is uses may be represented in this platform as well. It is important that stakeholder representatives are indeed representing groups of stakeholders and are not just speaking for themselves. NGOs are often well placed to represent certain groups of users. Inclusion of representatives of water users in the platform is likely to be successful first at water basin level.

Step 3 - IWRM Objectives and Targets

A water management plan is made to achieve certain goals. For a good plan these goals are first made as specific as possible and broken down to quantified objectives. Water development is never a purpose in itself. Water development is always done in support of other goals, in particular goals related to economic development, food supply, social development and environmental sustainability. Therefore IWRM objectives are closely linked to, and in principle supporting the broader objectives of the national development policy. These development objectives also determine to a large extend the targets for the water management plan. The IWRM objectives and targets will be discussed and amended and finally agreed with the stakeholders.

Step 4 - Analyze Water Related Issues

First the current situation needs to be established as accurate as possible. A thorough assessment is made of the available water resources and the current water uses as well as an inventory of the existing issues in water management. These issues may concern supplying water, treatment of wastewater or flood protection, but could also relate to management and organizational issues, financial and human resources and capacities, legal issues and awareness, etc. To draw up a list of issues as complete and comprehensive as possible requires a major effort with regard to data collection and consultations with stakeholders is indispensable. Most likely more than one consultation meeting of the stakeholder platform will be required to come up with a satisfactory list of water related issues.

Once these basics have been established and agreed the process moves on the planning phase.

Step 5 - Computational Framework

An inventory needs to be made of the available analytical tools both in the form of hardware (computers, measuring equipment, etc.) and in the form of software (data, modeling software, other tools, etc.). The available data, the analytical tools and the available human resources and capabilities would need to be in balance with the required output. There is no need for advanced modeling software when the necessary input data are not available. The tools used for preparation of this National IWM Plan are discussed in more detail hereafter in section A.2.

Step 6 - Development Scenarios

Plans are made to prepare for the future, but the future is not known (exactly). Based on historical data and developments elsewhere, we can make a fairly good prediction of how the future would possibly look like. Also taking into account the development objectives of other sectors helps us to estimate the future. Still for reasons beyond the control of the planners future developments might turn out to be not as good or may be better than estimated. To be safe different scenarios are defined such as (1) a most likely (or average) scenario, (2) a high scenario and (3) a low scenario. The high and the low scenarios are defined in such a way that realistically it may expected that the real future developments will fall within these upper and lower boundaries with a confidence level of say 95%. The robustness of the IWM Plan is tested for these extreme scenarios.

For the estimation of future (2021) water demands three socio-economic development scenarios are included, and for estimation of future water resources three climate change scenarios have been applied.

Step 7 - Assessment Potential Issues

For this step a considerable amount of data needs to be collected and for missing data estimates need to be made. Demographic and economic long term projections determine the future water demands and the impacts on water balances and water quality can be calculated or otherwise predicted. This defines the potential issues for the water sector.

Step 8 - Inventory Potential Measures

Considering the current and the potential future issues, a long list of all sorts of possible measures to deal with these issues is prepared. Because the water sector already is facing issues at present, quite a number of measures have already been defined and often implementation is already planned for or has even started.

Step 9 - Screening of Measures

Surely all potential measures would somehow deal with a specific issue, but often a measure that solves a particular issue in turn creates again another issue, e.g. providing water for developing an industrial park may lower groundwater levels depriving other users of water, while that industry is also a potential source of pollution. Then there are measures that are too expensive compared to the problem they solve, etc. For better understanding the measures are screened on their ‘effectiveness’ (assesses their problem solving capacity), their ‘efficiency’ (assesses their economic soundness), their ‘legality’ (assesses their institutional and legal suitability), their ‘legitimacy’ (assesses their social acceptability and sustainability) and their ‘sustainability’ (assesses their environmental sustainability). The screening also includes an assessment of the potential negative impacts of measures.

Step 10 - Status Report Water Resources Management

The outcomes of step 6-9 are then presented to and discussed with stakeholders, to elicit further suggestions and corrections.

Step 11 - Prioritize Measures / Define Alternative Strategies

Ranking measures according to their priority is necessary to assist decision-makers when implementation of the IWM Plan is met with constraints. This may be financial constraints, human capacity constraints, time constraints, and so on. In such cases choices need to be made for instance to delay implementation of some measures or to even completely cancel certain measures. Priority ranking of measures is subjective and depending on underlying preferences different persons, different organizations or different governments would rank priorities in the different ways in accordance with their own bias. Three different strategies are worked out to rank the measures: (1) a strategy with a bias towards economic development, (2) a strategy with a bias towards social improvement, and (3) a strategy with a bias towards environmental sustainability. A fourth strategy which is completely unbiased is included as well – the neutral strategy.

Considering the estimated cost level of all the measures in the IWM Plan, it may be expected that the financing for its implementation becomes a constraint. Assuming different levels of financing deficits, the effects of delaying some and cancelling other measures on the objectives and targets of the Plan are calculated for each to the four strategies.

Step 12 - First draft IWRM Plans

At this point the first draft of the IWM Plan is presented and discussed at the stakeholder platform to elicit comments and suggestions.

Step 13 - Implementation Planning

With the comments and suggestions incorporated the implementation of the IWM Plan can be planned. This includes further detailing of the measures by indicating the activities that are included, when the measure would be implemented, how the implementation of each measure will be financed including both the investment and the recurrent costs, which organizations are involved and what role they play.

Step 14 - Draft Final IWM Plan

The draft Final IWM Plan is then presented to the Ministry of Environment and Green Development for submission to the Government for final approval.

1.2 The computational framework

The processing and analysis of the available information was assisted by computational tools which were developed during the course of the project. Short descriptions of the main parts are provided here.

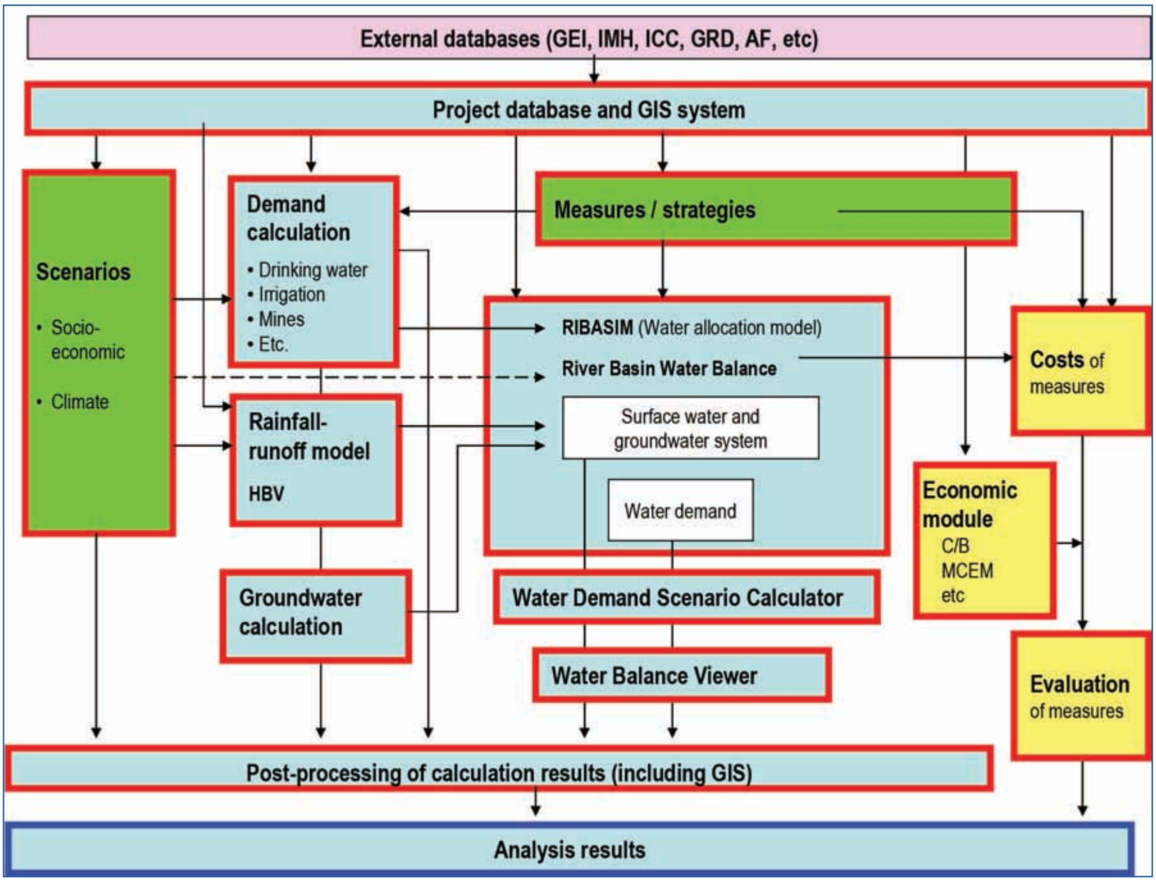


Figure A1.2. Computational framework applied for IWM Plan

IWRM database and GIS system

The main aim of the IWRM database is to store the basic data collected from external databases and other sources of information. The IWRM database is designed to work as a detailed centralized database, which may be extended with new data types in future. The modular design and GIS properties of the IWRM database provide much flexibility and opportunity to adjust the database to the needs of the users. The user-interface of the IWRM database is easy to use and the IWRM database allows all data collected by the project to be stored centrally and safely.

The IWRM database may serve as a preliminary information centre for the data needed to execute the tasks of Water Basin Councils supported by the Water Authority (WA). In the future the IWRM database may be extended to contain all data required by the WA. The set-up of the IWRM database also allows future connection with regional offices in the aimags using Internet technology.

An important aspect of the IWRM database is the data accessibility. The project formulated the directives and procedures for data accessibility in consultation with the WA. The requirements of the Water Basin Councils were important especially in order to provide these organisations with the necessary information.

The IWRM database is implemented using open source Relational Database Management software (PostgreSQL RDBMS software extended with PostGIS), that complies with up-to-date industry standards and which enables storage of spatial data in the database. The IWRM database User Interface is implemented using Microsoft Access which acts as a client on the PostgreSQL database and provides an easy to use environment to access the IWRM database tables.

The IWRM database User Interface is prepared in two languages: Mongolian and English. The data may be entered in two languages: Mongolian and English.

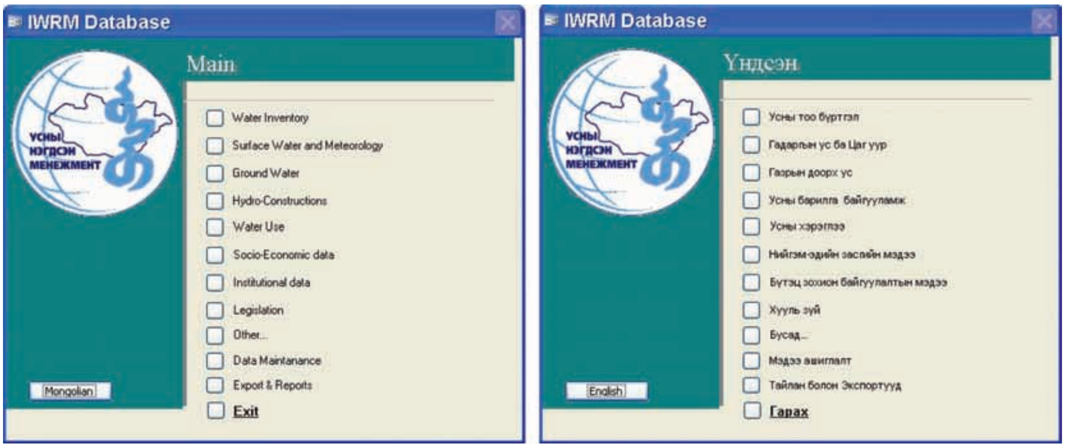


Figure A1.3. Main screen of the IWRM database in English and Mongolian language

Water Demand calculation

The calculation of water use and water consumption for the years 2008 and 2010 and water demand for the years 2015 and 2021 is executed using dedicated Excel spreadsheets combining number of users, water supply coverage water consumption norms and future growth rates according three scenarios: low, medium and high.

Rainfall-runoff model

The calculation of river runoff based on daily precipitation is carried out using the HBV model. The hydrological response of the land-phase in a river basin is simulated by three different components: a snow routine, a soil routine and a runoff response routine.

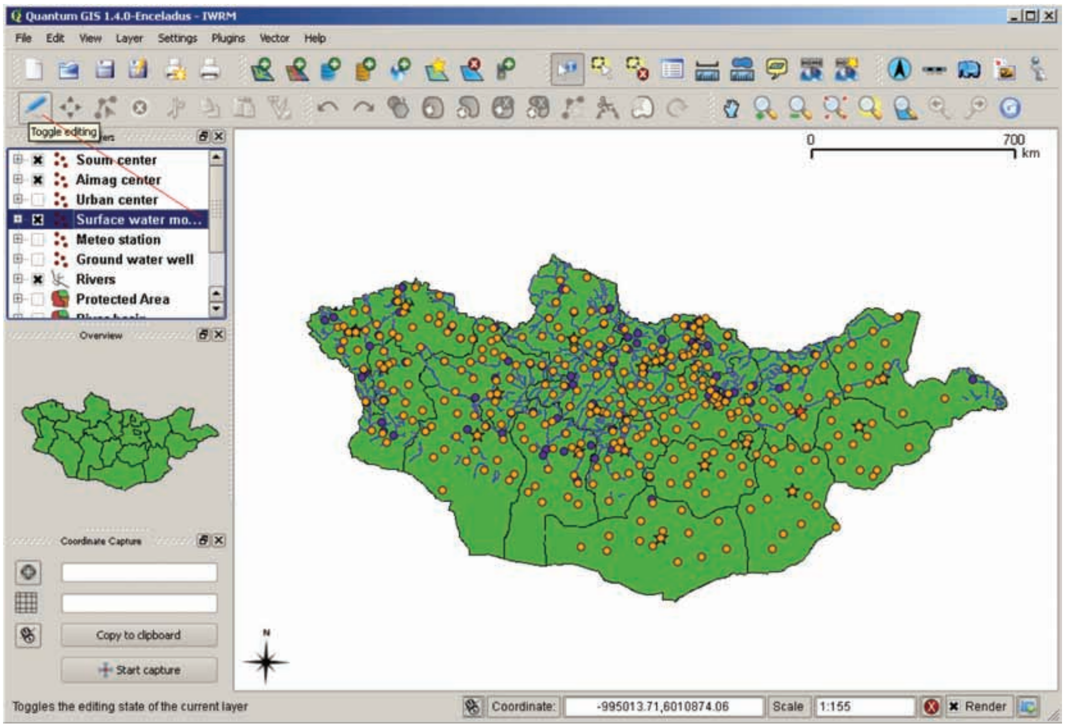


Figure A1.4. GIS part of the IWRM database

Groundwater calculation

The calculation of the groundwater resources in the 29 water basins is executed using Excel and GIS by processing information on groundwater recharge, distribution of aquifers and properties of boreholes. A groundwater model was prepared for the alluvial aquifer at Ulaanbaatar to obtain an estimate of the monthly infiltration from the Tuul River.

RIBASIM and water balance

The analysis of the water balance of the 29 water basins and more detailed of the soums in the Orkhon and Tuul river basins was done using the water allocation model RIBASIM, dedicated spreadsheets and the IWRM Water Balance Viewer described below.

Water Demand Scenario Calculator

The main aim of the calculator is to enable comparison of calculated water demand for different scenario growth percentages. The water demand is calculated by aimag and river basin for the years 2015 and 2021 using water use data by soum if available and estimates of growth rates. The user can change scenario growth percentages for each water user group and thus calculate water demand for three scenarios: low, medium and high. The water demand calculation result may be exported in MS Excel format.

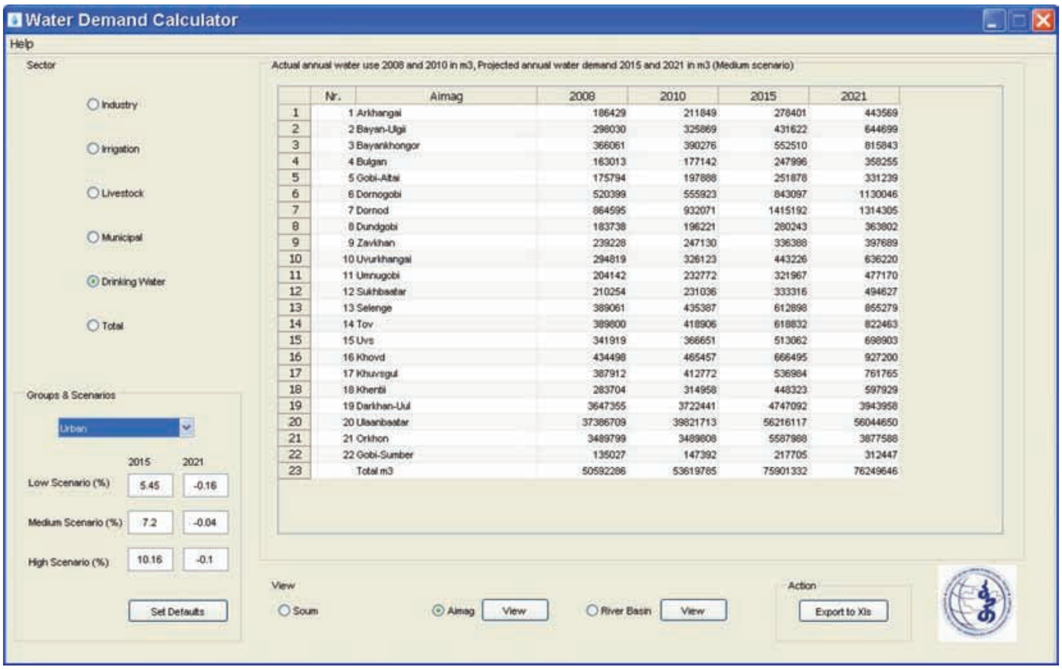


Figure A1.5. Main window of the Water Demand Calculator

IWRM Water Balance Viewer

The IWRM Water Balance Viewer allows viewing the Water Use and Demand, the Water Resources and the Water Balance by soum, aimag, or part of the water basin for all 29 water basins in Mongolia. The viewer presents the data in graphs and tables and on a geographical map. Data is shown for the years 2008, 2010, 2015 and 2021 using three scenarios: High, Medium and Low. The data may be exported to Excel for further processing.

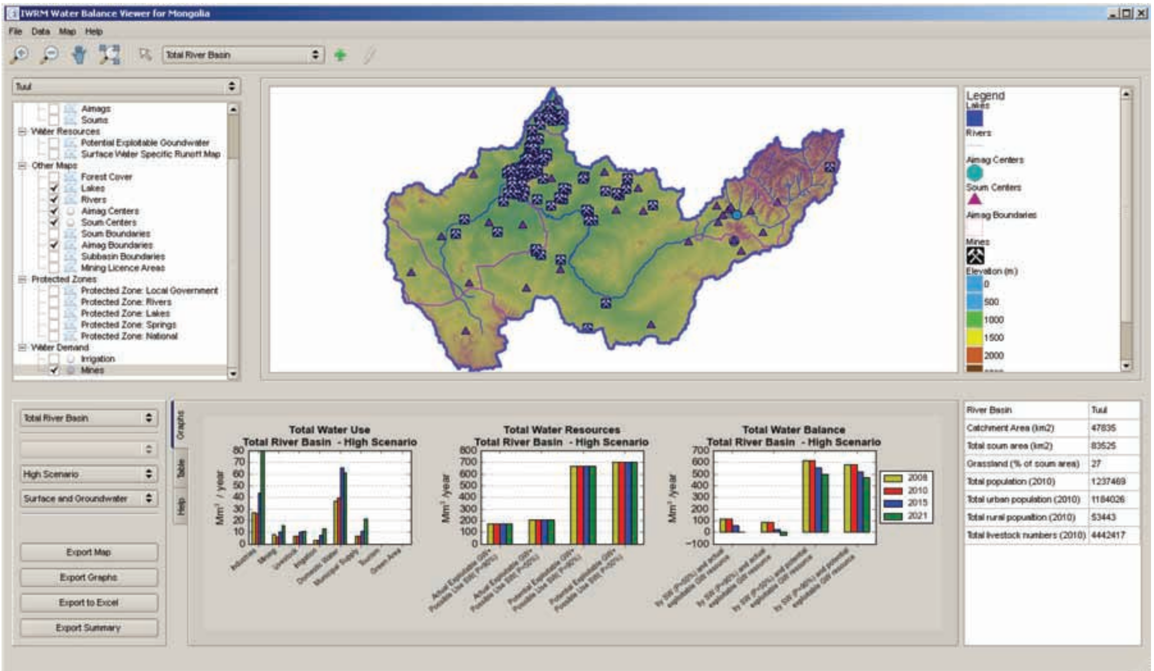


Figure A1.6. Main window of the IWRM Water Balance Viewer

Economic calculations

The calculations of the costs and benefits of the issues and measures were done using four steps:

- Step #1 – Identification: On the basis of a gap analysis in the specific water sub-sector, identification and description of the tasks to be performed as well as the benefits that will derive from them;
- Step #2 – Quantification: with tasks and associated costs and benefits described, estimation of the value of the costs and benefits. Because time matters in economic analysis, costs and benefits must be allocated to the years in which they occur. Where benefits cannot be quantified, unquantified benefits are described in detail;
- Step #3 – Time: based on an assumed project life of 25 years a discount rate is selected (which is the inverse of an interest rate) which is close to the Central Bank rate (also known as the “opportunity cost of capital”). The rate is used to calculate economic indicators as Net Present value and Benefit Cost Ratio (BCR);
- Step #4 – Discussion: several topics need to be covered before the economic analysis can be considered complete:
  - Unquantified Benefits: What are they? How important are they?
  - Sensitivity: BCR is a look into an uncertain future. It is imperative, therefore, that the sensitivity of the results to possible changes in major components of cost and benefit be estimated and discussed;
  - Risks & Constraints: BCR is made based on the assumption that the project in question is free and clear of constraints. Any possible constraints that might interfere with the ability to achieve the optimal results and risks of various kinds (e.g., engineering, political, currency, technology, etc) need to be discussed.

The Economic Benefit: Cost Analysis (BCA) is carried out using dedicated Excel spreadsheets.

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Introduction

PART B
The natural resources system – the supply

PART C
The users of the water – the demand

PART D
The policy and development context

PART E
THE ISSUES and how to address them

PART F
Strategies to address the issues

PART G
Implementing the plan

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