MONGOLIA WATER SECURITY ASSESSMENT

ADB TA 8855: Country Water Security Assessment
TA-8855 MON: Country Water Security Assessment

Final Report

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MNT 1.00 = $ 0.0004
$ 1.00 = MNT 2,345

ABBREVIATIONS

ADB  Asian Development Bank
AWDO  Asian Water Development Outlook
CHP  Combined heat and power
CSIRO  Commonwealth Scientific and Industrial Research Organisation
CWSA  Country Water Security Assessment
DALY  Disability-Adjusted Life Years
FAO  Food and Agriculture Organization
FIRR  Financially viable rate of return
GDP  Gross Domestic Product
KD  Key dimension
MCUD  Ministry of Construction and Urban Development
ME  Ministry of Energy
MET  Ministry of Environment and Tourism
MM  Ministry of Mining
MoFALI  Ministry of Food, Agriculture and Light Industry
MWF  Mongolia Water Forum
NAHMEM  National Agency for Hydrology, Meteorology and Environmental Monitoring
NARBO  Network of River Basin Organizations
NEMA  National Emergency Management Agency
NWC  National Water Committee
PUSO  Public Utility Service Organizations
RBA  River Basin Administration
RBC  River Basin Council
RBO  River Basin Organization
RBWS  River basin water security
SEC  State Emergency Commission
SME  Small or medium enterprise
TA  Technical assistance
UNDP  United Nations Development Program
UNESCO  United Nations Educational, Scientific and Cultural Organization
UNFCCC  United Nations Framework Convention on Climate Change
WSS  Water supply and sanitation

WEIGHTS AND MEASURES

°C – degree Celsius
ha – hectare
km – kilometer
km² – square kilometer
lpcd – liter per capita per day
aimag – The country is divided into 21 administrative units known as aimags.
soum – Each aimag is divided into smaller administrative units called soums.
bag – Soums are divided into bags, which are the lowest administrative units in the country.
ger – A traditional portable round tent used by the herders in Mongolia, called a Yurt in the Turkic language.
dzud – A complex and long-lasting phenomenon of Mongolia that is mainly caused by natural elements including sudden heavy snowfall, long-lasting or frequent snowfall, extremely low temperatures, or drifting windstorms.

NOTE

(i) In this report, "$" refers to US dollars.

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EXECUTIVE SUMMARY

This report describes the findings of Asian Development Bank (ADB) technical assistance (TA) 8855-MON: Country Water Security Assessment, which was managed by FCG ANZDEC from New Zealand and Mongolia Water Forum Uskhelts from Mongolia. The report incorporates four sections: (i) water resources profile; (ii) country water security assessment; (iii) institutional analysis; and the resultant (iv) water sector investment program.

Water Resource Challenges

On a national level, Mongolia has adequate exploitable water resources to meet water demand up to 2030. However, on a local level, the country faces some challenges, including:

- Estimated local water shortages due to highly concentrated water demand in some urban and industrialized areas, such as in the capital Ulaanbaatar and in mining regions in the South Gobi. Further, the insufficiency of renewable groundwater to meet high demand in the South Gobi Region results in the usage of uncertain non-renewable groundwater resources from deep aquifers.

- Potential local water shortages in dry months due to limited sustainably exploitable surface water resources, caused by major seasonal disparities in rainfall patterns, as well as environmental flow requirements of 90-95% of the average surface water flow.

- Low quality and usability of some surface water resources, caused by the discharge of untreated municipal and industrial effluent to water bodies.

- Limited potential for development of surface water resources, such as (hydro-) power dams and water transfers, by the transboundary water agreements.

Mongolia Water Security Assessment

Mongolia water security assessment is based on the methodology of ADB Asian Water Development Outlook 2016. The Asian Water Development Outlook introduced water security as a multidimensional concept, which can be assessed by identifying a sum of its five key dimensions (KDs): KD1 household water security, KD2 economic water security, KD3 urban water security, KD4 environmental water security, and KD5 resilience to water-related disasters. Each KD is valued from 1 (low water security / high risk) to 20 (high water security / low risk). Overall water security score, being a sum of five KDs, is maximum at 100.

Based on the KDs and overall value, the water security can be rated by an index from 1 to 5 corresponding to five water security stages: (i) 1 – hazardous (0<7.2 for KDs, 0<36 for overall water security); (ii) 2 – engaged (7.2<11.2 for KDs, 36<55 for overall water security); (iii) 3 – capable (11.2<15.2 for KDs, 56<76 for overall water security); (iv) 4 – effective (15.2<19.2 for KDs, 76<96 for overall water security); and (v) 5 – model (19.2<20 for KDs, 96<100 for overall water security).

This overall methodology of identifying five KDs and their estimated values for assessing country water security was utilized in this study. However, some elements of the methodology were customized to the Mongolian context, following extensive stakeholder consultations and piloting the assessment in the five selected river basins. Utilizing the lessons from the pilot studies, the water security scores for all 29 river basins have been determined. Based on the river basin scores, an overall score for the country has been calculated as well as the scores by drainage basin: Artic Ocean Basin, Pacific Ocean Basin, and Central Asia Closed Basin. The overall scores are determined by a weighted average of the 29 river basins, in which the weight of the basin was determined by population or area.

The base year for the Mongolian water security assessment is 2014, which follows the timeline of the program of the Government of Mongolia for reaching Sustainable Development Goals 2030.
Mongolia water security assessment results estimate the national water security score at 67.4 and index at 3.6, indicating capable water security stage. National results for the KDs range between 2.3 (engaged) and 4.9 (model). These results are as follows:

- KD1 household water security: score 11.4 / index 2.8 captures the challenges of low access to improved water and sanitation by herder communities.
- KD2 economic water security: score 13.0 / index 2.8 alerts that water may become a constraint to economic development, particularly in Ulaanbaatar and the mining regions of the Southern Gobi, and especially during periods of low discharges and drought.
- KD3 urban water security: score 13.1 / index 2.3 highlights the challenge of the limited proportion of urban population with access to piped water supply and sewerage, particularly in ger areas.
- KD4 environmental water security: score 15.2 / index 4.9 points out the high level of environmental water security and the country serving as the model in this dimension.
- KD5 resilience to water-related disasters: 14.6 / index 3.7 classifies Mongolia as capable in resilience to water-related disasters such as floods, droughts and dzuds.

The participatory process for adoption of the water security assessment methodology included a capacity building program for staff of the pilot River Basin Organizations. This allows for a continuous water security assessment and enables the River Basin Organizations to actively take steps towards improving water security.

**Institutional Analysis**

Institutional analysis examines administrative, legal, financial, and social framework for water resources management. A benchmarking analysis of 21 River Basin Organizations in Mongolia was conducted. The average score of 1.8 (out of 4.0) for the 21 River Basin Organizations indicates that the River Basin Organizations in Mongolia have basic capacities to support water resources management. The next stage is to move the River Basin Organizations from the current monitoring and supporting role to being proactive drivers of sustainable water resources management. For this, core weaknesses need to be overcome, including lack of budget, weak linkages with the aimag and soum government as well as with water sector agencies, and the lagging progress in establishing River Basin Councils.

Institutional analysis also assesses the effectiveness of water services providers, which play a key role in ensuring that water investments are efficiently managed. The analysis revealed that there were significant gaps in government finance and capacities, and that management contracts for water services providers are loose, with shortcomings in achieving efficiencies. The study concluded that new approaches are required to strengthen effectiveness of water services providers. It is suggested to provide water services providers with clear performance targets and hold them accountable on these targets, to move water services providers from public to corporate entities, to strengthen an independent regulatory body to ensure management, financial and technical compliances, and to set water tariffs at levels which allow for cost recovery of operation and maintenance costs.

**Water Sector Investment Program**

Based on the findings of the water security assessment and institutional analysis, the water sector investment program provides details on key investments and TA. It builds on the Integrated Water Management Plan 2013 and follows the targets set out in Mongolia’s Sustainable Development Vision, while it incorporates key existing studies and project plans. The proposed investment areas to improve water security over a 13-year period (201–2030) are as follows:
• Investment for household water security targets improved WSS for rural communities, by increasing awareness of the risks of poor WSS, identifying adequate low-cost WSS facilities, and providing support for herder families to self-finance low-cost WSS.

• Investment for economic water security supports creation of an enabling environment for sustainable investment by focusing on the following key physical investments: (i) 70,000 ha of new and upgraded irrigation; (ii) livestock water points, pasture and livestock management; (iii) development of water supplies for mining, with a special focus on the critical Southern Gobi Region; (iv) 650 MW of renewable hydropower.

• Investment for urban water security targets improved urban WSS through investment to upgrade systems in Ulaanbaatar, 21 aimag centers, and 300 soum centers. Investment will incorporate mechanisms to improve technical, financial, and economic viability of urban WSS with special focus on the needs of the ger areas.

• Investment for environmental water security targets strengthened river basin governance and water resources management capacity at national and local level (via TA). Environment-specific and cross-cutting investments are proposed to support water resources protection and enhancement.

• Investment in reducing water-related disasters targets improved knowledge on disaster risks to increase effectiveness of investments on water-related disaster reduction. Physical investments are proposed in the areas of urban flood protection and management and integrated disaster risk management.

The estimated overall cost of the proposed water sector investment program is $6.5 billion, of which $1.8 billion (27%) is estimated to come from government, $1.1 billion (16%) from beneficiaries, and $3.7 billion (56%) from private sector finance.

Total TA budget requirement to support the investment plan in planning and design, institutional development, and targeted pilot investments, is estimated at $228 million (about 4% of the total investment costs). Of this, $100 million is estimated to come from government and $128 million from private sector finance. The TA budget requirement from government finances for stage one (2018–2025) is estimated at $50 million.

Financing of the water sector investment program comes at a difficult time for the Mongolian economy with Gross Domestic Product (GDP) growth in 2016 of 1% compared with 17% in 2011. The investment program will cost around $500 million per year over the 13 years, which is approximately 4% of the 2016 GDP and is significantly above current levels of investment in the water sector. Recommendations on how the government can develop a flexible and dynamic approach to investment in the water sector by incorporating a wide range of financing modalities are included in the report.
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I. INTRODUCTION

This report for Asian Development Bank (ADB) Technical Assistance (TA) 8855-MON: Mongolia Country Water Security Assessment (CWSA) describes the results of the water security assessment and institutional analysis, and the proposed investment program for the water sector. It incorporates following sections: (i) water resources profile; (ii) CWSA, (iii) institutional analysis; and (iv) water sector investment program.

Government of Mongolia recognized a need for innovative, multi-sectoral approaches to sustainable water resource management and for the required knowledge to support implementation of these approaches. Through the Ministry of Environment and Tourism (MET), it requested ADB in February 2014 to provide a TA in conducting water security assessment.\textsuperscript{1,2} The TA, approved in December 2014, was designed following ADB’s country partnership strategy results framework\textsuperscript{3}. FCG ANZDEC from New Zealand, in association with Mongolia Water Forum Uskhelts (MWF) from Mongolia, was engaged by ADB to implement the TA. The TA commenced on 13 July 2015 and was completed on 31 May 2017.

Mongolia is the second largest landlocked and the most sparsely populated country in the world\textsuperscript{4}. Its economy grew significantly over the past two decades. While the growth slightly slowed down in 2015 and 2016, it is predicted to accelerate in 2017 on large mining investments, and moderate in 2018 as coal production reaches full capacity, driven mainly by agriculture and construction. This economic growth has been followed by increasing urbanization. Ulaanbaatar, the capital and the country’s largest city is home to about 45\% of Mongolia’s population.

As the socio-economy adjusts from a low-intensity rural economy to a mixed economy with rapid urbanization and industrialization, water resources in the country are in a state of change too. Water security has an increased importance for sustained economic growth. The Government of Mongolia aims to ensure water resources security and environmental integrity, while maintaining economic growth. This TA aims to support improving policies and strategies to promote water security, and to ensure that ADB’s strategy and programs respond to water security challenges in Mongolia.

\textsuperscript{1} Ministry of Environment and Tourism (June 2016). Previously Ministry of Environment, Green Development and Tourism, name change was adopted in 2016
\textsuperscript{4} Mongolian Statistical Information Service, http://www.1212.mn
II. WATER RESOURCES PROFILE

A. BACKGROUND

Mongolia is the second largest landlocked country in the world, covering a land area of around 1.6 million km$^2$; with population of around 3.1 million in 2016, it is the most sparsely populated country in the world$^5$. The Constitution and the 1992 Government Administration Law proclaim Mongolia as a unitary state with three tiers of local government. The country has 21 administrative units known as aimags, which are divided into smaller administrative units called soums, which are further divided into lowest administrative units called bags. Governance of administrative and territorial units is based on the principle of centralized authority with gradual delegation of central power to local governments.

Mongolia's economy grew significantly over the past two decades, with Gross Domestic Product (GDP) growing from $2.5 billion in 2005 to an all-time high of $12.6 billion in 2013; it slightly slowed down in 2015, with GDP at $11.7 billion$^6$ (Figure 1). The growth further slowed in 2016 to 1.0%, from 2.4% in 2015.

![Figure 1. Mongolia's GDP (current $ billion)](image)


The economic grow has been characterized by intensifying industrialization. Highest contribution to GDP comes from the services sector, and from mining and agriculture. Figure 2 shows that mining accounted for 17% and agriculture for 14% of the economy in 2015. It was estimated that Mongolia's economy will accelerate at 2.5% in 2017 on large mining investments, and moderate at 2.0% in 2018,

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$^6$ GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data are in current U.S. dollars.
as coal production reaches full capacity, being driven by agriculture and construction\textsuperscript{7}. The growth has been followed by increasing urbanization. The capital, Ulaanbaatar, is home to about 45\% of Mongolia's population.

The shift from a low-intensity rural economy to the economy characterized by rapid urbanization and expansion of industrialization, affects the change in water resources. Socioeconomic development requires increased demand for water. The 2030 Water Resources Group estimated that water demand is expected to triple in the next two decades and water supply to decline, and predicted water deficit in Mongolia by the end of the next decade. Sustainable water resource management is thus critical to Mongolia's long-term socioeconomic development.

\begin{figure}
\centering
\includegraphics[width=\textwidth]{gdp_by_sector.png}
\caption{GDP by Sector (2015)}
\end{figure}

Mongolia's water resources form part of three main hydrological basins:

- Arctic Ocean Basin, which drains northward through the Russian Federation into the Arctic Ocean;
- Pacific Ocean Basin, which drains westward through the People's Republic of (PR) China into the Pacific Ocean; and
- Central Asian Closed Basin.

The country is divided into 29 river basins for water resources management purposes.

On a national level, Mongolia has adequate exploitable water resources to meet water demand up to 2030. However, on a local level, the country faces some challenges, including:

- Estimated local water shortages due to highly concentrated water demand in some urban and industrialized areas, such as in the capital Ulaanbaatar and in mining regions in the South Gobi. Further, the insufficiency of renewable groundwater to meet high demand in the South

\footnote{\textsuperscript{7} \url{https://www.adb.org/countries/mongolia/economy}, accessed on 31 May 2017}
Gobi Region results in the usage of uncertain non-renewable groundwater resources from deep aquifers.

- Potential local water shortages in dry months due to limited sustainably exploitable surface water resources, caused by major seasonal disparities in rainfall patterns, as well as environmental flow requirements of 90-95% of the average surface water flow.
- Low quality and usability of some surface water resources, caused by the discharge of untreated municipal and industrial effluent to water bodies.
- Limited potential for development of surface water resources, such as (hydro-) power dams and water transfers, by the transboundary water agreements.

B. Water Supply: Water Resources of Mongolia

Total water resources of Mongolia are estimated as 599 km$^3$. Setting Mongolia’s water resources into the context of area and population, water per square kilometer is 22 km$^3$/year and per capita equals 11 km$^3$/year$^8$. Majority of water resources comes from surface water (97.9%) and only 2.1% comes from groundwater resources$^9$.

Water resources can be classified as renewable and non-renewable$^{10}$. Total natural renewable water resources (sum of internal renewable water resources and natural incoming flow originating outside the country) in Mongolia are estimated at 35 km$^3$/year (long-term annual average$^{11}$), of which 22 km$^3$/year is from surface water and 13 km$^3$/year is from groundwater recharge$^{12}$ (Table 1).

<table>
<thead>
<tr>
<th>WATER RESOURCES</th>
<th>AMOUNT (km$^3$/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation (long-term annual average)</td>
<td>351.0</td>
</tr>
<tr>
<td>Renewable water resources (long-term annual average)</td>
<td>34.6</td>
</tr>
<tr>
<td>Surface water</td>
<td>22.0</td>
</tr>
<tr>
<td>Exploitable surface water (after extracting environmental flow requirement)</td>
<td>1.2-2.0</td>
</tr>
<tr>
<td>Renewable groundwater</td>
<td>12.6</td>
</tr>
<tr>
<td>Exploitable groundwater</td>
<td>0.6</td>
</tr>
</tbody>
</table>


As there is no transboundary water inflow into Mongolia, internal renewable water resources$^{13}$ are same as total renewable water resources. Around 60% of renewable water resources flows into the Russian Federation and PR China. Only 1,200 million cubic meter (Mm$^3$) is stored in dams.

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$^{8}$ Based on long term average actual renewable water resources


$^{10}$ Renewable water resources represent the long-term average surface water and groundwater. Non-renewable water resources are groundwater resources that have a negligible rate of recharge on the human time-scale.

$^{11}$ Long-term annual average is the arithmetic average over at least 20 years.


$^{13}$ Internal renewable water resources consist of flow of rivers and recharge of aquifers generated from endogenous precipitation.
In Mongolia, environmental flow requirements are set at 90-95% of the long-term average flows. The Integrated Water Management Plan 2013 estimates that 19 km\(^3\)/year are required to be allocated as environmental flow, leaving 2.0 km\(^3\)/year for possible use in an average year and 1.2 km\(^3\) in a dry year. Spatial distribution of water resources varies throughout the country. Figure 3 illustrates availability of water resources in cubic meters per square kilometer and per capita for three major river basins.

Figure 3. Spatial Distribution of Water Resources

Source: TA 8855-MON: Mongolia Country Water Security Assessment

Lowest water resources are in the Central Asian Closed Basin, which includes the Gobi Desert. The lowest per capita water availability is in the Arctic Ocean Basin, reflecting the high population of Ulaanbaatar.

Historical trend in renewable water resources shows that over the past 20 years, the average water resources have been about 25 km\(^3\)/year, which is 27.7% lower from the 40-year average. During this period, renewable water resources have always been below the 40-year average. During the past 40 years, the maximum renewable resources reached 78.4 km\(^3\)/year (1993), with a minimum of 16.7 km\(^3\)/year (2002).

14 The environmental flow is determined based on percentages provided for all river basins in the “Surface Water Monograph” (Davaa, Myagmarjav, 1999).
Figure 4. Historical Trend in Renewable Water Resources (1975–2015)

Source: MET. 2015.

1. Precipitation

Average precipitation in Mongolia is 244 mm/year according to the Food and Agriculture Organization (FAO). Fluctuations in precipitation have localized characteristics, varying from less than 80 mm/year in the Gobi in the south to around 350 mm/year in the northern mountain areas. Contribution of precipitation at levels above 250 mm/year in the areas of higher altitudes water resources is considered significant. During 1940–2015, average annual precipitation decreased by 7.3%.

2. Surface Water

Mongolia has 3,811 rivers (and around 7,000 springs), 3,500 lakes, and 262 glaciers:\textsuperscript{15}

- The longest rivers include Orkhon River (1,124 km), Selenge River (1,024 km), Kherlen River (1,090 km), Zavkhan River (808 km), and Tuul River (704 km).\textsuperscript{16} The rivers originate from the three mountain ranges: Khangai-Huvsgul, Khentii, and Mongol Altai. The spring flow originates from snow and ice melt, and starts from the end of March to the end of April.
- The lakes can be fresh water lakes and brackish water lakes. Total water resources of fresh water lakes amount to 500 km\textsuperscript{3} while total volume of the brackish water lakes is 90 km\textsuperscript{3}.\textsuperscript{17} The largest fresh water lake is Lake Khuvsgul (380 km\textsuperscript{3}) and the largest brackish water lakes are Uvs Lake and Khyargas Lake. Majority of the lakes are in the steppe and Gobi Region (66%) and the rest are in the mountains (34%).
- The volume of the glaciers in Mongolia is estimated at 63 km\textsuperscript{3}, occupying an area of 659 km\textsuperscript{2} at an altitude range of 2,800-4,400 m.

\textsuperscript{15} Surface Water of Mongolia, 1999, Edited by B. Myagmarjav and G. Davaa, Ulaanbaatar, (in Mongolian).
\textsuperscript{17} MET. 2013. Integrated Water Management Plan 2013, Mongolia.
There are only two large and 10 small dams, with a total storage capacity of 1.2 km$^3$ of surface water, or 5.5% of total renewable surface water. The large dams are the Dorgon and Taishir. The dams are mainly for electricity generation, with an installed hydropower capacity of 28 MW/year.

3. Groundwater

The level of knowledge on groundwater is significantly lower than that on surface water, with only few monitoring stations having records longer than 10 years. There is no sufficient knowledge on the quantity of total groundwater reserves, including non-renewable reserves.

Groundwater resources can be renewable and non-renewable (fossil aquifers), a further distinction relates to deep aquifers and shallow aquifers. Groundwater is abstracted from two types of aquifers, fissured and the higher yielding granular aquifers, which occur in the alluvial sediments situated along river valleys; the yields of the fissured aquifers are low and variable. There is hydraulic connectivity between the surface water and alluvial groundwater. Groundwater recharge can reach up to 40-60 mm/year in alluvial deposits.

Studies from the Integrated Water Management Plan 2013 assessed the potential exploitable renewable groundwater resources at 13 km$^3$/year$^{18}$. The officially approved groundwater resources for exploitation however are only 0.6 km$^3$/year, or about 6% of the groundwater potential. This low figure reflects the limited information on groundwater availability, which is supported by properly explored and approved groundwater resources, hydrogeological investigations have concentrated on areas to meet specific groundwater needs. It is estimated that more comprehensive groundwater studies and analyses will likely show that the quantity of exploitable groundwater resources could significantly increase from the current level of 0.6 km$^3$/year.

Figure 5 illustrates groundwater resources in cubic meters per square kilometer and per capita for each river basin. Lowest renewable groundwater resources are in the Central Asian Closed Basin, which includes the Gobi Desert.

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$^{18}$ MET. 2013. Integrated Water Management Plan, Mongolia.
C. Water Demand

Estimates of current (2014) and future water withdrawal (2030) measure gross water withdrawal requirements and losses. Current water withdrawal is based on 2014 data from soums and aimags, which provides an update from the estimates in the Integrated Water Management Plan 2013. Projections of water demand to 2030 have been made based on various sources. There is high uncertainty in the projections of water demand, which is highly sensitive to the rate and type of investments, particularly in mining, industry, and irrigation.

1. Water Demand at National Level

Total water withdrawal is estimated at 534 Mm$^3$/year in 2014. Projected water demand in 2030 is 65% higher from 2014, being at 884 Mm$^3$/year. These estimates are reasonably in line with the Integrated Water Management Plan 2013, although there are differences in the sectoral allocation. This highlights the uncertainty of projecting future water demand.

Estimated demand for water per sector is: industry 25%, WSS (WSS) 16%, crop land (40%), and livestock (19%).

Table 2. Water Demand (2014 and 2030)

<table>
<thead>
<tr>
<th>COMPONENT</th>
<th>DEVELOPMENT TARGET 2030</th>
<th>WATER WITHDRAWAL (Mm$^3$/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>2014</td>
</tr>
<tr>
<td>1. Total WSS</td>
<td></td>
<td>83</td>
</tr>
</tbody>
</table>
The table shows the water supply services to different regions of Mongolia:

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Services Description</th>
<th>Zonal Coverage</th>
<th>2030 Water Demand (Mm³/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Improved WSS to rural communities</td>
<td>100% traditional</td>
<td></td>
<td>6 7 1</td>
</tr>
<tr>
<td>b. Improved WSS to 331 soum centers</td>
<td>30% full services</td>
<td></td>
<td>4 12 8</td>
</tr>
<tr>
<td></td>
<td>50% partial services</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20% traditional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Improved WSS to 21 aimag centers</td>
<td>40% full services</td>
<td></td>
<td>18 38 20</td>
</tr>
<tr>
<td></td>
<td>60% partial services</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Improved WSS to Ulaanbaatar</td>
<td>80% full services</td>
<td></td>
<td>55 104 49</td>
</tr>
<tr>
<td></td>
<td>20% partial services</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Irrigation

- Irrigated area increased by 70,000 ha: 215 315 100

3. Livestock

- Improved access to water: 100 110 10

4. Industry, municipal and public services

- Water meets expansion of industry and other non-domestic use: 63 155 92

5. Energy

- 70% coal power plants: 33 33 0
- 30% renewable energy: 0

6. Mining

- Water supports expansion of mining: 40 110 70

Total: 534 884 350

Notes:

- **WSS**: Full services piped house connections and wet sanitation (160 liter per capita per day (lpcd)); partial services: stand pipes and dry decentralized sanitation (30 lpcd); traditional (20 lpcd); 30% losses are added to these values. Rural population will remain stable, with only small increase in water demand.
- **Irrigation**: Water demand for increased 70,000 ha is based on the mix of planned rehabilitated and new irrigation; an increment of 100 Mm³/year.
- **Livestock**: Growth of livestock will slow down, supported by the initiatives for sustainable livestock management.
- **Industry, municipal and public services**: These are primarily located in urban areas and have been included as part of the demand for urban water. Projections for 2030 water demand for Ulaanbaatar (from the master plan) are that industry, public and municipal services are taken as 115% of WSS demand; industry, public and municipal services for aimags and soums are taken as 80% and 40% of the respective WSS water demands.
- **Energy**: Water demand by energy is estimated to increase by 19,000 GWh by 2030, however a switch to 30% renewable energy and investment in energy- and water-efficient coal power stations are assumed to compensate any additional water use.
- **Mining**: Demand for water estimates are based on ADB (2014) Demand in the Desert.

Source: TA-8855 Mongolia Water Security Assessment

2. Water Demand at River Basin Level

By using soum data it has been possible to estimate the water withdrawal for all 29 river basins; the breakdown of water withdrawal by river basin is shown in Figure 6.

Some key points include:

- Almost half of national domestic water supply (44.0%) occurs in Tuul alone due to the large population of Ulaanbaatar, 15.6% occurs in the Kharaa, 7.5% in the Orkhon, 3.5% for the Kherlen, Khyargas lake-Zavkhan, Uvs Lake–Tes and Khar lake-Khovd and less than 1% for the rest of the other river basins.

- About half of the country’s water withdrawal for crops occurs in only three river basins: Kharaa (21.6%), Selenge (11.6%), Orkhon (16.6%), while the other 25% occurs in Kherlen (7.9%), Khyargas Lake-Zavkhan (7.7%), Khar Lake-Khovd (6.5%) and Uvs Lake-Tes (4.5%).

- About 40% of the country’s livestock water withdrawal occurs in four river basins; Orkhon (13.0%), Umard Gobi Guveet Khalkh Dundad Tal (14.0%), Kherlen (8.4%) and Khar Lake-Khovd (6.0%). The rest of the river basins each use less than 5%.
About 85% of the country’s industrial water withdrawal occurs in six river basins: Galba Uush Dolood Gobi (32.4%), Tuul (22.4%), Selenge (12.4%), Kharaa (6.9%), Kherlen (5.7%), and Umard Gobi Guveet Khalkh Dundad Tal (5.1%), and about 1% in each of the other river basins. The biggest mining industries and heat and power plants are in these six river basins. It is estimated that more than 85% of industrial water use is required for the mining and energy sectors.

**Figure 6: Surface and Groundwater Withdrawal by River Basin (%)**

Source: TA 8855-MON: Mongolia Country Water Security Assessment

**D. Comparison of Water Supply and Demand**

An estimate of the predominant water source for water demand allows for a better understanding of the sustainability of withdrawals and provides insights for design of investment programs.

There is no clear information available that distinguishes between surface and groundwater withdrawal; also, the hydraulic connectivity between surface and groundwater in the river valleys requires consideration. Various water resources assessments indicate that groundwater surface water withdrawal accounts for 20% and groundwater for 20% of water use in the country. However, the results of this study suggest that water use from surface water and groundwater are equally distributed at 50% across the country.

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Comparing renewable water resources with water withdrawals, it becomes apparent that the country is reasonably well positioned to meet the current and 2030 water demands. On a local level, there are spatial differences in water resources and demand, resulting in localized shortages.

Total water withdrawal in 2014 (534 Mm$^3$) is only 1.5% of total renewable water resources. The estimated 65% increase in water demand by 2030 to 884 million m$^3$/year would require 2.5% of total renewable water resources.

Figure 6 illustrates estimated water withdrawals as percentage of renewable water resources by river basin. It is apparent that river basins in the Gobi Region are highly dependent on groundwater, with Galba Uush Dloodin Govi Basin using 98% groundwater to meet the demand. In most river basins, total water withdrawal is less than 10% of total renewable water resources. However, withdrawals from the Tuul, Kharaa, and Orkhon River basins already exceed this threshold, i.e. the environmental flow requirement is not maintained, which impacts ecosystem integrity and thus ecosystem service provision. Further, this indicates that, as surface water availability is considerably reduced when maintaining environmental flows, it is likely that there will be some constraints to meeting the needs of socioeconomic growth in the future, especially in the low water months of dry years.

The Integrated Water Management Plan 2013 carried out water demand-supply balance assessments at the national and river basin level, which show that when considering overall water resources, most basins have a positive balance in 2014 and in 2030. There is however a significant spatial variability in water availability and demand. A more targeted assessment by the 2030 Water Resources Group found that expected water supply-demand gaps by 2030 and 2040 include the capital Ulaanbaatar, as well as for Mongolia's key coal mining regions, Tavan Tolgoi and Nyalga Shivee Ovoo.

E. Transboundary Water

While there are no rivers flowing into Mongolia, there are about 210 rivers that flow out of Mongolia into the Russian Federation and PR China. The drainage area which flows into the Russian Federation covers almost one-third of Mongolia's territory. Mongolia has signed transboundary agreements to protect, utilize, and control pollution with the Russian Federation and PR China:

- Agreement with the Government of the Russian Federation identifies broad areas of cooperation, including: (i) to prevent pollution and maintain rational use of transboundary waters including environmental flows, (ii) to investigate transboundary water resources including biology and water chemistry, (iii) to exchange information including on flood and industrial calamities, (iv) to prevent pollution and monitor water quality, (v) to work in the field of the protection of fish and birds, and to protect natural environment for migratory birds, (vi) to implement continued cooperation, including in integrated methodology on monitoring, defining environmental flows, allocating transboundary water for water utilization, and developing norms and principles for water utilization.

- Agreement with the government of PR China incorporates areas of cooperation, including: (i) to investigate and survey dynamics, resources and quality of boundary waters, (ii) to monitor and reduce pollution of transboundary waters, protect aquatic animals and others, (iii) to develop approaches for breeding and protection of fish resources, and (iv) to establish a joint committee on transboundary waters.

This importance of strong transboundary agreements and management is reflected in Russia's 2013 request to reconsider the proposed World Bank funded Orkhon-Gobi water diversion project and the

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2016 suspension of funding for two hydropower projects on the Selenge and Orkhon rivers. Under the transboundary agreement, as the upstream country, Mongolia has special responsibilities to protect the larger ecosystem of the Orkhon-Selenge River Basin, which feeds Lake Baikal the world’s largest freshwater body and the United Nations Educational, Scientific and Cultural Organization (UNESCO) world heritage site in Siberia.

F. Water Quality

Although most of the river flows are derived from the undisturbed mountain catchments, some downstream parts of rivers are polluted due to rapid urbanization and by industrial and mining activities. While incidents of pollution affecting drinking water quality are rare, 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 wastewater treatment are increasingly a threat to the quality of water sources in urban areas.

Mongolia has about 120 wastewater treatment plants, 75% of which are municipal wastewater treatment plants and the remaining 25% are industrial wastewater treatment plants. Total treatment capacity of all wastewater treatment plants and facilities is 400,000 m$^3$/day. Total output of all polluted drainage of Mongolia reaches 350,000 m$^3$/day of which it is estimated that about 37% (130,000 m$^3$/day) is discharged untreated into the soil affecting groundwater or into the rivers.\(^\text{22}\)

In recent years, exploration for natural resources has increased rapidly and currently many river basins are under intensive use to support mining activities of gold, silver, coal, precious stones, gravel, and other natural resources. About 1,000 enterprises are engaged in mining of which more than 200 are small-scale gold mining companies that are operating over around six million hectares of land; some gold miners are reported to be using mercury in the gold extraction processes which can feed into surface water and leach into groundwater. The surface water inventory revealed that gold mining activity affects the quality of 28 rivers in eight provinces. The upper stream areas of the Orkhon River, downstream reaches of the Tuul River, and the Eroo River in the Selenge River basin are specifically affected. The Orkhon, Tuul, Kharaa and Khangal River basins are experiencing increased pollution from urbanization and industry.\(^\text{23}\)

Surface water quality, by river basin, is shown in Figure 7.


Groundwater quality is mostly considered to be good, and safe for consumption without further treatment. However, there are areas where concentrations of high levels of total dissolved solids and hardness are found in groundwater. There are some reports of localized high concentrations of arsenic and too high or too low concentrations of iodide and fluoride. In rural areas, wells and boreholes used for drinking water supply are often not protected by fencing, thus water polluted by animal waste can return to the well or borehole and contaminate the source.

G. Climate Variability and Climate Change

Mongolia is identified to be one of the most vulnerable countries to the impacts of climate change due to its geographic location and the state of socioeconomic development. ADB study\textsuperscript{24}, covering four member countries—PR China, Japan, the Republic of Korea, and Mongolia—reports that the economic losses from climate-related natural disasters since 1970 have been significant in absolute terms ($2 billion for Mongolia). It assesses a 10% loss of GDP by 2100, due to climate change under a business-as-usual scenario, which is higher from the other assessed countries. Major identified issue was the loss of livestock production due to the degradation of pasturelands. Droughts and dzuds lead to major losses of livestock (almost 30% of livestock died because of the dzud of 2010).

Climate change is estimated to have significant impact on Mongolia:\textsuperscript{25,26}

- Mongolia has warmed by about 2.07°C between 1940 to 2013 and will continue to warm by an estimated 2.56°C – 5.16°C by 2090. For every 1°C increase in temperature, a 2% annual river flow decrease can be expected. Continued warming may exacerbate existing a diminution of water resources and desertification, the latter already affecting 78% of the country.


\textsuperscript{25} MET. 2014. Mongolia Second Assessment Report on Climate Change

- At the country level, average annual precipitation is projected to increase and Mongolia will be slightly wetter by 20 mm/year by 2050 and by 44 mm/year by 2090. Most of the increase is expected to occur in the winter. The projected increase in precipitation together with greater seasonal variation and more severe extreme events will increase the frequency and severity of floods. The impact of precipitation changes will become greater than the impact of temperature fluctuations. If annual precipitation drops by 10% and the temperature remains constant, it is estimated that the average river flow would reduce by 7.5%.

- There has been an estimated loss of 28% of glacier volume in the last 70 years. This trend is expected to continue and it was predicted that glacier melt will peak in the period 2030 to 2050 and decline thereafter. While glacier melt is still increasing river water availability, the gradual decline of glaciers will increase the variability in water flow in longer term.

Climate change studies show that 72% of the country is vulnerable to drought. Climate change projections show a gradual increase in drought and a considerable increase in dzuds until 2100.

Over the last 20 years, a reduction of river flows has been recorded. It is not clear whether this is a part of the cyclical nature of the climate or a long-term trend, while IWMP2013 assessed that this appears to be within the range of normal climate variability rather than climate change. Groundwater is less vulnerable to annual variations in rainfall patterns and the indicative increase in rainfall should be positive for groundwater although the possibilities of increased higher intensity rainfall may reduce the proportion of infiltration. The high availability of water resources compared with demand will help buffer the impacts of climate change on a national level. This is especially the case as much of the water demand is from groundwater, which will help buffer seasonal and annual variations, if groundwater withdrawals are kept within sustainable levels.

The impacts of climate change on water security primarily relate to the impacts on agriculture crops and livestock as well as increased flood risk:

- The cropped area in Mongolia is small, which means that overall impact on crop production by climate change would be less than the impact to other countries in the region. Some studies have estimated that crop yields would be improved by the longer growing season, earlier rains, higher temperatures, and increased precipitation. The increased potential evapotranspiration would however increase water requirements. Other studies, however, have indicated that there could be negative impacts on yield from extreme high and low temperature events. Expansion of irrigation and improved cultivation techniques would form an important measure to adapt to climate change.

- Climate change impacts on livestock include direct effects on the livestock, as well as indirect impacts on the pasture. Various studies show that although precipitation may not change significantly, the frequency and impact of drought events would affect productivity of pastures and meat production. The increase in winter precipitation will affect the risk of dzuds, which would impact meat production. It is estimated that nearly all pasture land has experienced changes both from climate change and grazing pressure. Combined with other factors including overgrazing, it is estimated that most soils would become fragile by 2030. Studies in the Kharikaraa/Turgen River basin demonstrated that above ground carbon levels could decrease by 10-23% from combined grazing and climate change with medium grazing, and by 50-70% with intensive grazing.

- Increased frequency of extreme rainfall events will increase the risk of flooding.

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III. COUNTRY WATER SECURITY ASSESSMENT

This chapter presents methodology and findings of the Mongolia’s CWSA, which was conducted at the river basin level. The CWSA results were used for identifying the needs for possible investments through water sector development program (2018–2030). The results will also provide a quantitative and comprehensive platform for dialogue and targeted actions to move towards a water-secure future. Detailed methodology tailored for Mongolia CWSA was developed through stakeholder participation, and the stakeholders were trained in collecting data and conducting analysis. This allows for future continuous water security assessments by responsible staff and organizations.

A. Methodology

1. Asian Water Development Outlook 2016 Methodology

Water security is a relatively recent term in water resources management. The commonly used definition is of Grey and Sadoff (2007): water security is 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.

To quantify water security, the concept of a water security index was introduced and defined by ADB as part of the Asian Water Development Outlook (AWDO) 2007 for the First Asia Pacific Water Summit held in Japan during 3-4 December 2007.\(^2\)\(^8\) The AWDO methodology was further developed in 2013, including quantitative measurements and providing a direction for governance, investments, capacity building, monitoring, and reporting. It was once again revised in 2016, and the methodology was used to assess water security of 48 Asian countries, including Mongolia.

AWDO introduced water security as a multidimensional concept, which can be assessed by identifying a sum of its five KDs: KD1 household water security, KD2 economic water security, KD3 urban water security, KD4 environmental water security, and KD5 resilience to water-related disasters. The KDs are quantified by aggregated indicators, whose value is determined based on the values of several selected constituent sub-indicators (Table 3).

<table>
<thead>
<tr>
<th>KD</th>
<th>DESCRIPTION</th>
<th>INDICATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Household</td>
<td>The extent to which countries satisfy household water and sanitation needs,</td>
<td>Piped water access (%)</td>
</tr>
<tr>
<td>water security</td>
<td>and improve hygiene for public health</td>
<td>Sanitation access (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hygiene (age-standardized disability-adjusted life years—DALY(^2)(^9))</td>
</tr>
<tr>
<td>2 Economic</td>
<td>The productive use of water to sustain economic growth in food production,</td>
<td>Productive economies in agriculture (agricultural dependency, utilization</td>
</tr>
<tr>
<td>water security</td>
<td>industry and energy sectors of the economy</td>
<td>efficiency)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Industry (industrial water productivity, industrial consumption) Energy (</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% hydropower potential developed, % hydropower dependency)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resilience storage, inter- and intra-annual rainfall variability)</td>
</tr>
</tbody>
</table>


\(^9\) DALY is a measure of the diarrheal incidence per 100,000 people
3 Urban water security

The level of water services in urban areas to support vibrant and livable water-sensitive cities

Water supply (%)
Wastewater treatment (%)
Drainage (flood damage)

4 Environmental water security

The extent to which river basins are being managed well to sustain ecosystem services

River health
Hydrologic alteration
Environmental governance

5 Resilience to water-related disasters

The capacity of communities to cope with and recover from the impacts of water-related disasters

Floods and windstorms
Drought
Storm surges and coastal floods


Each KD is valued from 1 (low water security / high risk) to 20 (high water security / low risk).

While each KD allows for insight into the water security of its dimension, overall water security can only be assessed, and decisions in the water sector can only be effectively guided, when all KDs are combined. National or river basin water security is assessed as a composite result of the KDs. Thus, the maximum score for overall water security, being a sum of five KDs, is 100.

Based on the KDs and the overall value, water security can be rated by an index from 1 to 5 corresponding to five water security stages:

5 – model (19.2<20 for KDs, 96<100 for overall water security)

All people have access to safe drinking water and sanitation facilities; economic activities are not constrained by water availability; water quality meets standards for people and ecology; and water-related risks are acceptable and relatively easy to deal with.

4 – effective (15.2<19.2 for KDs, 76<96 for overall water security)

Nearly all people have access to safe drinking water and sanitation facilities; water service delivery is mostly formal and effective to support economic development; water quality is in general acceptable and attention is given to ecological restoration of water bodies; and water-related risks are seriously brought down by infrastructure and warning systems.

3 – capable (11.2<15.2 for KDs, 56<76 for overall water security)

Access to safe drinking water and sanitation facilities is further improving, also in rural and poor areas; water productivity in economic activities has improved; water quality is improving through regulation and wastewater treatment; first measures are taken to restore ecological health of the water bodies; and the most serious water-related risks are being addressed.

2 – engaged (7.2<11.2 for KDs, 36<55 for overall water security)

More than half the people have access to modest drinking water and sanitation facilities; water service delivery is starting to develop, supporting economic activities; first measures are taken to improve water quality; and first attempts are being made to address water-related risks.

1 – hazardous (0<7.2 for KDs, 0<36 for overall water security)

Drinking water and sanitation facilities are limited and impose serious health risks; water service delivery is mostly informal and a constraining factor for economic activities and development; water quality is poor and dangerous for people; serious damage to aquatic ecology is present; and droughts and floods drive people into poverty.

2. Adjusted AWDO Methodology for the Mongolian Context

The major objective of quantifying water security in AWDO 2016 was to compare water security across ADB member countries. For that reason, the methodology had to be applicable to all countries.
considered in AWDO 2016. However, it is evident that these countries are very different in physical conditions and challenges, and that the situation differs even within the countries.

Applying the AWDO methodology in just one country, such as in this CWSA, allows for adjusting the methodology to take the specific situation of the analyzed country into account. The overall AWDO methodology of identifying five KDs and their estimated values for assessing country water security was utilized in this study. However, the ways in which the KDs are determined was adjusted, following extensive stakeholder consultations and piloting the assessment in the five selected river basins. Further, to take regional differences within Mongolia into account, the CWSA was performed at the river basin level.

Figure 8 illustrates the iterative nature of, and the key steps taken during, development and implementation of the CWSA methodology. AWDO methodology was used, adjusted, and piloted and verified.

**Figure 8. CWSA Methodology Development**

The CWSA was conducted in cooperation with key stakeholders at national and river basin level. To determine the required adjustments to the methodology, the following steps were followed:

First, the TA team reviewed the AWDO 2016 indicators used for estimation of the five KDs, and evaluated applicability of these indicators and availability of data at river basin level in Mongolia. Based on this preliminary review, the TA team adjusted some indicators and added several new sub-indicators to reflect the circumstances of some areas (Table 4).

Second, for each of the 5 KDs, a pilot river basin was selected for further analysis of the applicability of the methodology. The selection was based on the presence of typical characteristics in the basin for that KD. Selected five pilot river basins are listed in Table 4 and the locations are shown in Figure 9.
Third, the TA team collected primary and secondary data to test and finetune the indicators and indexes for the five KDs in the pilot river basins. Primary data were collected during focus group meetings, individual interviews, as well as during workshops and surveys at aimag and soum level. About 500 people participated in the meetings, and more than 1,000 people completed questionnaires, which were collected and analyzed. Data were evaluated for reliability and trustworthiness, and triangulated wherever possible. Based on the analysis of the five pilot river basins, the assessment methodology for determining the KDs in Mongolia was finalized.

Fourth, the methodology was applied to the remaining 24 river basins.

Finally, utilizing the lessons from the pilot studies, the water security scores for all 29 river basins have been determined. Based on the river basin scores, an overall score for the country has been calculated as well as the scores by drainage basin: Arctic Ocean Basin, Pacific Ocean Basin, and Central Asia Closed Basin. To derive the national CWSA and considering Mongolia’s unequal distribution of population across the wide country, the weighted average of all river basin specific KD scores based on population (rural for KD1; urban for KD3, and total for KD2 and KD5) and land area (for KD4) (Table 4) was taken. This weighting has also been applied for the averages for drainage basins.

### Table 4. Pilot River Basins and Adjustments to AWDO 2016 Methodology

<table>
<thead>
<tr>
<th>#</th>
<th>KDS</th>
<th>PILOT RIVER BASIN</th>
<th>WATER SECURITY FOCUS</th>
<th>ADJUSTMENTS TO AWDO 2016 METHODOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>KD1</td>
<td>Household water security</td>
<td>Kherlen</td>
<td>Household water security for herder communities</td>
<td>Exclusive focus on rural household water security. Adjustment of criteria of ‘piped water supply’ to ‘improved water supply’, as piped water supply is not feasible for herder households. Adjustment (softening) of scoring for sanitation. Addition of sub-indicator on distance of main water source to herder households.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>KD2</td>
<td>Economic water security</td>
<td>Galba, Ursh Dolooodyin Gobi</td>
<td>Economic water security for mining, industry, energy, and agriculture</td>
<td>Addition of sub-indicator for the livestock, adding greater detail to the agricultural sector as livestock is the predominant activity and has different water requirements than crops.</td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KD3</td>
<td>Urban water security</td>
<td>Tuul River basin</td>
<td>Water security for Ulaanbaatar</td>
<td>Adjustment of sub-indicators on water supply and sanitation in same manner as in KD1.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KD4</td>
<td>Environmental water security</td>
<td>Khar Lake-Khovd</td>
<td>Environment</td>
<td>Simplification of scoring methodology.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KD5</td>
<td>Resilience to water-related disasters</td>
<td>Buuntsagaan Lake-Baidrag</td>
<td>Drought, flood, and dzud preparedness</td>
<td>Replacement of sub-indicator ‘storm surges and coastal floods’ with sub-indicator resilience against ‘dzud’, as Mongolia is landlocked and faces challenges with dzuds.</td>
</tr>
</tbody>
</table>

Source: TA 8855-MON: Mongolia Country Water Security Assessment
In line with the government program for reaching Sustainable Development Goals 2030, the base year for water security assessment is 2014 and the analysis has been based on 2014 socioeconomic data of 330 soums and 20-30 year averages of climate and water resources data derived from the hydro-meteorological monitoring network. Although the country and river basins’ water security indicators are based on 2014 data, the assessment can, with reasonable confidence, be considered as the ‘2016 Mongolia Country Water Security Assessment’.

Staff from the River Basin Organizations (RBOs) of the five pilot river basins followed the CWSA process and were trained on the CWSA methodology. This participatory approach, which integrates capacity building, enables the water security assessment to be periodically at the river basin and at the national levels after the completion of the project. This approach allows for active planning and management of water resources and thus lead to sustained water security.

3. Findings from the CWSA

Mongolia CWSA results estimate the national water security score at 67.4 and index at 3.6, indicating capable water security stage. National results for the KDs range between 2.3 (engaged) and 4.9 (model). These results, graphically illustrated in a radar chart of five KDs’ quantitative variables, are as follows:

- **KD1 household water security: score 11.4 / index 2.8** captures the challenges of low access to improved water and sanitation by herder communities.

- **KD2 economic water security: score 13.0 / index 2.8** alerts that water may become a constraint to economic development, particularly in Ulaanbaatar and the mining regions of the Southern Gobi, and especially during periods of low discharges and drought.

- **KD3 urban water security: score 13.1 / index 2.3** highlights the challenge of the limited proportion of urban population with access to piped water supply and sewerage, particularly in ger areas.
- **KD4 environmental water security**: score 15.2 / index 4.9 points out the high level of environmental water security and the country serving as the model in this dimension.
- **KD5 resilience to water-related disasters**: 14.6 / index 3.7 classifies Mongolia as capable in resilience to water-related disasters such as floods, droughts and *dzuds*.

![Figure 10. National Water Security for Mongolia](image)

It is apparent that all KDs are at a similar level, i.e. between 11.4 and 15.2. Water security for KD1 (rural household water security) is the weakest and for KD4 (environmental water security) is the strongest. It needs to be noted that average scores for KD2, KD3, and KD5 are strongly influenced by the scores of Tuul River basin, as approximately half of the population lives there.

The value of the (rural) household water security (KD1) is relatively low, affected by low access to improved water and sanitation of the herder communities.

The value of the economic water security (KD2) is also of concern and reflects some water constraints especially during periods of low discharges and drought. This is especially the case in the south of the country where full dependency on groundwater affects economic development.

The value of urban water security (KD3) is low due to the limited proportion of the population with access to piped water supply and sewerage. The low values of the water supply and sanitation indicators for both urban and rural areas are hot spots, requiring focused management and targeted investments to improve access to reliable and affordable water sources and sanitation facilities.

The value of the environmental water security (KD5) is high, largely due to the low population, good water quality, and reasonable proportion of land designated as state and local protection area. The low use of fertilizers for agriculture in the country also benefits environmental water security.

KD5, resilience against water-related disasters, scores reasonably well.

The scores of the five KDs and the key interventions to increase water security are shown in Table 5.
Table 5. Key Interventions for Water Security

<table>
<thead>
<tr>
<th>WATER SECURITY DIMENSION</th>
<th>KD</th>
<th>AVERAGE SCORE</th>
<th>RANGE OF SCORES</th>
<th>CORE INTERVENTIONS TO IMPROVE WATER SECURITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>KD1</td>
<td>2.8</td>
<td>2-3</td>
<td>Improved awareness and access to improved WSS for rural herder communities.</td>
</tr>
<tr>
<td>Urban</td>
<td>KD3</td>
<td>2.3</td>
<td>1-3</td>
<td>Massive requirements for financing. Major inequities in level of service between central and ger areas. Sustainability requires improved levels of cost recovery for operation and maintenance.</td>
</tr>
<tr>
<td>Environment</td>
<td>KD4</td>
<td>4.9</td>
<td>4-5</td>
<td>Strengthening of the institutional framework for management and control. Ensuring sustainable abstractions from groundwater and rivers including improved monitoring and control.</td>
</tr>
<tr>
<td>Water-Related Disaster</td>
<td>KD5</td>
<td>3.7</td>
<td>3-4</td>
<td>Improved analysis of various disaster risks to improve cost effectiveness of interventions. Key areas include; flood, drought, and dzud.</td>
</tr>
</tbody>
</table>

Source: TA 8855-MON: Mongolia Country Water Security Assessment

The river basin water security scores for each of the 29 river basins are illustrated in Figure 11 and Table 16, along with the average river basin water security scores (un-weighted and weighted).

As Figure 11 illustrates, there are no major differences in water security across Mongolia’s river basins, with river basin water security (RBWS) scores ranging from 57.2 for Khuisin Gobi Tsetseg Lake basin to 70.1 for Uvs Lake–Tes basin.

No clear distinction or pattern of scores between the different river basins can be identified. There are also no major differences in water security across the three major drainage basins.

There seem to be several reasons for the lack of variance over the river basins, including the banding criteria that were selected for some sub-indicators: (i) some criteria were so strict that all river basins scored the lowest value, i.e. the score 1; (ii) other criteria were rather ‘easy’, making all river basins to comply with that criteria and produce the maximum score of 5; and (iii) some indicators were not relevant in certain river basins (e.g. industry and hydropower), resulting in a flat score for those indicators.
Figure 11. Range of Scores for River Basin Water Security

Note: River Basin Water Security Score (RBWS) ranges from 1 (worst) to 100 (best)
Source: TA 8855-MON: Mongolia Country Water Security Assessment
<table>
<thead>
<tr>
<th>River Basin</th>
<th>KD1</th>
<th>KD2</th>
<th>KD3</th>
<th>KD4</th>
<th>KD5</th>
<th>RBWS score</th>
<th>RBWS Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score range</td>
<td>1-20</td>
<td>1-20</td>
<td>1-20</td>
<td>1-20</td>
<td>1-20</td>
<td>1-100</td>
<td>1-5</td>
</tr>
<tr>
<td>Selenge</td>
<td>12.0</td>
<td>14.0</td>
<td>12.5</td>
<td>14.7</td>
<td>13.3</td>
<td>66.5</td>
<td>3.5</td>
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<tr>
<td>Khuvsugul lake Eg</td>
<td>12.0</td>
<td>12.1</td>
<td>8.8</td>
<td>18.7</td>
<td>13.2</td>
<td>64.7</td>
<td>3.4</td>
</tr>
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<td>Shishkhid</td>
<td>11.3</td>
<td>10.8</td>
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<td>18.7</td>
<td>12.9</td>
<td>62.4</td>
<td>3.3</td>
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<td>Delgermurun</td>
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<td>12.2</td>
<td>11.3</td>
<td>17.3</td>
<td>12.0</td>
<td>64.6</td>
<td>3.4</td>
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<td>Idar</td>
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<td>10.0</td>
<td>12.5</td>
<td>16.0</td>
<td>13.9</td>
<td>64.4</td>
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<td>Chuluut</td>
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<td>11.0</td>
<td>12.5</td>
<td>16.0</td>
<td>13.6</td>
<td>64.1</td>
<td>3.4</td>
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<td>12.2</td>
<td>7.5</td>
<td>17.3</td>
<td>13.1</td>
<td>61.5</td>
<td>3.3</td>
</tr>
<tr>
<td>Orkhon</td>
<td>11.3</td>
<td>15.2</td>
<td>12.5</td>
<td>14.7</td>
<td>14.0</td>
<td>67.7</td>
<td>3.6</td>
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<td>Tuul</td>
<td>12.0</td>
<td>12.6</td>
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<td>12.0</td>
<td>14.9</td>
<td>65.3</td>
<td>3.5</td>
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<tr>
<td>Kharaa</td>
<td>11.6</td>
<td>15.4</td>
<td>12.5</td>
<td>13.3</td>
<td>13.4</td>
<td>66.3</td>
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<td>Eero</td>
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<td>17.3</td>
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<td>11.6</td>
<td>12.5</td>
<td>18.7</td>
<td>14.9</td>
<td>68.9</td>
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<td>Ulz</td>
<td>11.1</td>
<td>12.3</td>
<td>12.5</td>
<td>12.0</td>
<td>16.7</td>
<td>64.7</td>
<td>3.4</td>
</tr>
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<td>Kherten</td>
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<td>13.7</td>
<td>11.3</td>
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<td>16.6</td>
<td>69.4</td>
<td>3.7</td>
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<td>11.2</td>
<td>10.0</td>
<td>20.0</td>
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<td>68.0</td>
<td>3.6</td>
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<td>12.8</td>
<td>12.5</td>
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<td>16.4</td>
<td>66.6</td>
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<tr>
<td>Umard govin guwet khalkhiin</td>
<td>10.8</td>
<td>12.0</td>
<td>12.5</td>
<td>14.7</td>
<td>16.5</td>
<td>66.4</td>
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<tr>
<td>Galba Ursh Doloodyn gov</td>
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<td>12.4</td>
<td>8.8</td>
<td>13.3</td>
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<td>13.8</td>
<td>13.3</td>
<td>15.0</td>
<td>63.9</td>
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<td>10.6</td>
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<td>17.3</td>
<td>15.0</td>
<td>66.2</td>
<td>3.5</td>
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<td>Orog Lake-Tiyi</td>
<td>11.4</td>
<td>14.3</td>
<td>12.5</td>
<td>17.3</td>
<td>12.4</td>
<td>68.0</td>
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<td>Buuntsagaan lake Baidrag</td>
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<td>13.8</td>
<td>13.8</td>
<td>16.0</td>
<td>12.9</td>
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<td>3.6</td>
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<tr>
<td>Khyargas lake Zavkhan</td>
<td>11.6</td>
<td>12.4</td>
<td>13.8</td>
<td>17.3</td>
<td>13.3</td>
<td>68.4</td>
<td>3.6</td>
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<tr>
<td>Khuisiin lake</td>
<td>11.5</td>
<td>9.6</td>
<td>7.5</td>
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<td>13.9</td>
<td>57.2</td>
<td>3.1</td>
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<tr>
<td>Uench – Bodonch</td>
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<td>10.0</td>
<td>10.0</td>
<td>18.7</td>
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<td>Bulgan</td>
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<td>16.0</td>
<td>12.9</td>
<td>64.0</td>
<td>3.4</td>
</tr>
<tr>
<td>Khar Lake Khovd</td>
<td>10.9</td>
<td>13.2</td>
<td>12.5</td>
<td>16.0</td>
<td>15.2</td>
<td>67.8</td>
<td>3.6</td>
</tr>
<tr>
<td>Uvs Lake – Tes</td>
<td>11.8</td>
<td>13.4</td>
<td>13.8</td>
<td>16.0</td>
<td>15.2</td>
<td>70.1</td>
<td>3.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>River Basin</th>
<th>KD1</th>
<th>KD2</th>
<th>KD3</th>
<th>KD4</th>
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<th>RBWS score</th>
<th>RBWS Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score range</td>
<td>Avg</td>
<td>Avg</td>
<td>Avg</td>
<td>Avg</td>
<td>Avg</td>
<td>Avg</td>
<td>Avg</td>
</tr>
</tbody>
</table>

| Mongolian Average           | 11.5| 12.3| 11.6| 16.0| 14.1| 65.5       | 3.5        |
| Mongolia - weighted average | 11.4| 13.0| 13.1| 15.2| 14.6| 67.4       | 3.6        |

| Arctic Ocean Basin          | 11.7| 13.1| 13.4| 15.6| 14.5| 68.3       | 3.6        |
| Pacific Ocean              | 11.8| 13.4| 11.4| 16.1| 16.4| 69.2       | 3.7        |
| Central Asia Closed Basin   | 11.2| 12.6| 12.5| 15.0| 14.6| 65.8       | 3.5        |

**Notes:**
1. Each score ranges from 1 (worst) to 20 (best).
2. The overall River Basin Water Security Score (RBWS) ranges from 1 (worst) to 100 (best).
3. The River Basin Water Security (RBWS) Index ranges from 1 (worst) to 5 (best).

Source: TA 8855-MON: Mongolia Country Water Security Assessment
The water security score indicates that, in terms of water security stages, all river basins are capable and some are even close to effective. There is good scope to make significant improvements; the most important needed investments by KD are:

- KD1: improved water supply and sanitation for herders.
- KD2: improved water supply for mining, energy and extension of irrigation.
- KD3: improved water supply and sanitation in urban centers.
- KD4: improved sewage treatment capacity.
- KD5: building resilience against water-related disasters, including storage for flooding and drought.

B. KD1: Household Water Security

1. Customized Methodology and Indicators

Household water security (KD1) provides an assessment of the extent to which countries are satisfying their household water and sanitation needs and improving hygiene for public health in all communities. Universal access to clean water and sanitation focuses on two targets: (i) Sustainable Development Goal 6; and (ii) Mongolia’s 2030 Sustainable Development vision. Household water security is an essential foundation for efforts to eradicate poverty and support economic development.

The Kherlen River basin has been selected as a pilot river basin to test and study KD1. The Kherlen River is the longest river in Mongolia with a drainage area of 107,813 km². The river basin consists of 36 soums of six aimags as well as the Baganuur, which is a part of the peri-urban district of Ulaanbaatar.

The AWDO household water security index is a composite of three indicators: (i) access to piped water supply (proportion of population); (ii) access to improved sanitation (proportion of population); and (iii) hygiene, quantified by DALYs per 100,000 people for the incidence of diarrhea.

In assessing household water security for the Kherlen River basin, following adjustment to the AWDO methodology have been made:

- KD1 is now only addressing the rural population (the urban population is considered in KD4). 
  Based on extensive consultations with government and stakeholders, it was agreed that the assessment of KD1 would focus on one-third of the total population that live in rural areas, who are engaged in pastoral livestock herding as their primary source of livelihood. This group currently has the lowest levels of access to improved WSS.

- The criteria for water supply has been changed from ‘piped’ to ‘improved’. Traditionally, herders move four times a year depending on availability of pasture and water and many households live remotely from aimag and soum centers, away from any piped service of WSS. This means that providing ‘piped’ water to herders is practically and economically impossible.

- Scoring for the improved sanitation has been adjusted: the criteria for the lowest scores of the access to improved sanitation (1, 2, and 3) have been slightly reduced. The scoring interval has been adjusted considering Mongolia’s 2030 Sustainable Development Vision to provide improved sanitation to 40%, 50%, and 60% of the population in the periods 2016-2020, 2021-2025, and 2016-2030 respectively.

- An indicator for ‘distance to water source’ was added. Camping of a herder depends on the access to safe and affordable water sources at reasonable distances from the home. Water supply points in the pasture areas are very important for both herders and livestock. Therefore, the AWDO framework has been adjusted to reflect this lifestyle of pastoral system of Mongolia. As herders generally go at least once a day for water for their livestock and get water for domestic use, distance to the water supply point has been added as one of the indicators to
assess the herder water security. The distance assessed in this study was 1,000 meters. (percentage of persons that get their water at >1,000 m distance).

Therefore, the adjusted household water security index for Mongolia is a composite of four indicators as shown in Figure 12: (i) access to improved water supply (proportion of population); (ii) access to improved sanitation (proportion of population); (iii) hygiene, DALYs per 100,000 people for the incidence of diarrhea; and (iv) distance to water source points (meters).

**Figure 12. Indicators for the Household Water Security Assessment Framework**

Source: TA 8855-MON: Mongolia Country Water Security Assessment

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2. **Household Water Security Scores at National Level**

Figure 13 shows the results of assessing KD1 at the country level.

**Figure 13. Country Household Water Security**

Source: TA 8855-MON: Mongolia Country Water Security Assessment

All the four indicators are scored between 1 and 5 against a set of predefined criteria.
The total KD1 score for Kherlen River basin is the sum of these four indicators: improved water supply (1), improved sanitation (1), hygiene (4.9), and distance to water source (5). This results in a score for KD1 of 11.9. The maximum score for KD1 is 20.0. Both water supply and sanitation have scores of about 1 (out of 5); as with many other river basins, poor access by herders to improved WSS is a critical area. Hygiene and distance have higher scores of between 4 and 5 (out of 5), which indicates less concern in these areas. The occurrence of diarrheal diseases is less than 4.5 per 1,000 inhabitants. About 23% of herders take their water from more than 1,000 meters.

The application of the adjusted methodology of KD1 to the Kherlen basin shows that this adjusted methodology can be applied. The data is available and the values of the four indicators can be determined. Discussion is possible about determination of the soum averaged value for the basin. It seems reasonable that a population weighted average will be used.

3. Household Water Security Scores at River Basin Level

Access to Improved Water Supply

The criterion for water supply is that 60% of the rural population should have access to improved water supply. All soums scored 1 for this sub-indicator, which is very low. None of the soums can reach the criteria of 60% to go to the next level. Data per river basin is provided in Figure 14.

According to the National Statistical Office, sources such as boreholes, protected springs, and public tap stands or standpipes are classified as ‘improved’, as they are protected from contamination by capping and fitted with water pumps. Sources classified as ‘unimproved’ include dug wells, unprotected springs, and surface water abstraction points on rivers, dams, lakes, and streams. Herders depend on two water sources: boreholes and protected springs, both of which are classified as ‘improved’.

Figure 14. Rural Household Access to Improved Water Supply

Source: TA 8855-MON: Mongolia Country Water Security Assessment
Access to Improved Sanitation

The criterion for improved sanitation is that 40% of the rural population should have access to improved sanitation. All soums scored only 1 for this sub-indicator.

According to the National Statistical Office, piped sanitation, septic tanks, ventilated pit latrines and bio-toilets are classified as 'improved sanitation facilities', while simple pit latrines and open defecation are classified as 'unimproved'. In rural area households only use simple pit latrines. It should be noted that many herder households, especially those which live near to aimag and soum centers, use improved ventilated pit latrines. However, only less than 30% have access to such improved sanitation.

The data by river basin is given in Figure 15.

Figure 15. Herder household access to sanitation

Hygiene

The criterion for hygiene is the number of diarrhea occurrences per 1,000 people. If the number of diarrhea occurrences per 1,000 people is less than two, it is considered as 'model' (score = 5); if the number is between 2 and 5, it is considered 'effective' (score = 4).

As Figure 16 shows, the actual number of occurrences of diarrhea in Mongolia is very low. This results in very high scores (4 and up) for this criterion. The high score for hygiene despite the lower indicators of WSS is due to the Mongolian tradition of not drinking un-boiled water and the low population densities in the rural areas. Also, extremely cold and long-lasting winters do not favor disease-causing organisms. Moreover, in winter, the herdiers are quite isolated, which reduces spread of disease.
Distance to Water Source

The score for this sub-indicator depends on the percentage of herders which need to get the water for their livestock from more than 1,000 m. The actual distance is illustrated in Figure 17. It becomes apparent that the percentage of herders that must travel more than 1,000 m differs per river basin. Roughly, it can be said that the herders from the Central Asian Closed Basin, especially from the Southern Gobi Region, need to travel longest for water, with a maximum of 37% having to travel for more than 1,000 m to the next water source in the Umard Gobi Guveet-Khalhiin Dundad Tal River basin. Distance for all river basins is low, hence, the scores for this sub-indicator are high.
4. Risks and Management Options

Some potential risks associated with low WSS at the household level, as well as possible management options to improve rural WSS, are given in Table 7.

Table 7. Potential Risks to Water Supply and Sanitation

<table>
<thead>
<tr>
<th>RISKS</th>
<th>IMPACTS</th>
<th>POSSIBLE ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited improved water source points in permafrost area</td>
<td>Use of surface water for drinking</td>
<td>Introduce thermal system/feasible technical solutions suitable for wells in permafrost area to prevent freezing. Advance in regular dissemination of surface water quality information to rural population with insurance of suitability for drinking purpose</td>
</tr>
<tr>
<td>Limited improved water source points in spring and autumn places of herders</td>
<td>Pasture degradation, overgrazing around limited water source points</td>
<td>Increase water source in spring and autumn places</td>
</tr>
<tr>
<td>Insufficient water quality monitoring for wells intended for drinking water</td>
<td>Long-term health issues</td>
<td>Develop water quality monitoring program of wells for drinking purpose and ensure dissemination of results to users</td>
</tr>
<tr>
<td>Pit latrine pollution: Soil pollution in summer places of herders</td>
<td>Groundwater pollution, Livestock diseases</td>
<td>Advance feasible and cost-effective technical solutions for on-site sanitation and pit latrines facilities</td>
</tr>
</tbody>
</table>
### Economic Water Security

#### Customized Methodology and Indicators

Economic water security (KD2) describes the extent to which a country can meet the water demand in terms of quantity and quality for the various economic sectors, including agriculture, industry, and energy.

Galba Uush Dolood basin, commonly known as Galba Uush basin, was selected for the study of economic water security. The basin is a large and sparsely populated area, with few transport links but with enormous mineral wealth, including large coal and major copper deposits. Most of the mining activities in the South Gobi Region are in the Galba Uush basin.

The economic water security index per AWDO consists of four indicators: (i) broad economy; (ii) agriculture water productivity; (iii) energy water productivity; and (iv) industrial water productivity.

#### Figure 18. Economic Water Security Assessment Framework

No significant adjustment was made to the AWDO framework for this KD, except that the livestock sector is added as an important economic sector in Mongolia next to arable farming.

In Mongolia, given the climatic conditions, a major part of the agricultural sector consists of livestock, with 80% of agricultural land allocated as pasture. To account for the different water requirements of livestock when compared to crops, it was decided to divide the indicator for agriculture into two indicators for the CWSA in Mongolia, namely into crop and livestock. Therefore, the livestock and agricultural sector water productivity and self-sufficiency have been taken as two separate indicators.
This means that in the Mongolia CWSA, five indicators are being evaluated, as compared to four in the AWDO methodology.

2. **Economic Water Security (KD2) Scores at National Level**

![Figure 19. Country Economic Water Security](image)

Source: TA 8855-MON: Mongolia Country Water Security Assessment

The results of the assessment show that **KD2 scores 12.4** (out of 20) for Galba Uush Dolood basin. The scores for broad economy, crop land, industry and energy are around 3. For the indicator on livestock, the Galba Uush Dolood basin scores around 4 (‘effective’).

The basin experiences a high degree of intra-annual rainfall variability and there is no dam or water storage facility. For the coal mining regions within the Gobi, a recent assessment by the 2030 Water Resources Group (2016) found that a water supply-demand gap of 35% (34 Mm³/year) can be expected by 2030 in the Nyalga Shivee Ovoo region, and a 60% water supply-demand gap by 2030 in Tavan Tolgoi. Key drivers for the water gap are planned investments in value-adding mining infrastructure (power plants, coal washing, coal to liquid plants and coal to briquette plants). Providing surface water from the north, e.g. via the assessed Orkhon-Gobi water transfer scheme, is very costly. Thus, focus should be set on water demand reduction measures, along with further investigations on the sustainable use of groundwater in this area.

3. **Economic Water Security Scores at River Basin Level**

**Broad Economy**

This indicator measures physical possibility to supply the demand, based on the climatological variability of the water resource, the water balance (including storage facilities) and our knowledge on the system.

The **score for Mongolia is 2.9**, showing that improvements can be made, among others, by increasing storage facilities of water to be able to deal with the climate variability in the country. The present storage capacity in dams is only 1.2 km³, which is about 3% of the renewable water resources. Further, the present storage is mainly used for hydropower; 98% is provided by two major hydropower plans, the Tahir on the Zavkan River and the Durgen on the Chonokhairakh River.
Crop Agriculture

This indicator measures water productivity ($\text{million/km}^3$ of water) in agriculture and the self-sufficiency ratio.

The water security index for crop agriculture in Mongolia amounts to 2.7 (out of 5.0), reflecting the challenges related to agriculture. The short growing season, extreme fluctuation in temperature and precipitation provide limited potential for agricultural development. Cultivated crops include wheat, barley, potatoes, and about 30 types of vegetables.

Currently, about 54,000 ha are under irrigation against a potential area of around 400,000 ha. The Government of Mongolia aims to increase irrigated land to 120,000 hectares by 2030, to support self-sufficiency in food. There are currently more than 200 irrigation schemes in Mongolia. Density of irrigation schemes is highest in the Kharaa River basin and the downstream parts of the Selenge and Orkhon River basins. Almost all irrigation systems are recognized as underperforming regarding water efficiency and the sustainability of infrastructure; investment in maintenance is insufficient.

Livestock

Similar to crop agriculture, the indicator for livestock measures water productivity ($\text{million/km}^3$ of water) and self-sufficiency ratio for livestock. On a national level, the water security index for livestock amounts to 4.0 (out of 5.0), i.e. it is classified as ‘effective’ and suggests that there are no major challenges affecting water security. The non-population-weighted average gave a score 4.7. The low score of Tuul River basin (score 3.0), with their high population, caused the score to drop to 4.0.

The livestock sub-sector accounts for almost 10% of export earnings and approximately 80% of total agricultural production. About 20% of households and over 70% of employment in rural areas are directly engaged in the livestock sector providing food and goods for internal use and exports. The livestock numbers are increasing from year to year. Regarding water security, there is a need to balance sustainability of the environment and the economy. Therefore, investing in the improvement of livestock health, productivity, and marketing needs to be balanced with water supply side management, which would facilitate better quality products and export-oriented development.

Industry

This indicator measures the water productivity of industrial output (m$/\text{km}^3$). The CWSPA index for industry results in 3.3, classifying it as ‘capable’.

Industrial activities vary strongly across the river basins. In many river basins, there are no industrial activities. This makes the scoring for the water productivity in these basins unfeasible. In the approach followed for this CWSPA, a score of 1 is assumed in case there were no industrial activities. This leads to an underestimate for the score of the water productivity in industry for the country as a whole. This explains the low score of 3.3. Without the population weighting, the score would be even lower at 2.3. Most industry is found in the Tuul River basin and in the river basins of the Gobi Desert, where the CWSPA indices are 4.0 and 2.0 respectively.

31 Water is a critical natural resource necessary for efficient livestock production and mitigating environmental risks associated with production. The government is investing in increasing water supply sources. In 2014, the government invested MNT 7 billion ($2.9 Million) to construct 465 wells and MNT 1 billion ($0.41 Million) for water pumps operated by renewable energy. Currently, there are an estimated 41,000 wells in the pasture areas. While the government pursues a goal to limit livestock population according to the pasture carrying capacity, the policy, inputs, and services are not in place to enable this. As of 2014, livestock numbers exceed the pasture carrying capacity.
Mongolia’s key mining activities, the backbone of the economy, are in the Gobi Desert. Coal mining activities are in two key areas: The Nyalga Shivee Ovoo, Bagnauur, as well as Tavan Tolgoi. Mongolia’s largest copper mine, Oyu Tolgoi, is also located in the Gobi Desert. While most of Mongolia’s industry, excluding mining, is in Ulaanbaatar in the Tuul River basin, total water usage is comparatively low when compared to other sectors. However, the predicted water supply-demand gap in Ulaanbaatar by 2030, can be expected to impact industrial activities if business-as-usual prevails.

**Energy**

The energy indicator measures water productivity (GWh/km³) of energy generation in the river basins as well as the minimum platform that should be achieved. While the significance of this indicator at the river basin level, in particular for small river basins, is expected to be low, the score was included across all river basins. The weighted average score is 3.3 (out of 5), while the non-weighted score would be 2.4; the Tuul River basin with a score of 4.0 increased the weighted average.

Most energy is generated in Mongolia by coal-fired power plants, which predominantly require water for cooling; combined heat and power plants are one of the key water users in the Tuul River basin, particularly in the capital Ulaanbaatar. Hydropower generation does not ‘consume’ water itself. However, the increased surface open water in the reservoirs leads to increased evaporation.

4. **Risks and Management Options**

Potential risks associated with the economic water security and some possible management options are outlined in Table 8. A main risk is the natural variability of the supply and the limited storage facilities in Mongolia. Increasing water productivity in agriculture and energy is related to the political choice to be independent from neighboring countries and to generate clear energy. The water supply to the mining areas in the Gobi deserves special attention.

Although KD2 is not directly related to environmental issues (measured by KD4), it should be kept in mind that investments in the economic sector that leads to increased water use can have negative (but sometimes also positive) effects on the environment.

<table>
<thead>
<tr>
<th>RISKS</th>
<th>IMPACTS</th>
<th>POSSIBLE MANAGEMENT OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insufficient water storage to support dry periods and drought years</td>
<td>Reduced water resources for all economic activities.</td>
<td>Develop long-term river water regulation works at head waters and major rivers.</td>
</tr>
<tr>
<td></td>
<td>Crop failure and increased dependency on imported agricultural products, such as wheat, flour, and vegetables.</td>
<td>Increase in irrigated area, rehabilitation of existing irrigation schemes, increase in irrigation efficiency - priority should be given to major crop land regions.</td>
</tr>
<tr>
<td>Limited energy security</td>
<td>Dependency of energy import, with potentially increased energy costs.</td>
<td>Increase water efficiency in existing power plants.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mandate dry/ air cooling for all new power plants and expand energy production.</td>
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<td></td>
<td></td>
<td>Use treated wastewater for power plant water demand.</td>
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<tr>
<td></td>
<td></td>
<td>Promote renewable energy.</td>
</tr>
<tr>
<td>Limited ground water resources in strategic mining areas</td>
<td>Insufficient water for mining and related value adding industries; Increased conflict between local community and mining companies</td>
<td>Enforce water demand saving measures in mining and mining related industries, Increase investigation and verification of ground water resources.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promote public awareness of water resources information.</td>
</tr>
</tbody>
</table>
Increased waste water discharges from mining

Increased surface water pollution

Strengthening of legislation and standard enforcement.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

D. KD3: Urban Water Security

Urban areas in Mongolia are defined as a settlement of over 15,000 people: all aimag centers have populations which meet this criterion. The capital city of Ulaanbaatar as well as the aimag centers have become important economic drivers in Mongolia. The soum centers with populations of around 2,000-5,000 fall below the urban category in the official statistics, however the inhabitants are counted as urban population. Moreover, a soum center is a permanent settlement where people have a right to get affordable WSS facilities and are included in the urban water security assessment.

1. Customized Methodology and Indicators

The Tuul River basin was selected as the case study to assess urban water security (KD3).

The AWDO urban water security index measures how countries are creating better urban water services and management to develop vibrant, livable cities and towns and provides an assessment of the extent to which countries are satisfying their household water and sanitation needs and improving hygiene for public health in all communities.

The AWDO framework of KD3 is a composite of four indicators addressing urban water supply: (i) access to piped urban water supply (proportion of population); (ii) urban wastewater collected (proportion of population); (iii) economic damage due to floods and storms (proportion of GDP); and (iv) river health (taken from KD4).

In assessing urban water security for the Tuul River basin, following adjustment to the AWDO methodology have been made:

- The criteria for urban water supply has been changed from 'piped' to 'improved'. There is no piped water supply in most of the soums. Most of the soums however have protected wells, which is in the category of improved water supply source. Therefore, the access to improved water supply has been used as criteria.

- For urban sanitation, instead of urban wastewater collected, access to improved sanitation (proportion of population) was used. All aimag centers and only a few soum centers are equipped with seweraged wastewater treatment. Most of the public and commercial buildings are connected to this system. There are also a few apartment buildings in most of the aimag centers connected to wastewater treatment. Even in Ulaanbaatar, about 60% of the population lives in houses not connected to the wastewater treatment. However, it should be noted that about 98% of households have a latrine within their household premises. Therefore, access to improved sanitation has been used as criteria.

- For estimating urban flooding indicator, statistical methods, flood frequency analysis, and rainfall-run-off analysis used to estimate 1000, 100, 50, and 25-year floods. The score of the drainage is based on a 1:50 year flood. The most challenging issue to calculate this indicator is that there are no observed flood events and corresponding damages expressed in money.

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32 Mongolia experienced a 2.6% annual rate of urban spatial expansion from 2000-2010, the fifth highest in the region and ahead of 10 other countries. However, it remains to be at the third place in the world for low urban population density.
Therefore, the adjusted urban water security index for Mongolia is a composite of four indicators: (i) access to improved urban water supply (proportion of population); (ii) access to improved sanitation (proportion of population); (iii) urban flooding; and (iv) river health (taken from KD4).

The score of urban water security is 2 and is the lowest amongst of the KDs. Wastewater treatment is scored just 1 by option 1 and 2 by option 2.\(^3\) The population of Ulaanbaatar, soum and aimag centers are lacking in having access to sewerage system. Additional efforts and well-targeted investments are required to improve sanitation in the urban centers including the use of decentralized sanitation for low-density urban areas.

2. Urban Water Security Scores at National Level

Mongolia’s national country water security assessment score for urban water security (KD3) is 13.1 (out of 20). The scoring on the three indicators assessing urban water security is illustrated in Figure 20. The figure shows that the score for water supply at 4.6 (out of 5) is high. However, it needs to be noted that this is mostly due to the adjustment in methodology to reduce the required from piped to improved water sources. The score of 1.9 (out of 5) for sanitation highlights that sanitation is a major issue in the urban areas in Mongolia. The score for drainage (3.0 out of 5) shows that further improvements should be made.

![Figure 20. Urban Water Security](source: TA 8855-MON: Mongolia Country Water Security Assessment)

3. Urban Water Security Scores at River Basin Level

Water Supply

The criterion for this sub-indicator in CWSA Mongolia is the percentage of people that have access to improved water supply. The criterion of AWDO 2016 methodology is stronger as it relates to ‘piped water supply’, while this assessment refers to ‘improved water supply’. The situation in Mongolia is illustrated in Figure 21. If the percentage of people having access to improved water supply is less than 60%, the score is 1 (‘hazardous’). Across all river basins, the score for improved water supply is very high with 4.6 (out of 5).

33 Option 1 is access to piped sewerage and option 2 is access to improved sewerage.
Sanitation

The criterion for sanitation is to have at least 40% of people having access to improved sanitation; below 40%, a score of 1 is given. Figure 22 shows that most river basins achieve the 40% target and thus score a 2. Only one river basin (Shishkid) scores with 60.6% and has a score of 3. The river basin facing the greatest challenge around sanitation with less than 25% of people have access is Kherlen. The result is an average score for the whole country of 1.9 (out of 5), indicating the challenges Mongolia faces with respect to sanitation.
4. Risks and Management Options

While most of Mongolia’s population has access to ‘improved water sources’, water supply facilities need to be further improved to provide ‘piped water supply’, where practically and economically feasible. Once expanded, the CWSA for Mongolia can be re-adjusted to assess ‘piped water supply’ as criterion for urban water security, rather than just ‘improved water sources’.

To allow for urban water security, it is crucial to improve sanitation. Nearly 50% of the municipal waste water treatment plants do not function properly; the discharge of insufficiently treated municipal wastewater, together with untreated industrial effluents (including tanneries and mining) cause significant surface water pollution. Further, flash floods in the summer can cause inundation and overtopping of pit latrines and soak pits from urban ger areas in urban centers, which are contributing to water pollution and pose threats to human health. There are also water pollution challenges related to flooding of solid waste sites and the effects of increased runoff due to development of roads and buildings.

Surface water depletion and degradation adversely affect human health and affect the rural areas downstream causing issues for livestock watering which indirectly limits the use of pasture land and irrigation and threatens biodiversity and wildlife habitats.

There is a need for targeted measures and focused investment in flood management river works in aimag and soum centers. The investment needs to be balanced with parallel investments in sewerages
and on-site sanitation facilities; both are high priorities to provide environmentally friendly, economically viable access to reliable sanitation infrastructure. In parallel, it is also important to invest in wastewater discharge monitoring and strengthening of the capacity of monitoring to prevent pollution of the environment with special focus on rivers and lakes. Potential risks associated with urban water security and possible management options are given in Table 9. Some of the risks described in household water security are also a concern to urban water security; only the additional risks for the urban sector are included in the table.

Table 9. Potential Risks to Urban Water Security

<table>
<thead>
<tr>
<th>RISKS</th>
<th>IMPACTS</th>
<th>POSSIBLE MANAGEMENT OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growing urban population, in ger areas and apartments</td>
<td>Increased demand on water</td>
<td>More detailed assessment of water resources Development of water storage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Promote demand based management</td>
</tr>
<tr>
<td></td>
<td>Increased number of pit latrines</td>
<td>Strengthening related standard enforcement Advance feasible and cost-effective technical solutions for onsite sanitation facilities and advocacy</td>
</tr>
<tr>
<td>Limited expertise in managing centralized water supply and waste water treatment</td>
<td>Freezing of high investment in centralized system</td>
<td>Ensure an advance of onsite or decentralized sanitation facilities in aimag and soum centers as well as in ger area of Ulaanbaatar</td>
</tr>
<tr>
<td>Poor flood drainage system</td>
<td>Increased flood damages</td>
<td>Improve drainage system, particularly in Ulaanbaatar</td>
</tr>
<tr>
<td>No flood protection works in aimags and soums centers</td>
<td>Increased risk of floods</td>
<td>Construct flood protection works in aimag and soum centers</td>
</tr>
<tr>
<td>Degradation of river basin health</td>
<td>Decreased ecosystem services</td>
<td>Strengthening enforcement of standards and regulations on treatment and discharge of municipal and industrial wastewater</td>
</tr>
</tbody>
</table>

Source: TA 8855-MON: Mongolia Country Water Security Assessment

E. KD4: Environmental Water Security

1. Customized Methodology and Indicators

Water security for the environment is a somewhat intangible concept, as many of the issues are largely invisible to the general population. Anthropogenic changes have profound impacts on water flows and the natural environment and in time will affect the capacities to sustain human wellbeing. The core assets of nature include water security and underpin humanity’s options and future opportunities, even if the legacy of market forces driving much of the political and business decision making do not yet reflect this reality.

Environmental water security (KD4) describes how well a country is able to develop and manage its river basins with the aim to sustain the critical ecosystem services that are provided by rivers. Environmental water security is measured by three separate components, as shown in Figure 23. Each of these represents a separate process that contributes to or reduces environmental water security.
2. Environmental Water Security Scores at National Level

The total score of KD4 for Mongolia is 15.2 (out of 20) with the individual scores on the sub-indicators illustrated in Figure 24. On a national level, Mongolia has high scores for governance of the environment. The score for river health is 3.4, (out of 5) indicating that Mongolia faces challenges in this regard; for about 60% of the river basins the river health index is lower than the country average, demanding special attention in the Gobi and in the steppe region, such as in the basins Menengiin Tal, Umard Goviin Guveet-Khalhiin Tal, Galba-Uush-Doloodiin Govi and Altain Uvur Govi, there are high hydrologic alterations which is mainly a response to the very low quantities of surface water resources in these basins. The score on governance of the environment is lowest in the river basins Selenge, Orkhon, Tuul, Kharaa, Ulz and Galba-Uush-Doloodiin Govi, largely due to higher populations and water pollution.

3. Environmental Water Security Scores at River Basin Level

River Health

The sub-indicator river health describes the level of threats to the water quality and ecosystems of the river systems. Typical driving forces are population growth, water demand, economic development and agricultural land use. The score is determined by a pixel based GIS analysis.
The overall score is 3.4 (out of 5.0). The scores for river health are for most of the (sparsely inhabited) river basins high. None of the basin score lower than 3. Two basins score the perfect 5, i.e. Onon and Buir Lake Khalkh Govi.

**Hydrologic Alteration**

The sub-indicator Hydrologic Alteration describes how much the river flow and dynamics have been changed from its original state. Changes may be due to abstractions, weirs, dams, etc. These changes put pressure on aquatic ecosystems.

The score for Hydrologic Flow Alteration at the national level is 4.0 (out of 5) which is good; some river basins however only score 3 (out of 5), such as Menengiin Tal, Uamrard Govind Guveet Khaihnin, Galba Ursh Doloodying Govi and Altain Uvur Govi. This scoring reflects that most river systems in Mongolia are still hardly ‘developed’. Only a few dams have been built and withdrawals are small due to limited economic activities in the basin. The limited withdrawals are also due to strict regulations in the country on the amount of permitted withdrawals. MET (2016) has regulated these withdrawals as percentage of the long-term average discharge. The allowed withdrawals are specified by river basin and by location (upstream, middle stream and downstream) and range from 0 to 10%.

**Governance of the Environment**

The sub-indicator governance on the environment captures how complete and effective governmental regulations are to protect the environment. This is a very strong point in Mongolia. Mongolia has passed over 30 environmental laws on healthy human living conditions, ecologically balanced socioeconomic development, and on conservation, sustainable use and restoration of natural resources including water resources in the country. Several initiatives, such as the National Sustainable Program (2016), Water Program (2010), and the State Energy Program (2015) and the State Forest Program (2015) were approved to conserve and manage the country’s fragile environment in a sustainable manner, while supporting national development. Mongolia has joined 14 UN Conventions and international treaties on the environment. However, it must be stated that implementation and enforcement of these laws and strategies are hampered by inconsistent and often weak enforcement of regulations.

The overall score on governance for the environment in Mongolia is 4.1. More than 50% of the river basins scored the highest score (5.0), while three river basins score only 1 2, namely Tuul, Kharaa and Ulz.

4. **Risks and Management Options**

KD4 has the highest score of all five KDs. Economic development and climate change poses potential risks for future environmental water security. These risks, their impacts and possible management options are shown in Table 10.

**Table 10. Risks to Environmental Water Security**

<table>
<thead>
<tr>
<th>RISKS</th>
<th>IMPACTS</th>
<th>POSSIBLE MANAGEMENT OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased human pressure such as mining, exceeding of pasture capacity, urbanization, etc.</td>
<td>Reduced river health and damage to the river ecologies due to over-abstraction. Increased pollution of water resources due to untreated municipal and industrial effluent, as well as mining and agricultural run-off.</td>
<td>Strengthened Conservation of Catchment Areas. Advance in developing regulations for natural and artificial rivers Increased investment in implementation of IWRM plan at river basin level Increased allocation of water fee to water and environment management</td>
</tr>
</tbody>
</table>
Increased enforcement of mining operations to meet national environmental standards and best practices
Increased enforcement of municipal and industrial wastewater treatment and discharge
Clearance of polluted section/parts of water bodies, particularly of the Tuul river

No clear regulation on quality assurance, publishing and sharing data on water resources, withdrawal and demand
Using or reporting of different numbers of water resources by different individuals and organizations lead to misunderstanding among users and prevents fact-based decision making.
Assignment of responsibility to particular institutions on verifying and managing data on water resources, e.g. Institute of Meteorology, Hydrology and Environmental Research and Information be responsible for surface water resources information

Source: TA 8855-MON: Mongolia Country Water Security Assessment

F. KD5: Resilience to Water-Related Disasters

Weather and water-related hazardous events such as floods, thunderstorms, show and windstorms have increased by about four times for the last 25 years (MEGDT, 2014). Annually there are about 70 weather and water-related events in Mongolia, out of which 40% are heavy rain and flash floods. The trends are shown in Figure 25. This figure is excluding droughts and dzuds which are more slow-moving natural hazards that occupy a large area and last for longer times.

**Figure 25. Trends of Weather and Water-Related Events, 2014**

1. Customized Methodology and Indicators

Resilience to water-related disasters (KD5) describes the capacity of a country to cope with and recover from the impacts of water-related disasters. The areas considered in the framework are shown in Figure 26 below. More details on the methodology are provided in Appendix 1.

**Figure 26. Water-Related Disaster Security Framework**

![Diagram of water-related disaster security framework](Source: TA 8855-MON: Mongolia Country Water Security Assessment)

For the CWSA Mongolia the sub-indicator ‘storm surges and coastal floods’ from the AWDO 2016 methodology was removed, as Mongolia is a land locked country, and replaced with ‘dzuds’. A dzud is a severe winter event that can take different forms; a white dzud results from high snowfall, which prevents livestock from grazing, while a black dzud results from a lack of snow and resulting in lack of access to snow as a source of water. These important weather-related phenomena can result in the death of large number of livestock.

2. Resilience to Water-Related Disasters Scores at National Level

The overall score for KD5 is 14.6 (out of 20) while the individual scores of the three indicators are illustrated in Figure 27. The river basins most at risk from water-related disasters, especially from flood and dzud are: Buuntsagaan lake-Baidrag, Orog Lake-Tyi, Shishkhed and Delgermiren river basins. The river basins Galba Uush Dolood Gobi and Umard Gobi Guveet Khalkh Tal basins are most vulnerable to drought. The severe natural conditions and low levels of investments result in limited capacities to cope with the many hazardous natural events in Mongolia.

**Figure 27. Resilience score for Mongolia**

![Diagram of resilience score for Mongolia](Source: TA 8855-MON: Mongolia Country Water Security Assessment)
3. Resilience to Water-Related Disasters Scores at River Basin Level

Flood and windstorms

The sub-indicator flood and windstorms expresses the capacity (resilience) of the country / river basin to deal with the impacts of floods and windstorms. It is a dimensionless indicator that combines quantitative information on the exposure to floods, the vulnerability and the coping capacity of the river basin.

On a national level, Mongolia’s average index to resilience to water-related disasters is 4.3. (out of 5). Most river basins have scores (4.0 and above), while the most threatened river basin is Galba Ursh Dollodyin Govi has a score of 2.8.

A distinction should be made between ‘regular’ high discharge floods and flash floods. The high discharge floods are due to snowmelt in combination with rainfall; in most cases the slow increase of river water levels and flooding over the riparian zone and floodplains can in most cases be accommodated by the river system and does not cause serious damage. These kinds of floods can even be beneficial to the ecosystems and wetlands. Inundation of the floodplains support high levels of soil moisture supply of nutrients, which is very beneficial in repairing ecosystems as well as for replenishing groundwater aquifers; this is important as many rivers are covered by ice for almost 6-8 months per year. Flash floods are short duration extreme flood events that are more destructive and cause substantial damage. The Khar Lake-Khovd, Shishkhed, Delgermuren, Orog Lake-Tyin river basins are at the greatest risk of flash flood exposure. The upper streams of the Khyargas Lake-Zavkhan, Ider, Chuluut and Orkhon rivers are also exposed to flash floods.

Flood management in Mongolia is in its infancy and is typically reactive, rather than proactive; the lack of investment in (flash) flood protection works on rivers makes many urban centers vulnerable to flash floods. A map showing the geographical occurrence of flash floods in Mongolia is provided in Figure 28.

Compared however to drought and dzud, floods do not pose a major problem in Mongolia.
Figure 28. Flash Floods in Mongolia

Similar to the sub-indicator on floods, the sub-indicator drought expresses the capacity of the country / river basin to deal with occasional droughts in the country. Drought is a dimensionless indicator that combines quantitative information on the exposure to droughts, the vulnerability to droughts and the coping capacity of the river basin to deal with it.

The outcome of the assessment shows that all river basins suffer from drought, with an average national score of 3.4 (out of 5). The river basin Galba Usj-Dollodoyin Govi is the most under risk with a score of 1.8, while the river basin Ulz is under least risk with a score of 4.1.

Mongolia is an arid country that remains sensitive to summer precipitation fluctuations and shortages. As most of the precipitation falls in summer, there are issues surrounding the low humidity in the soil during the spring planting period. In the steppe and Gobi regions, a reliable harvesting of vegetables or other crops is only possible with the provision of irrigation, and although grain crops can be cultivated without irrigation, they are very susceptible to precipitation variations. The most severe drought happened in 2015, and approximately 80% of crops were lost resulting in a requirement to increase the level of crop imports three times that of normal years.34

Pasture productivity varies significantly depending on the summer rainfall; studies have found a decrease in rangeland productivity during dry summers of 12-48% in the mountain areas and of 28-60% in the desert steppe. Livestock needs good nutrition for growth and weight gain in summer and

34 FAO. 2016. Country Brief: Mongolia
autumn. In areas where good quality grass is available, livestock can attain their maximum weight by the end of autumn. Dry or prolonged periods of drought over the summer result in animals not having sufficient strength and energy to meet the shortage of feed and low temperatures in winter. Drought is one of the key determinants of the vulnerability of livestock to climate change as shown in Figure 29, with drought being a major driver of dzuds for the following winter. It further shows that drought and dzud events have been increasing since start of the 21st century.

Figure 29. Relationships between Drought, Dzud and Livestock Mortality, 2016


Dzud

The sub-indicator dzud measures the resilience of the river basins to dzud which are severe winter events. As with floods and drought is a dimensionless indicator that combines quantitative information on the exposure to droughts, the vulnerability to droughts and the coping capacity of the river basin to deal with it. Dzud is the most serious weather-related disaster in Mongolia and is strongly related to health of the pasture areas during the summer, low rainfall results in animals not having sufficient body weight to meet food shortages during severe winters. All river basins suffer from dzud to some extent; the national score is 3.2. The worst affected river basin is Delgemurun, with a score of 2.3, and the least affected is Galba Ursh Doloodyn Govi, with a score of 4.9.

Very severe dzuds occurred in the years 1944-45, 1967-68, 1978-79 and 1999-2002, during which time an abnormally high number of animals died. During the dzud in 1944, 32% or 8.8 million of the domestic livestock died. During the 1967-68 dzud, 2.6 million or about 11.9% of livestock died. The 1999-2000 dzud was very serious and herders lost more than 25% of livestock, 10 times higher than...
the normal years’ loss. The government funding for a disaster of this magnitude was inadequate to meet the urgent demands of the affected population, and Mongolia requested international relief assistance in February 2000. Mongolia also faced severe dzud over three consecutive years from 2000-2002, which affected 50-70% of the total territory and caused the death of more than 12 million livestock. More than 12,000 herders’ families lost all their animals, and many thousands of families had to subsist below the poverty line. Some people who lost all their animals even committed suicide. Such long-lasting (three consecutive years) winter dzuds followed by summer drought had not occurred in Mongolia in the last 80 years.

The most recent dzud happened in 2010, and 10 million livestock perished. It was the most severe dzud, which affected 15 out of the out of 21 aimags; snow depth reached 0.30-0.48 m and affected 28% of the population or about 800,000 people.35

4. Risk and Management Options

The risks, impacts and possible management options for KD5 are given in Table 11.

**Table 11. Potential Risks to Resilience to Water-Related Disasters**

<table>
<thead>
<tr>
<th>RISKS</th>
<th>IMPACTS</th>
<th>POSSIBLE MANAGEMENT OPTIONS</th>
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<tbody>
<tr>
<td>Increased evidence</td>
<td>Increased flood damage</td>
<td>Invest in flood protection work in aimag and soum centers. Improve flood protection work in major cities including: Ulaanbaatar, Erdenet and Darkhan. Improve hydrological studies to support infrastructure development like construction of bridges, roads, dams and others.</td>
</tr>
<tr>
<td>of flash floods</td>
<td>Increased health issues in urban areas</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased probability</td>
<td>Decreased water resources</td>
<td>Increase natural and artificial water storage such as river water regulation, rain water harvesting, etc.</td>
</tr>
<tr>
<td>of drought</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased probability</td>
<td>Negative impact on herders’ livelihood due to death of livestock; unsustainable economic growth</td>
<td></td>
</tr>
<tr>
<td>of dzud</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: TA 8855-MON: Mongolia Country Water Security Assessment

Discussion on CWSA Mongolia and comparison with previous AWDO assessments

Mongolia’s water security has been assessed as part of the previous AWDO assessments in 2013 and 2016. A comparison of the outcome of the CWSA for Mongolia in this study and that of the previous AWDOs can be seen in Figure 30.

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As can be seen, the previous AWDO assessments resulted in lower scores on water security in each key dimension. This can be explained in part by the adjusted methodology, as is described in Appendix 1, and in part that more and better data was available for the Mongolia CWSA.

The adjustments to the methodology were made to fit the Mongolian context this included changing the criteria for water supply security from ‘piped water supply’ to ‘improved water supply’, reflecting the fact that herder households cannot be connected to piped water supplies, as they change location each season. These adjustments, however, have ‘softened’ the AWDO criteria somewhat, explaining the comparatively high water security in the CWSA. It also does not so well reflect the situation in ger areas where piped water is a feasible option.

An issue with the results of the adjusted methodology is that the range of the results for the river basins is small. By adjusting the banding of the criteria some more distinction between the river basins can be achieved which makes priority setting on actions a bit more straightforward.

Another issue is that some sub-indicators are not really applicable across all river basins. Examples are the KD2 sub-indicators industry and energy (generation), activities that in some river basins do not exist. It is suggested to reconsider the approach, with particular focus on how to take this into account in the scoring.

The development of the AWDO approach was based on the assumption that the methodology should be applicable to all countries ADB is involved in. Data availability at country level was a major issue and has resulted in an approach that is not country specific, i.e. does not rely on data that countries should provide. In cases in which an individual country applies the AWDO methodology, these data constraints play a lesser role. For the river health sub-indicator (KD4), for example, AWDO requires a calculation with a complicated GIS procedure, while it would have much easier (and maybe even more accurate) to use the monitoring water quality data that is available for Mongolia. Further adjustment to consider these factors may be considered in future CWSAs.

G. Conclusions and Recommendations

The overall conclusion is that applying the AWDO approach at country level is possible. The specific conditions of the country require some adjustments to the methodology. The application at the river basin level requires a reconsideration of the sub-indicators that are used in AWDO. The overall approach of AWDO with five KDs and the way of scoring can remain the same. An added value of applying AWDO in a country water assessment is that it provides information on investment opportunities in the country, in general and, in the case of CWSA Mongolia, specific for ADB.
CWSA Mongolia was a good first step in developing the AWDO methodology to be applicable within a country. Based on the experience gained with CWSA Mongolia, it is recommended to investigate how further the methodology should be adjusted. Some first ideas on this are the following:

- KD1: adjust the banding (scoring table) of all four indicators.
- KD2: simplify the scoring on industry and energy; adjust the broad economy indicator to include the water balance of the river basin (supply-demand).
- KD3: use piped WSS as criteria; adjust the banding; drop the urban factor and river health index.
- KD4: replace the AWDO methodology by a simple approach based on monitoring data.
- KD5: adjust the banding.
IV. INSTITUTIONAL ANALYSIS

Strong and integrated institutions are the foundation for sustainability and security of water resources. The water sector in Mongolia is at a critical transition stage and there is a need for all involved institutions to work in a more integrated approach to ensure maximum and sustainable benefits from the country’s water resources.

This study examined the current administrative, legal, financial, and social framework for water resources management. Effectiveness of water services providers, who play a key role in ensuring that water investments are efficiently managed, is assessed. Building on the analysis, proposals are made for strengthening the institutions to ensure sustainable water resources management.

A. Legal and Policy Framework

The country's water policies are defined by the Constitution of Mongolia and the Environmental Protection Law of Mongolia. In addition, there are 53 laws regulating protection of environment and proper use of natural resources, with nine laws that specifically regulate effective use; protection, and restoration of water resources; and water use fees and water supply. Water laws have been brought together under an umbrella of laws for water resources management. Further, there are various water policy documents. Water legislation and water policies are based on hydrological units.

The 2004 Water Law initiated reassignment of many water functions from central to local government, with provincial and district governors being responsible for the matters related to use, protection, and restoration of water resources.

The 2012 Water Law replaced the 2004 Water Law and introduced new concepts:

- Defining mandates of state organizations that are in charge of development and adoption of integrated water resource management plans;
- Introducing RBOs which work in parallel in 29 river basins, paving the way for decentralization of water management and facilitating involvement of citizens in water management;
- Opening the way for private sector to engage in water management activities through public-private partnerships;
- Including the guiding principles of integrated water resources management as described by Dublin Principles;
- Strengthening legal status of integrated and cross-sectoral water management through establishment of the National Water Committee (NWC).

The ratified Constitution of 1992 allows lower administrative units to organize their own functions and responsibilities, which enables implementation of solutions to local-scale issues where they can be locally resolved, under supervision of central government.

Integrated Budget Law launched in 2013 supports decentralization through granting local government discretionary powers to use local development funds.

A national Integrated Water Management Plan was prepared by MET in 2013, establishing the basis for integrated water resources management. Building on the Integrated Water Resources

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36 Dublin Principles include: (i) fresh water is a finite and vulnerable resource, essential to sustain life, development, and environment; (ii) water development and management should be based on a participatory approach, involving users, planners, and policy-makers at all levels; (iii) women play a central part in provision, management and safeguarding of water; and (iv) water has an economic value in all its competing uses and should be recognized as an economic good.
Management Plan 2013, 29 river basin management plans are currently being prepared; once completed these plans will be approved by provincial parliaments (Khurals).

B. Institutional Framework

Main government organizations and line ministries involved in water use are shown in Figure 31 and Table 12.

Table 12: Responsibilities of Government Organizations Linked to the Water Sector

<table>
<thead>
<tr>
<th>NATIONAL GOVERNMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>NWC</strong></td>
</tr>
<tr>
<td><strong>National Council</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MINISTRY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ME</strong></td>
</tr>
<tr>
<td><strong>MM</strong></td>
</tr>
<tr>
<td><strong>MoFALI</strong></td>
</tr>
<tr>
<td><strong>MCUD</strong></td>
</tr>
<tr>
<td><strong>MET</strong></td>
</tr>
</tbody>
</table>

Source: TA 8855-MON: Mongolia Country Water Security Assessment
Provincial and district governments (aimag and soum) are responsible for implementation of measures relating to protection and restoration of water use and approval (by the Khurals) of water management plans prepared by the RBOs. Provincial and district environment departments are responsible for implementing environmental policies and measures to detect and prevent breaches in legislation. Responsible for land use management.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

1. **Central Government**

NWC is at the apex of central water management. It consists of representatives of different ministries. The 2012 Water Law has made the NWC a permanent body with a legal mandate and an elevated hierarchical position under the direct control of the Prime Minister. The committee has a key function to coordinate water resources actions between involved ministries and agencies.

At least five ministries are involved in management and exploitation of water resources. Their roles have evolved over time and despite institutional restructuring, their responsibilities for decision making remain complex with much of decision making remaining to be centralized. MET plays key role in transboundary water management.

2. **Local Government**

Lower level administration is divided into 21 provinces called aimags and an additional special administration for the Ulaanbaatar urban area. The aimags are further divided into 340 districts or soums. The lowest administrative level is the village administration called bag; there are 1,592 bags. The Ulaanbaatar urban authority is divided into nine districts called duregs and 152 small administrative units.

Aimag and soum governments have responsibilities for many water-related areas, including water resources and land use planning. Many ministries and government agencies have representation at local levels. Local ministry representatives are answerable to the central ministries as well as to the aimag and soum governors. Aimag and soum governors have a role to prepare budgets and implement water-related investments. Water and environmental management, monitoring, and control functions are assumed through MET, which has representatives at aimag and soum level as well as at the river basin level through river basin administrations.

National Agency for Hydrology, Meteorology and Environmental Monitoring (NAHMEM), which is under MET, monitors rainfall and river flows with representatives at aimag and soum level; a linked research institute prepares status reports.

State inspection agency carries out some tasks of monitoring and enforcement relating to water. The aimag tax division is responsible for collecting water use fees.

3. **River Basin Organizations**

The concept of river basin management was established under the 2004 Water Law to manage 29 river basins with boundaries based primarily on hydrological boundaries. RBOs have responsibility to implement effective water management, i.e. they have two core functions: (i) to prepare river basin management plans for each river basin; and (ii) to support implementation of the river basin management plans.

The 2012 Water Law enabled creation of 29 RBOs consisting of two parts: (i) River Basin Administrations (RBAs), each consisting of around 5-12 government staff who report to the River Basin Management Division of MET; and (ii) River Basin Councils (RBCs), each consisting of around 30 members with representatives from government, stakeholders, and water users.

RBAs in Mongolia are currently public or government organizations and are set up as integral part of the government system. They have strong legitimacy and are supported by laws and regulation. They are housed in the MET, which provides a strong line of communication and liaison with that ministry.
They are however distant from local government, and other ministries and agencies and stakeholders. In general, a government-based RBA housed in one government department may lack the flexibility to engage with other government departments and stakeholders. This could affect its effectiveness. Although there has been good progress in establishing the RBAs, it is considered that there is insufficient capacity of the RBAs to effectively take on the very challenging issues of water resource management, including balancing strong commercial pressures from mining, industries, and water authorities with environmental sustainability.

Large geographic areas and the need for adequate representation of different stakeholder groups require a bottom-up approach to stakeholder consultation. Some RBOs have established councils as well as sub-councils; this appears to be a good concept which should be given more consideration. Two levels of RBC are: (i) a soum level council with representatives of different water stakeholders and civil society; and (ii) a river basin level council formed from representatives of the soum level councils. Development of RBCs is significantly lagging, and establishing RBCs and achieving their operational functionality will be challenging. The role of the RBC is to ensure effective engagement and participation with stakeholders in water resources management. Presently RBCs are planned without a firm structure and adequate financing. It is unclear on how the RBCs will operate and if they can be made functional and effective. Without the RBCs, the original concept of decentralized RBO management and stakeholder participation is weakened. The river basin is geographically too large a unit for real and effective direct engagement between RBO and stakeholders.

4. Other Organizations

State Emergency Commission (SEC) is composed of 10 key ministries and agencies, and is chaired by the Deputy Prime Minister. SEC is the primary decision maker for political and operational issues during the advent of a national emergency, and is responsible for briefing the government on issues raised by the National Emergency Management Agency (NEMA) and the humanitarian community. NEMA assesses funding requests and resource requirements.

Mongolia has established a Climate Change Coordination Office to carry out activities necessary to implement the commitments and duties under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, to manage nationwide activities and integrate climate change related issues in various sectors. The inter-disciplinary and inter-sectoral National Climate Committee under the MET coordinates and guides national activities and measures to adapt to climate change and mitigate greenhouses gas emissions.

Externally funded projects are supported by private sector consultants and nongovernmental organizations (NGOs). Mining and industries use private sector companies for planning studies and design. Most of the river basin management plans have been supported by private sector organizations. Involvement of NGOs in the environmental sector has been growing over the past decade and provides significant support to the water sector. NGOs act as lobbying organizations for various water issues, providing a valuable avenue for stakeholder participation and planning, and filling the gap of the limited capacities of the RBCs.

C. Assessment of the Water Management Framework

1. Policy and Institutional Requirements for Water Security

The AWDO water security assessment provides a starting point to assess water security and effectiveness of water resources planning, investments, and service delivery. Linkages between water security KDs and water sector institutions is shown in Table 13.

<table>
<thead>
<tr>
<th>WATER SECURITY</th>
<th>KD SCORE</th>
<th>WATER SECTOR</th>
<th>POLICY AND INSTITUTIONAL ISSUES</th>
<th>RESPONSIBLE AGENCIES</th>
</tr>
</thead>
</table>

Table 13: Linkages Between Water Security and Water Sector Institutions
<table>
<thead>
<tr>
<th>KD1</th>
<th>Household water security</th>
<th>2.8</th>
<th>Rural water supply for herder communities</th>
<th>Lack of policy on WSS for herder communities; Lack of awareness of rural WSS; Low interest to invest in WSS.</th>
<th>MoFALI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Irrigation</td>
<td>Lack of finance and organization for efficient operation and management.</td>
<td>MoFALI</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Livestock water supply</td>
<td>Overgrazing and impact of water points affect pasture sustainability; Poor finance and organization to maintain existing wells.</td>
<td>MoFALI</td>
</tr>
<tr>
<td>KD2</td>
<td>Economic water security</td>
<td>2.8</td>
<td>Industry and Mining</td>
<td>Lack of coordination between RBOs, line ministries, governments, and private investors; Inconsistent regulatory procedures and standards, delays issuing permits, lack of long-term planning; Stakeholder challenges (e.g., resistance from communities and mining companies). Uncontrolled abstractions and discharge of insufficiently and untreated wastewater to the environment.</td>
<td>MM, MoFALI, MET</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Urban WSS</td>
<td>Inadequate tariffs and poor cost recovery to meet operation and management costs; Low returns on investment; Poor performance of water service providers; Discharge of insufficiently and untreated wastewater to the environment; Inequity of WSS service levels within urban areas; Lack of agreement and policy on provision of urban WSS service levels.</td>
<td>MCUD, Municipality of Ulaanbaatar (MUB), City Governor, aimag and soum government</td>
</tr>
<tr>
<td>KD3</td>
<td>Urban water security</td>
<td>2.3</td>
<td>Urban WSS</td>
<td>Lack of strong regulatory and enforcing body; Complex environmental standards and weak enforcement of environmental regulations; Lack of mechanisms to monitor water use and effluents discharge; Limited scope to penalize non-compliance.</td>
<td>MET and line agencies</td>
</tr>
<tr>
<td>KD4</td>
<td>Environmental water security</td>
<td>4.9</td>
<td>Environmental water management</td>
<td>Lack of understanding of risks results in inefficient use of scarce finance; Limited coordination between agencies; Lack of training and resources to better support disaster management.</td>
<td>NEMA, MET, and line agencies</td>
</tr>
<tr>
<td>KD5</td>
<td>Resilience to water-related disasters</td>
<td>3.7</td>
<td>Water-related disaster management</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average 3.3

Source: TA 8855-MON: Mongolia Country Water Security Assessment
2. Benchmarking of RBOs

Performance of RBOs has been assessed through benchmarking, which is a process to evaluate how the RBOs are fulfilling their mandates against key performance indicators. A baseline benchmarking is done and a periodic benchmarking revision is proposed to be conducted every five years to assess how the RBOs perform over time.

One of the best and most used benchmarking methodologies in Asia has been developed by the Network of River Basin Organizations (NARBO) as a flexible framework of performance indicators to support initiatives to strengthen performance of RBOs. Adjustments have been made to the NARBO template to make it more user friendly and appropriate to the specific situation in Mongolia, while maintaining the key structure and form of the NARBO, which ensures a reasonable compliance with international best practice.

The RBO template uses a simple system of semi-quantitative scoring, which allows for a quick evaluation process, can be repeated periodically, and can be linked with the water security indices. The benchmarking covers five performance areas (A to E), measured by 14 performance indicators. The template also incorporates a section for the evaluators to describe the current situation and to provide a summary of initiatives to be taken up prior to the next benchmarking, which is suggested to be in 2020, after a four-year interval. The assessment was designed to assess combined functioning of the RBA and RBC.

The benchmarking has been based on a process of self-assessment conducted by the RBA managers working with representatives of the RBCs as they are in the best position to assess their organization and adequacy of resources. About 4-6 participants from each RBO carried out the benchmarking analysis; unfortunately, there was no representative from the RBC. It was seen that the evaluators were professional, pragmatic, and positive about the approach and understood the objectives of the process well.

Results of the benchmarking for the 21 RBOs are shown in Table 14 and Figure 32.

<table>
<thead>
<tr>
<th>PERFORMANCE AREAS</th>
<th>PERFORMANCE INDICATORS</th>
<th>CURRENT RATING 2016 (0-4)</th>
<th>TARGET RATING FOR 2020 (0-4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Status of the RBO</td>
<td>Adequacy of Institutional Framework</td>
<td>2016 RATING</td>
<td>TARGET RATING FOR 2020</td>
</tr>
<tr>
<td>4. Stakeholder Feedback</td>
<td>5. Stakeholder Livelihoods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Technical Development</td>
<td>9. Organizational Development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10. Water Planning and Management</td>
<td>11. Water Allocations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The average score for the current situation is 1.8 out of a potential 4.0. It has shown that the 21 RBOs have established a basic capacity as water agencies for raising awareness of water issues, support for water use monitoring, initial planning for river basins, and contributing to the decision making for the issue of licenses. The scores appear to be reasonably in line with the stage of development of the RBO. Scoring and stages of development of the RBO are described in Table 15.

### Figure 32. Average Benchmarking Scores Across RBOs

![Graph showing average benchmarking scores across RBOs](source)

**Table 15: Benchmarking and Stages of Development**

<table>
<thead>
<tr>
<th>SCORE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>RBOs are at a preliminary stage of being established. Limited influence and minimal contact with stakeholders.</td>
</tr>
</tbody>
</table>
RBOs are established. They are collecting data, preparing basin plans, and providing basic support for water management. Stakeholder participation is at a preliminary stage. Lack of finance is restricting activities.

RBOs are making significant inroads to management of water resources, adequate finance is in place. Implementation of plans is ongoing with reasonable level of stakeholder involvement. Strengthened linkages with line ministries and government are developed.

RBOs are providing significant impact through proactive management on integrated and sustainable management of surface water and groundwater resources. High level of stakeholder participation including active engagement with line ministries and provincial government. Financing for the RBOs is adequate and sustainable.

Source: TA 8855-MON: Mongolia Country Water Security Assessment adapted from NARBO

RBOs have been established to support the government’s policy of decentralized decision making through working relationships with the aimag and soum governments. Under the 2012 Water Law (Article 17.1.2), RBOs need to work closely on issues of inter-sectoral water management; decision making should be done at the aimag level with the RBA working with the aimag government. In practice, however, the RBOs, structured at Level 4 of MET, have limited autonomy, and most management decisions are required to go through various levels of MET. Further, issues relating to inter-sectoral decisions need to be referred to the NWC. Lack of clear understanding of the process of decentralization, which results in the mix of centralized and decentralized decision making, results in duplication of many functions and extends the level of bureaucracy. This makes decision making cumbersome and inefficient, and reduces effectiveness.

The RBOs have set a target score of 3.2 by 2020. This requires a significant shift from being relatively low-profile organizations to becoming proactive drivers integrated water resources management. This requires the RBO to become actively involved in all areas of water security. The water security assessment shows that water security is not solely an issue of water resources but also includes issues of finance, management, and cost recovery. The real benefits of the RBOs, to support sustainable and integrated management of water resources, will be seen when the RBOs achieve scores of 3 and above.

It needs to be noted that there was no input from the RBC for the benchmarking. While it is seen as a drawback, it does not invalidate the benchmarking as the RBC was a key part of the original design of devolved and participative river basin management.

3. **Budgeting and Finance**

Budgeting is a key component of meeting water security needs. Sector budgets are heavily directed towards Millennium Development Goals and government development targets; they are insufficiently linked to policy objectives. There is insufficient attention to designing sustainable systems with adequate levels of cost recovery for operation and maintenance.

The issues of financial viability of services in relation to affordability by poorer segments of society are not systematically addressed; there are large inequalities in water investments including the low-income ger areas and rural households.

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37 Decentralization means that decisions are taken at the lowest appropriate level, with full public consultation and involvement of users in the planning and implementation of water projects. The goal of decentralization is to devolve the authority for decision making, financing, and management to representative and accountable local governments, and delegate certain public functions to semi-autonomous or private sector entities, such as public or private utilities.
4. Water Service Providers

Water service providers abstract and manage water on behalf of the government and communities. Most of the water for urban water supplies, primarily for urban WSS, is managed by water sector providers. While the MCUD has overall responsibility for planning and development of urban services, operation and provision of these services fall under the responsibility of urban authorities at different levels. Urban water and wastewater service operations are mainly contracted to Public Utility Service Organizations (PUSOs), semi-privatized organizations which submit bids for these contracts based on a tariff for operation and maintenance. Many aspects of long-term security of water resources and the effectiveness of water investments hinge on the effectiveness and efficiencies of water service providers.

Ulaanbaatar WSS: WSS for Ulaanbaatar falls under the Municipality of Ulaanbaatar (MUB) with execution through the Water and Sewerage Authority of Ulaanbaatar (USUG), a corporatized public entity, wholly owned by the municipal government, which also owns the assets. USUG has rolling two-year performance contracts with the municipality, which specifies a number of targets and terms of remuneration. The role of USUG includes: (i) extracting water from aquifers from the Tuul River basin; (ii) providing WSS services to industrial customers; (iii) providing water services to customers in ger areas (through water kiosks supplied by piped connections or tanker trucks); (iv) emptying of some pit latrines in ger areas; and (v) providing bulk water supply to retail suppliers (Kantors) which then supply water (as well as heating) to apartments. The Kantors include Housing and Public Service Company (OSNAAG) and fully private operators.

Aimag and soum WSS: Urban WSS for soums and aimags are managed by the provincial and district administration, which have direct responsibility for planning, programming, and carrying out urban development activities. However, they have limited financial and institutional resources to fulfill these responsibilities effectively. Similar to the situation in Ulaanbaatar, in many cases PUSOs are contracted for management of operations and maintenance. PUSOs provide, similar to USUG, management of urban services including water supply, wastewater management, district heating, and solid waste management. In some cases, management is through community management organizations. Water infrastructure belongs to the state and most capital, operation, and repair costs remain with the local administrations. The aimag and soum governors however heavily influence their operations; getting agreements on adequate tariff levels for cost recovery is difficult. Most water tariffs are about half of the level needed to meet full cost recovery of operations leaving a high dependency on government support. Some PUSOs cross-subsidize the shortage of revenue from water supplies by the more financially viable district heating. In some soums, local community organizations have been given responsibility to support the management of water supplies.

Weaknesses of water services providers: Insufficient operation and maintenance for many water investments have resulted in poor performance and deterioration of infrastructure. Investments often do not meet their targeted output, which in turn affects water security. Government-owned companies and community organizations lack capacity and financial resources to effectively manage water schemes:

- Urban water providers are falling short of the requirements to provide for the expanding urban population. There are weaknesses in constructing infrastructure that is ‘fit-for-purpose’, sustainable, and meets the environmental requirements. Agencies lack the flexibility to address and adjust to real issues of adequate finance for operation and maintenance and skilled staff to operate schemes. Irrigation schemes are not meeting the potential production and suffer from lack of finance for operation and maintenance.

- Targets in the management contracts bear little relation to performance problems in the system. Performance indicators are mostly related to inputs, not outputs. Management contracts provide no financial certainty. They need to be held to certain performance standards, and must have the revenue required for proper operations and maintenance and funding for new capital expenditure.
● Water supply at aimag and soum centers includes partial supply of piped water, and sewerage demand is low and affordability is a problem.

● There appears to be lack of coordination among agencies and different levels of government as well as low interaction with stakeholders. Although many water activities are designed to be devolved to lower levels of government, many key decisions continue to be made at the central level.

● Investment in water utilities is currently constrained by the low economic and financial returns as well as low levels of cost recovery which put severe strain on government budgets, while limiting opportunities for external public or private sector finance. Low tariffs and high levels of unaccounted water result in poor and unsustainable operation and maintenance of utilities. Lack of finance is also affecting viability of water management and control activities. There are currently significant shortages of government finance for investment and operations due to the depressed nature of the commodities markets.

● Development of full public-private partnership arrangements, such as build and operate, in the water sector has been very slow. An agreement, however, has been recently reached to public-private partnership for investment and operation of the Ulaanbaatar Central Water Treatment Plant.

5. Community Water Users

A large share of the water use is currently from small water schemes, such as wells, ponds, and rivers which are largely managed by the communities or individual water users. Significant quantities of untreated wastewater from community water systems are released into drains and water bodies. Most of the population still uses decentralized on-site sanitation based on pit latrines; most of these are unlined and contribute to soil and groundwater contamination. Community water use is underfinanced and poorly managed, and although there are numerous initiatives by NGOs and other agencies to improve community water management, the impacts remain limited.

The roles and responsibilities of community water users are poorly defined, leaving a significant gap in the performance and risks on water security and sustainability. Government strategy on future of community water users and investment is unclear. This leaves communities and households unwilling to invest in WSS in the hope that government will at some time provide the necessary investments without charge.

Irrigation services are supported by MoFALI, which owns most of the irrigation infrastructure and provides support for maintenance. Day-to-day operations are through irrigation water user associations who are expected to provide some support maintenance; many of the irrigation systems are old and require high maintenance and periodic rehabilitation. Water points for livestock are provided by MoFALI with some small contribution by the herders who are also responsible for operation and maintenance costs.

6. Findings of the Institutional Assessment

Mongolia’s institutions and water governance are summarized in Table 16, following the assessment of core conditions for integrated water resources management, as described by UNESCO.38

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Table 16: Summary of the Findings of the Review

<table>
<thead>
<tr>
<th>CONDITIONS FOR INTEGRATED WATER RESOURCES MANAGEMENT</th>
<th>ASSESSMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Political will and commitment</strong></td>
<td>• There is a strong official commitment to develop integrated water resources management. The 2012 Water Law provides a sound basis for integrated water resources management and decentralization of decision making. In practice, however, much of the water resources planning and investment is sector-based and much of the decision making remains to be centralized.&lt;br&gt;• There remains a significant communication gap between line ministries, government, and RBOs.</td>
</tr>
<tr>
<td><strong>Basin development plan and clear vision</strong></td>
<td>• Currently 17 of 29 river basin integrated water management plans have been prepared by external consultants working with the RBOs with donor support, and have been approved by the local government Khurals. Three plans are in the process of approval.&lt;br&gt;• There is a need to update and adjust the plans through a dynamic planning approach. A properly managed GIS database provides a strong tool to keep abreast with water use and support planning.&lt;br&gt;• RBAs need access to specialist skills to update plans and assess more complex licensing applications.</td>
</tr>
<tr>
<td><strong>Participation and coordination mechanisms</strong></td>
<td>• Establishment and operationalization of RBCs is lagging. The parallel role of the RBA and RBC is in theory a good approach but how to put these into action is not clear.&lt;br&gt;• There are significant challenges in relationships between the RBAs, and aimag and soum administrations and line ministries that need to be examined and strengthened.&lt;br&gt;• RBOs need to focus on integrated river basin tasks and should not duplicate tasks that can be done by other agencies. Aimag and soum governments could take some of the RBO roles.</td>
</tr>
<tr>
<td><strong>Capacity development</strong></td>
<td>• The benchmarking scores show that RBOs are carrying out core functions. Achieving the next level requires the RBOs to work with multi-stakeholder groups to direct and drive sustainable water resource management. This will require a significantly strengthened organization with strengthened linkages to soum and aimag governments.&lt;br&gt;• RBOS are small with less than 10 staff per RBA. There has been good progress in capacity development by MET. There are, however, constraints in maintaining high levels of expertise. The 21 RBOs need to be able to access specialists.</td>
</tr>
<tr>
<td><strong>Investment and policy recommendations</strong></td>
<td>• Investment and policy decision making involves various agencies. RBOs sit outside the main nucleus of this decision making.&lt;br&gt;• RBCs are still being established, there is limited support to strengthen their role and they are largely not involved in decision making.</td>
</tr>
<tr>
<td><strong>Well defined flexible and legal frameworks and regulation</strong></td>
<td>• Much of implementation of water resources legislation depends on the aimag and soum government, who have less clear mandates and weak enforcement which limits the scope for enforcement of water resources plans and water licensing requirements at local levels.&lt;br&gt;• There are inconsistencies in regulatory arrangements, water resources regulations, and other sector regulations.&lt;br&gt;• Some of the functions which were proposed to be decentralized continue to be held by central government. This is creating uncertainty and some overlapping of responsibilities.</td>
</tr>
</tbody>
</table>
| Water allocation plans | Interaction with line agencies and RBOs needs to be improved.  
Responsibilities relating to licensing and monitoring of water use and effluent quality are not clear and need to be better defined. |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Adequate investment financial stability and sustainable cost recovery | External funding from donor agencies has heavily supported new initiatives for integrated water resources management. There are risks of funding shortfalls after the project completions.  
Financial independence and efficiency had the lowest score in the RBO benchmarking, and options for financial sustainability need to be assessed.  
Water service providers are inefficient and poorly funded, resulting in low levels of service delivery. |
| Good knowledge of the natural resources | Knowledge gaps need to be closed, especially relating to groundwater.  
There is a lack of access to specialist skills. |
| Comprehensive monitoring and evaluation | Water use and hydrological data surveys are undertaken by MET and RBOs. Groundwater monitoring and analysis is weak. Surveys need to be better targeted, cost-effective, and linked to mechanisms for evaluation and proactive actions.  
Information from different organizations needs to be compiled.  
Government needs to invest in groundwater assessments in certain critical areas, such as the South Gobi Region. |

Source: TA 8855-MON: Mongolia Country Water Security Assessment

D. Recommendations for Strengthening Institutions and Water Governance

1. Iterative Approach for Strengthening the Institutions

There are close linkages between integrated water resources management and water security. Integrated water resources management spiral model provides the model for an iterative approach to strengthen integrated water resources management in parallel with initiatives to strengthen water security. AWDO water security concept is particularly compatible with the integrated water resources management process; the further integrated water resources management is advanced, the higher are the AWDO water security scores (Figure 33).

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A five-year cycle of institutional monitoring and evaluation, and initiating adjustments and improvements based on lessons learnt is proposed. Taking 2012 (the time of 2012 Water Law) as a starting point, the first spiral would run to 2016 and the second stage would run from 2017 to 2021.

2. Strengthening Policy and Regulations

The regulatory and policy framework for the water sector needs to be fully analyzed and simplified; inconsistencies need to be identified and clarifications provided. The framework for inter-sector coordination is designed to be through the river basin management plans, which need to be developed through participation of stakeholders and line ministries. There is a need for preparation of an integrated water policy covering all water sectors and categories of water users.

Water situation is rapidly changing, requiring a dynamic mechanism for updating, adjusting, and refining river basin management plans, as new policies, strategies and data evolve. Typically, plans
should be updated every five years. Plans need to be updated based on detailed analysis of abstraction levels and environmental considerations\(^\text{40}\).

3. **Strengthening Capacities at National Level**

**Strengthening institutional direction:** Central government, through the NWC, needs to play a more proactive role to provide direction and define areas of responsibility of water sector institutions. Large-scale investments require a strong central level organization and specialists to support RBOs in water resources decision making. There is also a need for a strong organization to manage water resources from the perspective of three major river systems at the country level, while considering specific requirements of international transboundary rivers. Surface water development needs to work within the issues of the international transboundary rivers, which falls under the mandate of MET. Effective transboundary management requires a high level team to handle diplomatic arrangements supported by sophisticated water resources management of rivers, groundwater, and environment. This is currently lacking, as there are constraints in compiling water use data from each RBO into consolidated information for major rivers and groundwater systems.

**Strengthening technical capacities:** Capacity building requirements at the national level include: (i) high profile expertise to coordinate and liaise with water sector agencies; (ii) skills on integrated analysis, planning, and management of water resources at the country level for major river and groundwater systems, for conducting technical, social, economic, and environmental studies; (iii) high level technical, managerial, and legal support to drive integrated water resources management negotiations; (iv) specialist capacity to improve estimates of surface water and groundwater resources; (v) specialist expertise in surface water and groundwater quality, including contaminated water and soils; (vi) capacity to coordinate and develop water resources databases; (vii) improved understanding of water-related disaster risk and climate change adaptation; and (viii) specialist technical support for major investment projects and transboundary river management.

**Strengthening budgeting and finance:** Budget allocations need to be better balanced and targeted to meet specific critical areas. Massive budget fluctuations to the water sector due to the changes in commodity prices need to be smoothed through more effective and long-term fiscal planning, avoiding heavy government subsidies resulting from ineffective cost recovery systems. Budgets for water resources management and control need to be increased to meet the needs of long-term sustainable management; in parallel however the key institutions involved in water management need to make significant progress to improve efficiencies, remove duplication, and thus reduce costs.

4. **Strengthening Capacities of Soum and Aimag Governments**

**Aimag and soum** governments need to take on greater levels of engagement and ownership of the RBOs, including the establishment of stakeholder representation through the RBCs. Water resources and water use data needs to be compiled in standard databases at soum and aimag level, that allows data to be reconciled and analyzed by the RBOs. Using modern analysis based on databases and GIS, it is relatively easy to reconcile water resources data by administrative aimag or soum, by river basin, or by aquifer unit.

5. **Strengthening RBOs**

The role of RBOs needs to be strengthened to allow them to operate as autonomous and independent agencies to better coordinate water sector regulations. This requires increased financial resources and access to specialist legal personnel to interpret the regulatory framework of all water sectors.

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\(^{40}\) There is a lot of available information on water resources, much of which is in hard-copy reports held by different agencies that does not allow for updating or application to meet demands as well as quality control.
Remit of the RBOs: The benchmarking performed in this study identified the need to increase the mandate of the RBOs to move from basic monitoring and advisory tasks to being proactive drivers of sustainable water resources management. Further review of the remit of RBOs to assess gaps and identify areas for improvement is required. There is a need to develop mechanisms for the RBO to engage more closely with the line ministries, district administrations, higher level government, as well as stakeholders at different levels. The RBO should not be duplicating tasks that can potentially be handled by local government administrations. Some observations on the remit of the RBOs are shown in Table 17.

Table 17: Remit and Responsibilities of RBOs

<table>
<thead>
<tr>
<th>#</th>
<th>RBO RESPONSIBILITIES</th>
<th>OBSERVATIONS</th>
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<tr>
<td>1</td>
<td>Develop river basin management plans that set out assessments of future water demands, potential sources of water, and safe levels of abstraction to 2021.</td>
<td>Plans are scheduled to be completed by end 2017. Preparation of the plans has been supported by external finance and external consultants. Mechanisms and resources to update and refine plans are required. Specialist support may be required for more complex water situations.</td>
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<td>2</td>
<td>Support implementation and monitoring of river basin management plans through cross-sectoral and stakeholder coordination, including determining water supply sources and areas for waste water disposal.</td>
<td>The role of the RBO to ‘support implementation’ needs to be clarified; the RBO not an ‘executing agency’. Implementation of plans needs to be closely coordinated with national ministries, and soum, and aimag administrations. Decision making is complex and involves a mix of centralized lines of command and partial decentralization of decision making through the aimag government.</td>
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| 3  | Monitor:  
- Implementation of river basin management plans, including monitoring of water use;  
- Preparation of an annual surface water inventory;  
- Maintenance of an integrated water resources database. | RBOs should take a lead role in development and management of water monitoring systems. Improved and standardized monitoring framework is to be established, with monitoring tasks shared by different institutions. Annual inventory could usefully be expanded to include assessment of water security. The database needs to develop a standardized format and information to be sourced through soum, aimag, and water sector agencies and users. |
| 4  | Support establishment and operations of the RBCs, in conjunction with local administrations. | The role and functions of RBCs need to be assessed. There could be advantages to strengthen link of the RBCs with the aimag and soums governments as well as the RBAs. |
| 5  | Provide local governors and parliaments at all levels with professional guidance and support. Liaise and support meetings of local government and stakeholders. | RBOs should take a key role and advise on core aspects related to resources assessments and impacts on surface and groundwater. |
| 6  | Receive and process applications for water use, wastewater discharge, hydraulic structures, and make recommendations for approval to aimag and soum government. Prepare recommendation on water use and pollution fees. Provide recommendations on the cancellation of licenses. | The approach of different licensing responsibilities needs to be reviewed. Licensing approvals need to consider social, economic, and environmental aspects and a streamlined process needs to be established involving soum and aimag governments, RBOs, and if required central government. Specialist studies need to be commissioned for complex applications to be paid by water users. |
Approvals are: less than 50 m$^3$/day by aimag, 50-100 m$^3$/day by RBA directly, above 100 m$^3$/day as well as toxic waste by central government.

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<tr>
<td><strong>7</strong></td>
<td>Undertake or commission specialist surveys.</td>
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</table>
| **8** | Take a lead role in protection of rivers, lakes, groundwater, and drinking water supply sources in the basin.  
Support special protection of lakes rivers and environment. |
| **9** | Support monitoring and evaluation. |

RBOs need access to finances to contract specialist services; contracting procedures need to be simplified.  
Specialist skills shall be provided to assess issues including climate change impacts, and develop investment proposals.  
Responsibilities for monitoring and evaluation need to be reviewed to avoid duplication and save costs. Medium and major water users need to take on a role of self-monitoring of water use and effluent quality.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

**Consolidation of RBOs:** Effectiveness of RBOs is largely dictated by how well the RBO can develop strong partnerships with local water administrations and water sector agencies. There are practical difficulties of maintaining numerous small decentralized river basin units, which weakens integration with district administrations. Many RBOs must liaise with several aimags and similarly the aimag administration must liaise with multiple RBOs, which reduces efficiency and effectiveness of RBO support. Increased use of GIS, internet, and video conferencing can bridge communication gaps. Logistics, management constraints, capacity, and costs of maintaining large number of RBOs need to be considered. Acknowledging these difficulties, the government has recently decided to reduce the number of RBOs from 29 to 21. It is suggested that even further consolidation of the RBOs and river basins could result in advantages and efficiencies, and pave the way for a smaller number, but therefore strengthened and better-resourced RBOs. For example, the South Gobi Region is almost entirely a groundwater-dominated area with water resources dependent on aquifers rather than river basins. Consolidating the three currently separate RBOs to a new strengthened RBO (or South Gobi Water Authority), could be more effective and have better resources, while it would also simplify the complexities related to the integration of the river basin and aimag management institutions.

**Financing RBOs:** The lack of finance of the RBOs was the key weakness identified under the benchmarking and provision of increased financing was seen as a key requirement. RBAs currently receive 35% of the water fees and there is no allocation of funds for RBCs. Currently around 80% of the operational costs are required for salaries, which leaves a small allocation for activities. To improve financial situation of RBOs, the following is required: (i) assessment of potential to increase finances, including a review of potential financing sources; (ii) streamlining RBO tasks to increase efficiency and cost effectiveness; (iii) consolidation of RBOs; and (iv) incorporation of greater role of water users with respect to water use and quality monitoring in licensing agreements.

**Strengthening technical skills in RBOs:** Due to the decentralized nature of RBOs, it is not efficient to support permanent specialist skills in all areas in the RBOs, and hence there is a need to be able to access specialist skills when required; a key point raised in the benchmarking. While intermittent short-term training helps to fill some knowledge gaps, it is not a substitute for professional expertise. Specialist expertise is required to support the NWC, sector agencies, MET, and RBOs. The best approach for specialist support needs to be further assessed. Options include: (i) establishment of a specialist central water resources water management unit; and (ii) improved access to specialist skills through private sector and universities. The use of framework contracts is becoming a popular way to procure recurrent specialist support; through a framework contract a specialist organization is contracted to provide intermittent consultancy support services over a fixed period, typically five years.
The scope and form of the services are flexible and defined according to the specific needs at pre-agreed rates.

**Development of integrated water resources database:** It is recommended that an ‘integrated water resources database’ is developed to assess and monitor water security and water use issues, and support the planning. The database would be developed using GIS and would be designed for use by MET, RBOs, local administrations, and sector agencies. With GIS maps, data can be visually presented and detailed by: river basin, groundwater aquifer unit, and administrative unit (by aimag or soum as per requirements). Development of the database would include: (i) reviewing requirements and other ongoing databases; (ii) developing and programming the database; (iii) piloting and adjusting the database; and (iv) training and supporting the use of the database. The database would incorporate: (i) data on water assets including estimates of the condition of infrastructure as well as current water use and return flows; (ii) data on pipeline, planned, and potential water investment projects including costs and estimates of future water use; (iii) data on water licenses showing key conditions in license agreements; and (iv) data on authorized abstractions of surface water and groundwater, including water monitoring data on actual water use, wastewater quantities, and compliances. A key requirement is to link the water database with existing databases of mine operations, industry, irrigation, and water supply, being developed by the various ministries. Through regularly updating resources information in the database, the updating of the river basin management plans is simplified and streamlined.

**Amending legal framework of RBAs:** To strengthen RBAs, an adjustment to legal framework should be considered in the long term to enable a transition from public to corporate RBAs. A corporate type RBA can be a government-owned or private company or NGO that is engaged by the government with the remit to implement integrated water resources management. It has advantages that it can derive significant strength from its autonomy and flexibility to implement plans and development initiatives (within its mandate and financial capacity). It is able to respond faster to needs and opportunities. Also, it can feature a relative strengthening of the basin level perspective as compared with the public RBA. It can integrate mandates of different ministries and local government into a holistic approach for integrated water resources management. A corporate RBA is especially appropriate to situations such as Mongolia where there are complex systems of governance for integrated water resources management as well as complex technical and managerial issues relating to private sector. A corporate RBA requires adequate financial resources from revenues or royalties to pay for management costs. A corporate RBA would have flexibility to engage in and support water resource investments. A corporate RBA can be a non-profit organization. An example of a corporate RBO is Brantas RBO described in the box below. Besides the public and corporate type RBA, there are also hybrid options. For example, RBA could be set up as a government-owned company with functions managed in a corporate way, including staff employment conditions, more autonomous decision making, and cost recovery. In all cases, RBA reports to government agency of senior government officials either at central or aimag level.
Corporate RBOs, Indonesia

An example of a functioning corporate type RBO is Brantas River Basin Public Corporation in Indonesia, which was established as a fully corporate state-owned organization in 1990 with the remit to manage water resources and public infrastructure based on the principles of cost recovery from water resources management service fees paid by commercial users.

Brantas is a key river in east Java, Indonesia, with a catchment area of 11,800 km², which serves a population of 15.6 million. Key features include: (i) significant impacts on efficiency and productivity of water resources including increase of water service fees 8.8 times since 2001; (ii) established as a corporate type RBO to manage water resources on behalf of government; and has adopted ISO9001 since 1997; (iii) activities include water resources planning and management as well as investment and management of irrigation, industrial and domestic water, flood control, hydropower, catchments, water quality, pollution control, cloud seeding, environmental management, tourism, public involvement, consulting services, education, training and awareness; (iv) financed from government and from water services fee and commercial initiatives; (v) cross subsidizes water service fees from different commercial operations industrial water and hydroelectric power to subsidize low revenue operations including irrigation; (vi) developed own participatory management system, staff receive incentive payments depending on performance of the organization; and (vi) it uses the NARBO benchmarking approach; it was found that the score of corporate RBOs were found to be above average of non-corporate RBOs.

Establishing effective RBCs: The value of RBCs could be significantly increased if their remit was to incorporate holistic water issues and broader issues of water security, including performance of rural and urban WSS, socioeconomic development, agriculture water use, tariffs, cost recovery as well as water management. In this way, the RBCs would directly support aimag and soum administrations, and water sector agencies to meet performance target, as well work with RBOs towards sustainable water resources management. RBCs should be allocated budget to meet the needs of administrative expenditures.

Strengthening communication: Large size of Mongolia and the significant time and costs to travel even within the river basins is a constraint. Additional investment is proposed to strengthen internet communication including video conferencing between the soum, aimags, RBOs, and central government ministries.

E. Recommendations for Training Options

Government, especially MET, has put significant emphasis on training of central and RBO staff. In parallel, it is critical to strengthen capacities of environmental units at aimag and soum governments, who play a key role in enforcing water planning and management recommendations. There are scarce resources and a wide number of persons to be trained.

As integrated water resources management is vague and thus difficult to define, it makes the planning and design of training difficult. To ensure maximum cost-benefit from training, it is proposed that ‘rolling five-year plans’, and ‘detailed annual training plans’ are prepared, setting out objectives, types of training, and monitoring systems. Specialist training consultants, in consultation with MET, would prepare the training plan. Close involvement of various water sector agencies is critical, and training should involve persons from different sector agencies and other organizations at different levels. Training should be structured as a mix of on-the-job and classroom training.

Identified areas for training that could be taken up in the short term include:

- **Exposure to international best practices**: Implementing best practices in water security within the context of integrated water resources management requires special skills. Significant benefit to Mongolia can be achieved by exploring successful experiences and lessons from international and regional initiatives towards developing and introducing
integrated water resources management. There is good and relevant experience of the state of South Australia (the driest state in Australia at the end of the Murray Darling Basin and wholly dependent on it for water supply) in tackling water security through a range of measures including infrastructure development, demand management, irrigation and drainage efficiency, salinity management, robust governance measures and community engagement. The International Center of Excellence in Water Resources Management is an Australian government initiative that operates as a not-for-profit entity specializing in capacity building for the water sector. It has long-standing experience in working with developed and emerging countries and has hosted many study programs to Australia, including from Central and East Asia.

- **Exposure to different models of RBOs:** This requires assessment of operation and lessons learnt that could be applied to Mongolia. Brantas RBO in Indonesia is managed as a corporate RBO. It is successful and largely sustainable through self-financing. Issues of transboundary rivers are a major bottleneck for many potential water developments projects in Mongolia including hydropower and water transfers. Effective management of transboundary rivers requires very careful management and diplomacy. It is recommended that government officers are given exposure to international transboundary programs through study tours to see initiatives being implemented in other countries. A good example is the work being carried out by the Mekong River Commission which is currently supporting management and water sharing initiatives for the Mekong River in five countries: PR China, Lao PDR, Thailand, Cambodia, and Vietnam.

- **Exposure to different models of urban water utilities and authorities:** In recent years, many urban water organizations have implemented major initiatives to strengthen their operations through financial reforms and introduction of new management systems including public-private partnerships. New technologies including waste water treatment are urgently required for Mongolia, and it is important that options for new initiatives are explored and seen in practice before embarking on expensive investments.

- **Strengthening groundwater management:** This is an area requiring additional expertise, including understanding of aquifers, recharge, and interconnectivity of surface water and groundwater aquifers. Analysis of safe water abstractions and pollution need specialist techniques, including the analysis of low levels of toxic contaminants. RBOs need additional technical and institutional capacity to enforce regulations and drive through change to ensure sustainability.

- **Implementing river basin governance:** It is recommended to conduct on-the-job training in selected river basins to develop and pilot new approaches to planning and implementation of good governance and investment. Activities would involve the RBOs, aimag and soum governments as well as stakeholders.

**F. Recommendations for Strengthening Water Service Providers and Users**

1. **Strengthening Water Service Providers**

   Strong and self-financing water service providers are a critical component for successful implementation. To achieve this, water service providers need clear performance targets and to be accountable to meet these; there need to be adequate financial incentives to meet performance targets or disincentives (penalties) if these are not met. To meet the targets, water service providers need greater autonomy, including flexibility in management and tariff setting. It needs to be ensured that financial returns are balanced with social objectives. Experience has shown that water service providers work best within a commercial framework, balancing investments with revenues, but require working within a strong regulatory framework.
**Strengthening regulatory framework**: Regulatory framework requires strengthening in two core areas: (i) licensing and monitoring of compliance, currently managed through the RBOs who lack resources; there is a need for larger water users to take on self-regulation and monitoring of water use and effluent quality; and (ii) operational regulation currently through the Water Sector Regulatory Commission which lacks capacity and resources. Training in management of public-private partnership type contracts, tariff setting, service quality monitoring and enforcement, licensing, and public communications and outreach is required.

**Contractual options for water service providers**: Investments in urban WSS and irrigation need careful consideration of options for financing and management, which need to be appropriate to specific programs. An overview of generic options for water service providers is summarized in Table 18.

**Table 18: Contractual Options for Water Service Providers**

<table>
<thead>
<tr>
<th>ARRANGEMENT</th>
<th>ADVANTAGES</th>
<th>DISADVANTAGES</th>
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<tbody>
<tr>
<td>Corporatized public entity</td>
<td>Simple, as no complicated tender process is required. Offers a middle road between full private and government management. More flexibility to build in social requirements.</td>
<td>Requires effective public institutions and governance. Publicly owned and operated utilities do not respond as well to regulation as privately owned and operated utilities. Can be difficult to establish true arms-length relationship between government and utility managers.</td>
</tr>
<tr>
<td>Management contract: Government engages a private sector organization to manage operations.</td>
<td>Seen as a useful first step towards reforms and improvements in efficiency. Provides a good interim option prior to developing lease or concession type contracts.</td>
<td>Provides weak incentives to improve commercial management and technical efficiency. Ineffective changing and locking-in tariff and subsidy regimes. As much disruption as with a lease or concession, but less management autonomy.</td>
</tr>
<tr>
<td>Lease: A private company is responsible for operation and maintenance. Normally no investment is required. Assets remain the property of the government. Under a lease, the lease fee is fixed irrespective of revenue.</td>
<td>Strong incentives to improve commercial management and technical efficiency. Good for locking-in and changing tariff as needed. Can attract soft financing for capital expenditure (e.g. from international financing institutions).</td>
<td>Difficulty in determining who is responsible for which investments; can lead to disputes. Operator has little control over investment. Public sector still needs to provide capital for investment.</td>
</tr>
<tr>
<td>Affermage: Similar to lease, but the operator and contracting authority share the revenue from customers.</td>
<td>Operator has good incentives to invest efficiently. Private sector provides capital. Requires adequate tariffs and levels of revenue.</td>
<td>Cannot attract soft financing from international financing institutions for capital expenditure.</td>
</tr>
<tr>
<td>Concession: A private company is responsible for operation and maintenance and investment, assets are returned to the government at the end of the concession.</td>
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Source: TA 8855-MON: Mongolia Country Water Security Assessment
2. **Water Service Delivery Options for Low-Income Community Water Users**

Provision of WSS services to the peri-urban poor is socially desirable and a core part of the 2030 investment vision. Investment costs of urban WSS for the low-income peri-urban ger areas are however high and financially less viable, with operational cost recovery being marginal. It is critical that planning and design of investment needs to be linked to development of an effective management structure as well as capacity of beneficiaries to meet the requirements for cost recovery of investment and operation and maintenance. For example, studies on development of piped water and sanitation in Ulaanbaatar’s ger areas estimated that an 80% investment grant would be required for a private investor to achieve a financially viable rate of return (FIRR 15% and payback period of six years).41

Various initiatives have been piloted to promote beneficiary investment of improved on-site dry latrines. Despite partial subsidies, these have had mixed success. There is reluctance for ger residents to invest in sanitation, partly due to lack of security of tenure, and the hope that at some stage government or NGOs will provide free or subsidized sanitation. Private sector bathing houses have been developed with some success in ger areas of Ulaanbaatar to provide public facilities for bathing, sanitation, and laundry. This approach could be usefully applied to aimag and soum centers.

3. **Developing Community-based Water Management Systems**

There is increasing interest to develop community-based water providers, especially for peri-urban WSS and irrigation. Advantage of such arrangements is that community has a financial as well as benefit stake in successful operation of provision of water services.

The concept of community-based management is that metered bulk water is provided to a block of houses rather than individual houses. The local operator purchases bulk water and distributes the water to water users who are charged based on estimated water used and on an agreed tariff structure. Water within the block is managed by a local operator, either as a consumer cooperative or as a small or medium enterprise (SME). The water supply enterprise can be managed on a commercial basis by either a private company or by a community-based enterprise with the residents being offered options to purchase shares in the company. Revenue is used to pay for operational costs and investment with some dividend to shareholders.

A sewerage system could form part of the initiative, with each block provided with a single sewerage interconnection point, or alternatively could be on-site septic tanks or individual dry sanitation units. Installation of water or sewerage infrastructure would need to comply with strict design criteria for size and type of pipes and depths of pipes in the ground. Type of connection would depend on the recipient’s capacity and interest to invest, and the block could incorporate a mix of house, yard connections, or standpipes.

This approach is sometimes termed ‘condominium water and sewerage system’ and has been developed extensively in Brazil for low-income peri-urban communities. The experience of community-based management based on SME can also be applied to irrigation.

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Options for Community-Based Water Management in Brazil

The so-called condominial approach to the construction of water and sewerage networks was developed in Brazil during the 1980s as a response to the challenges posed by expanding water services into peri-urban neighborhoods. The model has been successfully applied to major urban neighborhoods including 0.5 million inhabitants in Brasilia and 1 million inhabitants of the state capital Salvador.

Whereas conventional systems essentially provide services to each housing unit, condominial systems deliver services to each housing block or any group of dwellings that could be termed a neighborhood unit or “condominium”. In addition, an integral condominial design incorporates possible decentralization of water supply, sewerage treatment facilities, and water storage to reduce costs.

The condominial approach allows for a much closer relationship between service providers and users, encouraging the two parties to come to an agreement to facilitate service expansion and adaptation to local needs and constraints. Thus, the condominium becomes not only a physical unit of service provision, but also a social unit for facilitating collective decisions and organizing communal actions. Members of the condominium must select the appropriate design of the condominial service and commit themselves to complementary actions ranging from sanitary education to direct participation in the construction and maintenance process.
V. PROPOSED WATER SECTOR INVESTMENT PROGRAM

A. Outline of the Water Sector Investment Program

The proposed water sector investment program sets out direction and details of key investments in the water sector for a 13-year period, from 2018 to 2030. It includes requirements for investment in water-related infrastructure by government, private sector, and beneficiaries.

Investment options are developed based on an analysis of challenges and opportunities for water security, considering requirements for social and economic development. Investment program builds on the Integrated Water Management Plan 2013 and incorporates other plans and project reports. It integrates objectives of Mongolia's Sustainable Development Vision 2030 to strengthen water security, and government objectives to strengthen economic diversification, employment creation, and environmentally sustainable development.

The investment program describes objectives, investment components, policy and institutional initiatives, environmental and social impacts, and financial assessment. It outlines physical investments and TA to support the investments.

The investment program period is over 13 years, from 2018 to 2030, and is split in two stages: stage 1 runs from 2018 to end 2024 (seven years) and stage 2 runs from 2025 to 2030 (six years).

Proposed physical investments are following:

- **Investment program for household water security** targets improved WSS for rural herder communities. The program will increase awareness of the risks of poor, and the benefits of improved, WSS, and support herder families to enable self-investment in low-cost WSS.

- **Investment program for economic security** shall ensure adequate water quality and quantity for economic activities and an enabling environment for investment that meets government objectives. Proposed physical investment includes: (i) 70,000 ha of new and upgraded irrigation area; (ii) livestock water points, pasture and livestock management; (iii) investigations to develop sustainable water supply for economic growth in the South Gobi Region; and (d) 650 MW of renewable hydropower.

- **Investment program for urban water security** supports development of improved water services for urban centers to meet domestic, industrial, and public services water demand. Investments aim to maximize the coverage of improved WSS for urban households, to improve water for industry, to improve effectiveness of wastewater treatment, and to support economic growth in urban and peri-urban areas. Physical investments target improvements of WSS for industry, municipal, and public services in Ulaanbaatar, 21 aimag centers, and 300 soum centers.

- **Investment program for environmental water security** include ensuring that policy and institutional frameworks enable sustainable water resources management. Environment-specific and cross-cutting investments are proposed to support water resources protection and enhancement.

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43 The Sustainable Development Vision 2030 is already underway and the investment plan has consolidated phase 1 and 2 of the sustainable development vision into stage 1 of the investment program.
● **Investment program to reduce water-related disasters** focus on improved knowledge of disaster risks to increase effectiveness of investments in flood, drought, and *dzud* protection; and in improved awareness to reduce water-related disaster risk.

TA is required to support the physical investments and will be financed by the Government of Mongolia and private sector (in cases where private sector financing is proposed for the investment). Key areas of TA are:

- **Planning and design of investment programs**: Investments need to be supported by planning, feasibility studies, and detailed design to assess technical, financial, and economic viability. Due diligence studies, including environmental and social impact assessments, are required to assess financing options, develop low-cost solutions, and maximize economic returns, while ensuring social benefits for poverty alleviation, employment creation, and health.

- **Stakeholder engagement and capacity building, as well as institutional development and policy support initiatives**: Investments need to be supported with stakeholder engagement, training, and institutional development. TA is also required for identification of areas where policy and regulations need to be adjusted.

- **Improving knowledge of water resources**: It is required to prepare location-specific detailed assessments of surface water and groundwater. Studies are required that improve understanding of groundwater resources in the proximity of industrial and mining areas in the Southern Gobi Region as well as of climate change impacts.

- **Strengthening capacity for integrated water resources management**: Key agencies’ capacity for sustainable water management needs to be strengthened. TA is required to improve coordination between agencies and stakeholders, strengthen water policies and regulatory framework, and conduct cross-cutting water resources assessment.

- **Strengthening private sector partnerships**: The proposed investment program includes a significant portion which shall be implemented through private sector and public-private partnerships. Strengthening and enabling public-private sector partnerships can lead to the provision of significant support in financing and operation of schemes.

- **Project management**: Implementation of the investment program requires project management and supervision of construction. The cost of this TA is approximately 5% of the investment costs.

Financial analysis assesses cost and benefits to an investor, while economic analysis assesses cost and benefits to the country. Following financial assessments were incorporated into the investment proposal:

- **Hydro-economic assessment** of the incremental cost to supply additional water based on unit cost of water ($/m³) using financial discounting to incorporate investment and operational costs. Cost curves have been prepared for the four main areas of incremental water demand: (i) Ulaanbaatar urban area, (ii) *aimag* and *soum* urban centers, (iii) irrigation, and (iv) mining.

- **Cost-benefit assessment and estimates of FIRR** are applied to focus on irrigation and livestock, for which benefits can be directly quantified.

The problem tree sets out key causes and effects of shortfalls of water resources management and investment, and impact on water security.
B. Investment Program for Household Water Security

Household water security assessment focuses on rural water security of herder households, who have the lowest access to piped water supplies and improved sanitation. Household water security index is 11.5 (out of 20). It shows low values in two of the four indicators: (i) access to improved water supply; and (ii) improved sanitation facilities.
Challenge

Only 50% of herder population have access to improved safe WSS. Most herders use dug wells and open water sources. Summer gers use river water, facing issues of permafrost in some areas. Sanitation facilities are minimal due to movement of herder camps. Improving household security in rural areas is difficult, due to dispersed and temporary nature of camps. Government has been providing deep wells for livestock, which also provide some benefit to herder families, but there is no specific program to meet the needs of potable WSS for herder families in pasture camps.

Objectives of Investment

Investment program for household water security follows the objectives of Mongolia Sustainable Development Vision 2030 to provide access to secure water supply for up to 90% of population and improved sanitation for 60% of population by 2030. A key objective of the investment program is to increase awareness of, and willingness by, herder communities to support and invest in improved WSS. Investments will focus on improving water quality within the household together with improving on-site sanitation. It is critical that the investment in herder WSS considers socioeconomic changes of herder communities, including gradual establishment of semi-permanent gers and parallel strategies for sustainable pasture and livestock management.

Investment Program

Proposed investments are shown in Table 19. The program is to be integrated and implemented in parallel with: (i) investment in water points for livestock; and (ii) improved WSS for soum centers where many herders are establishing base residencies. Investment in additional water points is not included in the household water security, as it is incorporated into investment for ‘water for livestock’.

Table 19: Investment for Household Water Security

<table>
<thead>
<tr>
<th>REF</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>A.1</td>
<td>(TA) Planning and Design for Herder WSS</td>
</tr>
<tr>
<td></td>
<td>TA to design sustainable integrated approaches to herder WSS, including low-cost sanitation, on-site initiatives for potable water such as simple household filtering, and increasing hygiene awareness.</td>
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<tr>
<td></td>
<td>TA includes: (i) assessment of how rural WSS can be applied to support socioeconomic development of herder communities; (ii) planning and design of a pilot investment program, and design of a financing support package; (iii) programs on training and awareness raising to increase willingness of herder communities to support and invest in WSS; training programs to improve hygiene of in-house water treatment (filtration, boiling and clean storage); and training and awareness in water hygiene for rural schools.</td>
</tr>
<tr>
<td></td>
<td>TA costs include pilot investments for 2,000 units (by Q4 2019).</td>
</tr>
<tr>
<td>A.2</td>
<td>Investment on Low-Cost Sanitation and Household Water Treatment for Herder Communities</td>
</tr>
<tr>
<td></td>
<td>Investment includes: (i) procurement of simple household water treatment kits and simple on-site dry sanitation facilities. The type of sanitation facility is to be assessed and piloted based on key needs of families with 2-3 gers, with a special focus on summer gers and portable kits; (ii) 80% of</td>
</tr>
</tbody>
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44 This is significantly lower than the national average of 80%.

45 For example, on-site sanitation using improved latrines and in-house water treatment systems are cost-effective options.

46 Herder camps are becoming more permanent, and traditional practice of moving four times a year is changing. Most herders now move only two times between winter and summer locations.
the investment cost will be borne by beneficiary and 20% as support subsidy from the government (the type of subsidy and mechanism to be assessed).

Total investment: 120,000 units; by 2024, 48,000 units (40% of families), by 2030 remaining 80,000 units will be dispersed.

Responsibility: Ministry of Food, Agriculture, and Light Industry

Source: TA 8855-MON: Mongolia Country Water Security Assessment

Institutional and policy initiatives: Investment program will incorporate development of policies and strategies for decentralized WSS systems.

Environmental and social impacts: There will be insignificant change to the quantity of water consumed. Location of herder camps and water points affect grazing patterns of livestock, which impacts the pastures and thus investments need to be planned and integrated with initiatives for sustainable pasture and livestock management. Low-cost non-sealed latrines would be adequate as soil groundwater contamination is not considered to be an issue in rural areas.

Financial and economic benefits: Investment program will result in reduced costs to collect water, and improved health and wellbeing.

C. Investment Program for Economic Water Security

The goal of economic water security is to provide water of sufficient quantity and quality to meet the demands of Mongolia’s economic sectors. Major economic water users include agriculture, mining, industry, and energy. **Water security index is 12.3** (out of 20).

While the assessment suggests that for most locations water demand can be met directly from surface or groundwater, two regions are expected to face water shortages in near future:

- For the South Gobi Region, this CWSA has identified potential future water shortages which is in line with previous assessments. It is estimated that water shortages in the South Gobi Region are likely to constrain development of mining and energy by 2023. Due to the lack of surface water, water is sourced from both renewable and non-renewable groundwater; there are however major uncertainties on the quantity of groundwater that can be viably and sustainably sourced. Investigations and investments are required to gain more clarity on potential groundwater sources and initiatives to support the adoption of water saving/demand reduction technologies. Given the partially non-renewable nature of groundwater resources, a decision needs to be made on how to proceed with applications for groundwater licenses. A further option is the Orkhon-Gobi water transfer scheme; recent studies by the 2030 Water Resources Group study found this to be not cost-effective and potentially not feasible given the constraints to water availability in the Orkhon River.

- In the Tuul River basin, current groundwater sources are estimated to meet the needs of Ulaanbaatar until 2025. Water supply planning needs to be extended to assess options for supplementary water. The Tuul Water Complex, a surface water reservoir, is currently being proposed to meet the shortfall. Further, water demand reduction measures need to be assessed, implemented, and enforced.

Bearing in mind the long time to develop major investment projects, the government needs to take an early proactive role in exploring the alternatives and preparing a clear development and investment program for water resources in the South Gobi Region and in the Tuul River basin.

As most industry is located near or in the urban areas, water requirements of industry have been incorporated in urban water security. Any industrial processes relating to mines are however incorporated into economic water-mining.

Investment programs for the specific economic sectors are presented in the following sections.
1. Water for Irrigation

Challenge

Irrigation remains a small sector with much of the irrigation infrastructure having deteriorated due to the lack of maintenance, unresolved ownership, and low efficiencies. The current area under irrigation infrastructure is around 50,000 ha, against a potential area of 400,000 ha. The current irrigated area represents about 10% of the sown area.

Irrigation systems are financed by the government but management is partially by the water user associations. There are issues related to a lack of adequate finance for operation. Irrigation water use efficiencies, the productivity of water ($/m$^3$), and yields are low due to the use of old technologies and equipment, the short growing period of 95-110 days, and low temperatures. It is only possible to grow a single crop per year; as a result, financial viability of irrigation investments is quite marginal. Thus, there is a need to focus on low-cost irrigation systems. It is likely that many of the old crop cultivation systems cannot be viably be restored under the current economic conditions and that new and appropriate technologies, improved management, marketing and financing systems need to be identified to improve financial and economic viability.

The north part of the country has more access to water from rivers and wells, whereas the southern Gobi part is drier with only intermittent surface water and severe constraints on groundwater.

Farmer Producer Organizations in India

Farmer producer organizations in India are an important initiative by the Ministry of Agriculture to mainstream the promotion and strengthen a member-based institution of farmers. The concept is that producers of agricultural products can form groups and register themselves as companies. Farmer producer organizations can be created at state, cluster or village level. Supply of inputs such as irrigation, seed, fertilizer and machinery, market linkages, training, credit, insurance, networking and financial and technical advice are the main activities envisaged for the farmer producer organizations. The goal of the farmer producer organizations is on enterprise development, promotion of sustainable, quality products. Essential for the sustainability is the creation of profit for the company, which can be reinvested or paid as a dividend to the shareholders. Farmer producer organizations are more flexible than cooperatives, which have frequently faced difficulties of registration and limitations of their sphere of activities and restrictions of their administration. Farmers, who are shareholders, own the farmer producer organizations, but there is also flexibility in how this is organized. The companies are managed through a board of directors elected by the shareholders.

Government strategy is to promote irrigated agriculture to support food self-sufficiency and improve rural livelihoods. There are ongoing programs by the government to rehabilitate irrigation systems with water from rivers, small reservoirs, and groundwater. The government is promoting private sector involvement in irrigation; and has recently reduced tax rate for agricultural enterprises, which helps to support private sector investment. There are now some successful private initiatives to grow wheat and vegetables, including some examples of intensive cultivation with drip irrigation and polyhouses.

Objectives of Investment

Key objectives of the irrigation investment include: (i) establishment of modern and well-managed irrigation systems to support food security and rural employment; (ii) that irrigation systems are financially and economically viable and operationally self-financing; and (iii) that modern and improved crop agriculture including marketing systems are developed to maximize investment returns.
Investment Program

The investment program follows the Mongolia Sustainable Development Vision 2030 (SDV2030) and the Irrigation Action Plan 2016-2025, which set out the objective to increase the irrigated area from the current 50,000 ha to 120,000 ha by 2030, with a focus on upgrading of existing irrigation schemes as well as opening new irrigation areas. The key parts of the irrigation investment program are summarized in Table 20.

<table>
<thead>
<tr>
<th>REF</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>B1.1</td>
<td>(TA) Planning and Design for Irrigation</td>
</tr>
<tr>
<td></td>
<td>To include: (i) review of irrigation development opportunities focusing on Orkhon and Selenge rivers; inventory and selection of optimum locations and prioritization of potential schemes for rehabilitation or new schemes; economic analysis and development of proposals for investment; and assessment of lessons learnt from private sector irrigation operations, e.g. the Gachuurt scheme; (ii) studies into new approaches for water saving technologies, including sprinkler, drip, spate, treated wastewater irrigation, small-scale rural and peri-urban irrigation; (iii) studies on viable financing and management strategies, including public-private partnerships, farmer producer organizations (see best case in box above), cooperatives and water user associations; (iv) planning for agricultural support initiatives to increase productivity, financial returns and resilience to climate change.</td>
</tr>
<tr>
<td></td>
<td>Planning and design of the irrigation schemes (for 5,000 ha by end 2018).</td>
</tr>
<tr>
<td>B1.2</td>
<td>Investment in Rehabilitation and Expansion of Irrigation Schemes</td>
</tr>
<tr>
<td></td>
<td>Rehabilitation and upgrading of existing schemes and new schemes (21,000 by 2024).</td>
</tr>
<tr>
<td>B1.3</td>
<td>Investment in New Technologies and Agriculture Production Support</td>
</tr>
<tr>
<td></td>
<td>To include crop husbandry, fertilizers, training, storage, agro-processing and marketing.</td>
</tr>
</tbody>
</table>

Responsibility: MoFALI.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

Institutional and policy initiatives: These will target strengthening of management, as well as financing for sustainable operation and maintenance. Management options for irrigation schemes will be through government-owned companies, private sector, water user associations, or hybrid arrangements. The program will incorporate strengthening policy and strategies on public-private partnerships, as well as lessons learnt from ongoing private sector irrigation schemes. Lessons learnt will be applied to support investment and management of irrigation, and development of technologies for improved crop agriculture.

Environmental and social impacts: Irrigation requires a significant amount of water, thus an expansion of irrigation schemes needs to carefully assess available water resources, considering existing and future water demand from other users, as well as environmental flow requirements. Irrigation demand is high in the early spring, when river flows are low and there may be issues of lack of water. Groundwater from riparian aquifers could potentially bridge the gap in supply.

Financial assessment: Financial returns from irrigation are low, due to the short growing period and temperatures being below the optimum levels. The FIRR curves for different investment and crops are shown in Figure 35.

Investments should achieve a FIRR of not less than 15% to be financially attractive for investment:

- Irrigated wheat is very sensitive to the investment costs. Yields are typically about 3 tons/ha and financially viable with investments up to $1,500/ha. There is potential for higher yields. For example, “Gachuurt”, a commercial company, achieved wheat yields of 4.5 t/ha in 2014; at this yield, investment up to $2,500 per ha would be financially viable.
- Vegetable production would be financially viable with investments up to $4,400/ha if yields of 15 t/ha can be achieved; and with investments up to $6,200/ha if 20 t/ha can be achieved. Vegetable production is a niche market and requires good access to capital, storage facilities, and marketing.

**Figure 35. FIRR Curves for Different Investments, Crops and Yields**

It is clear from the analysis that there are ceilings on investment costs per hectare to achieve financial viability. Thus, options for irrigation include:

- Direct pumping from a river or existing irrigation canal using sprinklers. This is the lowest cost system. A radial sprinkler system is estimated to have cost of MNT 3.3 million/ha ($1,500/ha), which would be financially viable for wheat production with a yield of 3 tons/ha.

- Pumping from a well using sprinkler irrigation would have higher costs of around MNT 10 million/ha ($4,000/ha) and would be financially viable for high yielding potatoes or vegetables, or for intercropping wheat at 4.5 tons/ha with vegetables and potatoes. Wells located close to rivers have the best yields, and the areas around are likely to have the best soils. For these wells, groundwater recharge is good due to hydraulic interconnectivity of surface water and groundwater.

- New irrigation with storage and canal systems have costs of $10,000/ha or more, and would likely not be financially viable. Rehabilitation of existing irrigation could be viable as much of investment is in the form of sunk costs.

Currently, irrigated crops consist only of about 10% of the cultivated area, and investment will help to increase production and reduce risk and uncertainty.

2. **Water for Livestock**

**Challenge**

Total pasture land area is estimated to be 128 million ha, of which about 5.0 million ha (3%) are currently not used for animal husbandry due to the lack of available water, while another 14.1 million
ha (11%) are estimated to be too remote for effective livestock production. In existing pasture areas, many wells are not used due to poor maintenance, which reduces available pastureland.

According to the 2015 census, Mongolia has reached the highest number of livestock in its history with a total estimate of 56 million animals, an equivalent to 100 million heads/unit of sheep. The number of livestock has significantly increased in recent years, due to government subsidies for wool production. Large increase in stocking numbers is also due to opening of new grazing lands from construction of new water points.

Application of internationally accepted procedures for calculating a resilient carrying capacity for Mongolian pastures indicates that carrying capacity has been greatly exceeded in many areas, and suggests that overgrazing is a primary factor explaining rangeland degradation observed in Mongolia. The overgrazing problem exists around traditional and constructed water sources. Climate change projections indicate that increased frequency of drought and overgrazing of pastures will worsen the situation and will leave most soils fragile by 2030. Thus, control of livestock numbers is a fundamental pre-condition for effective rangeland management.

Complexity of the livestock sector necessitates balancing economic returns from investing in water points and risks of irrecoverable long-term degradation of pasturelands caused by uncoordinated development of water points.

Livestock and Pasture Management in Australia

In northern Australia the four factors considered for stocking and sound grazing management were formulated as follows: (i) manage stocking rates to meet goals for livestock production and land condition; (ii) rest pastures to maintain them in good condition or to restore them from poor condition to increase pasture productivity; (iii) devise and apply fire regimes that enhance the condition of grazing land and livestock productivity while minimizing undesirable impacts; and (iv) use fencing and water points to manipulate grazing distribution.

Stocking rates that persistently exceed the carrying capacity of the land were found to result in a decline in land condition, loss of perennial grasses, an increase in bare ground and soil loss, with subsequent loss in pasture and livestock productivity and financial returns. Operating near or below the long-term carrying capacity of the land helps maintain land in good condition, which is crucial to maintaining the long-term productivity and sustainability of a grazing enterprise. Adjusting stock numbers depending on seasonal rainfall was an important management requirement.

Farmers in Australia found that moving livestock more frequently can help pastures to better survive droughts. Training is given to farmers to provide them the tools and confidence to measure how much nutrition there was in their pastures and help them to determine how many livestock could be sustainability supported. Although frequently moving livestock was more labor intensive than traditional methods it was seen that pasture responded to even short-term rest. There are many software products that farmers use to monitor their stock numbers and get stock production estimates based on different stocking mix, soil types, and weather scenarios.

48 Investment in water points allows for increased production in areas where pastures are underutilized due to lack of access to water.
50 Development of additional boreholes must incorporate consideration of wider management issues. FAO have cautioned that development of water sources should await both granting of grazing rights and users to organize themselves before it has a realistic chance of success.
Objectives of Investment

Three objectives of the water for livestock investment program include: (i) improved livestock production from pasture areas through provision and rehabilitation of livestock water points; (ii) increased production returns and reduced stocking numbers through improvement of water points as an integral part of a package of initiatives for sustainable pasture and livestock management; and (iii) effective operation and maintenance of pasture water points.

Investment Program

Investment will include new and rehabilitation of existing water points, support to establish herder groups, improved breeding marketing, fodder production, small-scale irrigation, improved capacities to maintain pumps and boreholes, and integrated support for rural livelihoods.

Based on a need of one well per 5,000 ha, it is estimated that 1,000 wells would be required to open 5.0 million ha of unused pasture. The lack of wells in these areas is partially due to the lack of water due to difficult hydrogeological conditions including permafrost in some areas. Also, tubewell costs are relatively expensive. It is estimated that on average a 100 m tubewell, including pump and pump house, costs around MNT 25 million/well ($11,000/well) equivalent to MNT 5000/ha ($2.2/ha).

It is estimated that investment in rehabilitation, in addition to the construction of some new water points, would increase the area for grazing by around 10%, or 12 million ha. The investment costs to rehabilitate wells and to construct some new wells is around $1.0/ha; $1.2/ha cheaper than opening new pastureland.

To ensure sustainability and to avoid degradation of pastureland, pasture and livestock management, training, legal and technical support and institutional support are required. The benefits and clear financial returns from having better quality but reduced numbers of livestock need to be demonstrated to herder households. The key parts of the investment program are summarized in Table 21.

<table>
<thead>
<tr>
<th>REF</th>
<th>DESCRIPTION</th>
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| B2.1 | (TA) Planning and Design for Livestock Water Points, Pasture and Livestock Management  
To include: (i) assessing integrated approaches to new and rehabilitated water points to support increased livestock production and improved pasture management; (ii) institutional support to develop policy and regulatory mechanisms for sustainable pasture and livestock management; (iii) assess approaches for herder groups to maintain water points and support pasture and livestock management initiatives; (iv) analysis of optimum location of water points to optimize production and support rural WSS; (v) development of GIS and monitoring systems; (v) design of parallel programs to improve pasture, production and marketing systems including: management of grazing areas, small-scale irrigation from water points, improved animal health and breeding stock, improved availability of fodder, strengthened marketing systems and increased opportunities for rural employment; and (vi) programs for training and awareness of herder communities.  
(Study by Q4/2017, detailed design for 10 million ha by Q4/2018) |
| B2.2 | Investment in New Water Points, Pasture and Livestock Management in Unused Grazing Areas  
Construction of 1,000 new water points in 5 million ha in pasture areas currently not used due to the lack of access to water. Parallel investment to support pasture management, livestock production and marketing systems, including management of grazing areas, fodder production, small-scale irrigation, improved animal health, breeding stock, marketing systems, employment creation, monitoring and evaluation systems  
(1.5 million ha by 2025, remaining 3.5 million ha by 2030) |
B2.3 Upgrade of Water Points and Pasture and Livestock Management in Existing Grazing Areas

Upgrade of water points for over 70 million ha in existing pasture areas. Parallel investment to support pasture management, livestock production, and marketing systems including management of grazing areas, fodder production, small-scale irrigation, improved animal health, breeding stock, marketing systems, employment creation, monitoring and evaluation systems (21 million ha by 2024, 49 million ha in stages to 2025-2030).

Responsibility: MoFALI in close cooperation with herder communities and associations.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

Institutional and policy initiatives: Investment in livestock water points alone does not address the issue of overgrazing of pasture areas. There is a need for a clear policy and strategy for sustainable management of pasturage and livestock, in conjunction with improved financial returns from lower-density grazing.

Environmental and social impacts: Developing water points alone will likely contribute to increase in livestock numbers and associated degradation of pasture lands. To mitigate this unsustainable development, it is proposed that investments in water points are combined with investments in pasture and livestock management, directed at increasing productivity and returns in parallel with reducing the numbers of livestock.

A financial assessment of an integrated investment in water points, pasture and livestock production systems has been carried out, which shows that there are good FIRR for investment in livestock water points. The analysis examined two development scenarios (Figure 36):

- New pasture areas: Opening new pasture areas provides the highest financial returns. An investment of $10/ha provides a FIRR of around 25%. This is comparable to the previous ADB Water Point extension program, which opened new pasture areas through a package of water points and pasture management at a cost of $10.0/ha.

- Existing pasture areas: Overall investment costs are lower. Financial assessment indicates that investments up to $5/ha would be financially viable (FIRR 13.3%) through: (i) increasing pasture area for grazing by 10% (or 12 million ha) through rehabilitating and constructing additional water points; and (ii) developing pasture and livestock management initiatives to increase productivity and financial returns from livestock and to avoid the gradual loss of production from overgrazing, which would increase financial returns by 15%.

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51 Investment in water points alone (without pasture management) has financial returns (FIRR) above 15% but is not considered as an investment option due to the lack of sustainability resulting from overstocking.

52 ADB. 2008. Mongolia: Water Point and Extension Station Establishment for Poor Herding Families


Figure 36. FIRR Curves from Investment in Water Points, Pasture and Livestock Management

Notes:
New pasture: Defined as area where less than 30% of the grazing areas are currently used for livestock. The financial analysis assumes that 70% of the land areas could be made productive and stocked through provision of new water points. Pasture and livestock management would be incorporated as part of the investment to ensure sustainable levels of stocking.

Existing pasture: Potential increase of grazing area is assumed at 10%, by rehabilitating and constructing new water points. In parallel pasture and production management initiatives are assumed to increase livestock production by 15% (consisting of some increase in production from current levels together with avoiding the likely loss of production from overgrazing).

Source: TA 8855-MON: Mongolia Country Water Security Assessment

3. Water for Mining

Challenge

Mongolia has some of the largest untapped mineral deposits in the world, and over the last 15 years the mining sector has taken off, driven by development of modern gold mining operations, development of copper extraction by Oyu Tolgoi, as well as by expansion of coal production in the south-eastern Gobi. Expansion has however recently slowed significantly, due to reduction of demand for commodities. While it is difficult to estimate development of mining to 2030, some projections include: (i) a fourfold increase in coking and thermal coal production, spearheaded by the Tavan Tolgoi coalfield owned by the Government of Mongolia through Erdenes Tavan Tolgoi LLC; and (ii) a nearly fivefold increase in copper production, driven largely by the Oyu Tolgoi copper, gold and molybdenum mega project owned by Oyu Tolgoi LLC.\(^5\)

All mines to some extent require water for their production including: extraction processes, value-adding processes, dust management as well as human consumption for the work force. Future economic contribution of the mining sector and its related industries depend on access to sustainable water resources.

Development of mining will largely be in the areas of optimum geological conditions for economic extraction of minerals, with water resources as a secondary parameter. Estimates by the Integrated Water Management Plan 2013 (IWMP2013) show potential mining abstraction in all river basins. The

\(^5\) Of which the Government of Mongolia owns 34% through Erdenes Oyu Tolgoi LLC.
highest and most critical river basin is the Galba Uush Dooldiin Govi, the area of the lowest water resources and with an estimated future increase in mining water demand of 33%. Based on the water supply-demand analysis, it becomes clear that already in the medium water demand scenario, with currently known water resources, water shortages are expected by 2030 in this region.

Options to prevent these shortages in the Southern Gobi Region include: (i) water demand reduction measures; and/or (ii) measures to increase water supply, i.e. groundwater abstraction from deep aquifers and/or a surface water transfer from the Orkhon River. Options to increase water supply in the Southern Gobi Region are expensive, with average cost-effectiveness ratios of around $2.6/m$^3$ compared to $0.35/m^3$ in northern river basins. Both options are environmentally and socially very sensitive.

Groundwater supplies are mostly non-renewable in the Southern Gobi Region, requiring a fundamental decision on how to deal with these resources. Further, there are conflicts between herders and mining operators on the usage of groundwater. A recent study by 2030 Water Resources Group found that water demand reduction measures for mining and energy were more cost-effective when compared to the options of deep groundwater abstraction or the Orkhon-Gobi surface water transfer. There are uncertainties on the viability and environmental impacts of groundwater as well as the Orkhon River for transfer. Reuse of treated wastewater may be a solution for mines located close to urban settlements.

To date, the environmental record of Mongolia’s mining sector is mixed at best. Many ongoing operations (including large- and small-scale mining), especially domestically-owned mines, are managed in a suboptimal way leading to lower levels of production and in many cases significant irreversible environmental damage. Despite the sector’s financial contribution to the economy, there has been minimal effort to assess and address the issues of environmental damage by mines. This is partly due to the lack of knowledge of the long-term impacts of mining. Many impacts can be rectified for minimal cost, which can also improve production methods and increase returns to mine owners.

Water for mining is a key challenge for sustainable water resources management, due to: (i) highest demand being in the Southern Gobi Region which is the most water short part of the country; (ii) high negative environmental impacts, including discharge of contaminated toxic wastewater containing cyanides and mercury to surface and groundwater; and (iii) impacts on local communities and alienation of the communities who are not beneficiaries and fear their livelihoods may be affected.

Most mine operations are capital-intensive and although they provide employment opportunities, they are perceived as extractive and do not directly support long-term rural development. The assumption is that short-term employment opportunities and the spin-off to local communities automatically balances the impacts on the communities.

The fact that mines use local water resources is one of the key areas of friction. Local communities desire to be consulted and heard. As indirectly affected persons, they consider themselves as stakeholders of the land and water rights in the area surrounding the mines.

Finance for water for mining and related industry is primarily through the private sector. However, potential large bulk water projects would require the government to take the lead and develop a public-private partnership to provide and sell bulk water to the mines and other water users in the Southern Gobi Region.

**Objectives of Investment**

The objectives include: (i) to improve knowledge and understanding of surface water and groundwater resources in Southern Gobi Region and other critical areas to ensure that a lack of sustainable and economical water will not be barrier to future investment in mining; (ii) to invest in new technologies for mining to improve productivity, reduce water use, and environmental impacts; and (iii) to strengthen benefit-sharing for local communities.
Investment Program

Investment program for sustainable water for mining is described in Table 22.

Table 22: Investment in Water for Mining

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
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</table>
| B3.1 | **(TA) Water Resources Assessment and Planning for Southern Gobi Region and Other Critical Areas**  
To include: (i) water resources assessment and detailed feasibility studies for different options for water supply in the Southern Gobi Region; surveys to include technical, environmental, financial assessments; including abstraction from shallow and deep groundwater aquifers, water efficiency and others; (ii) feasibility studies for sustainable water sources for mining and industry in other critical areas; (iii) design of water and waste water treatment investments to meet expansion of mine production; (iv) training and awareness in mining technologies and water management for government, private sector and local stakeholders; and (v) studies to investigate options for ‘payment for environmental services’ through appropriate water taxes. |
| B3.2 | **(TA) Studies to Assess Scope of Reduced Water Use and Improved Waste Water Quality**  
Assessment of possible technologies, selection of partner industries, and design of investment support packages for industry and mines. |
| B3.3 | **Investment in Water Sources and Waste Water Treatment for Mining**  
Investment in water sources and waste water treatment systems to meet the needs of new and expansion of existing mine operations.  
(In stages 2018 to 2030) |
| B3.4 | **Technical and Financing Support for New Technologies and Management Initiatives**  
Directed at water supply and wastewater management for mining and mining-related industry to reduce water use and improve wastewater quality. Investments target to improve processing efficiencies and mine productivity, reduce environmental impacts, and strengthen benefit-share for local communities. Priority to be given to mining-related industries with most potential to reduce water and environmental footprint with a focus on small-scale industries and mines which lack finance and technical skills.  
The investment program will also support: (i) clarifying inconsistencies in the sector and water resources and environmental regulatory procedures; (ii) establishing clearer demarcation of responsibilities between different parts of the government related to mining and water issues; (iii) strengthening of the policy and legal framework for issuing licenses; (iv) developing clear and transparent frameworks for costs of licensing and water abstractions; and (v) strengthening of compliance with license commitments. |

Responsibility: Ministry of Mines, MCUD coordination with MET. Investment through private sector and public-private partnerships.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

Institutional and policy initiatives: Meeting the needs of water security for mining requires a significantly strengthened institutional framework and knowledge base. Coordination between ministries and agencies, and the national and local governments, needs to be significantly strengthened. Initiatives to support mining need to be better integrated with the water resources planning and management. The investments will support the government proposals on State Policy for the minerals sector for 2013-2024 in areas of direct relevance to the water sector. The investment program will support: (i) clarifying inconsistencies in the sector and water resources and environmental regulatory procedures; (ii) establishing clearer demarcation of responsibilities between different parts of the government related to mining and water issues; (iii) strengthening of the policy and legal framework for issuing licenses; (iv) developing clear and transparent frameworks for costs of licensing and water abstractions; and (v) strengthening of compliance with license commitments.
**Environmental and social impacts**: Mining poses significant environmental and social impacts. The investments will be directed at sourcing sustainable and environmentally appropriate water sources as well as initiatives to reduce water use and improve effectiveness of effluent treatment.

**Financial assessments**: Financial analysis shows the provision of large quantities of water for mines in the South Gobi Region that causes very high costs. This study has assessed cost effectiveness ratios of water supply in the South Gobi Region to be in the range of $1.0-3.0/m$^3$. Water transfer options cost around $2.7/m^3$ and deep groundwater abstractions between $2.8-3.6/m^3$, with groundwater for smaller mines amounting to $0.5-1.5/m^3$. This compares to about $0.05/m^3$ using shallow groundwater or direct pumping from rivers, which is possible in the north of the country. There are many uncertainties in the analysis, including the costs and availabilities of groundwater and the costs of exploration and development. Both water transfers and abstractions from deep non-renewable groundwater are socially and environmentally sensitive.

Financial benefits for introducing new technologies to reduce water demand appear attractive. Especially water demand reduction measures for dust suppression, with an average cost effectiveness ratio against the baseline of around $1.6/m^3$, appears to be financially attractive in the Southern Gobi Region. The Oyu Tolgoi mine invested in water efficiency measures including on dust suppression with a water requirement of 0.55 m$^3$/ton, which is considered water-efficient in comparison with other large operations globally in arid areas.

4. **Water for Energy**

**Challenge**

There is a strong interdependency between water and energy systems, generally referred to as water-energy nexus: (i) energy is required for water uses, i.e. for pumping, water and wastewater treatment, transport and distribution of water supplies, for end uses such as irrigation systems and water system development; and (ii) water is required for energy production, i.e. for extraction of primary input such as coal at mines, as well as for conversion of primary inputs to energy, such as at coal power stations.

Current water consumption (2014) for energy production is estimated to be around 33 Mm$^3$/year, an equivalent of 6.6 m$^3$/MWh and about 6% of the total water usage. Currently about 20% of electricity is imported.

Mongolia’s energy demand is expected to increase fivefold by 2030, from current 5,000 GWh to around 24,000 GWh, with most of the energy facilities located in the two water stressed areas, i.e. the Tuul River basin and the Southern Gobi Region. Current water use by thermal power plants in Mongolia is in the range of 2.8 to 18.7 m$^3$/MWh, which is very high compared with the modern efficient systems, which typically have consumption levels of 1.9 m$^3$/MWh (supercritical tower closed loop cooling system) and potentially as low as 0.4 m$^3$/MWh (supercritical systems with once through cooling).

Although coal thermal plants will remain the primary type of generation, the government’s strategy based on the Energy Law of 2015 is to increase renewable energy to 30% of total energy use.

The potential to reduce water demands for energy by investing in new and water-efficient coal power systems, along with the development of renewable energy to meet 30% of Mongolia’s energy demand is promising. It is estimated that although energy demand could increase by about 500% by 2030, the overall water demand for energy could be potentially be reduced to the levels which are lower than the current levels.

**Objectives of Investment**

Investment objectives for energy are: (i) to maintain total water use for energy by 2030 at current levels of 33 Mm$^3$/year, (ii) to ensure that all coal power stations and combined heat and power plants by 2030 use efficient technologies for energy production to reduce water consumption per MWh (ii) to develop 1,300 MW of renewable power equivalent to 30% of the 2030 energy demand.
**Investment Program**

The investment program for energy until 2025 is estimated to amount to $10.3 billion investment, or $840 million per year. Converting coal power stations and combined heat and power plants to new technologies would benefit the water sector, but has not been considered as an investment for the energy sector and has not been specifically considered or costed as part of the investment program for the water sector.

For the water sector, the focus would be development of hydropower to support renewable energy. Assumption that 50% of the 1,300 MW of the renewable energy target would be met from hydropower indicates that around 650 MW of additional hydropower would be required by 2030.

Existing studies for hydropower need to be updated; costs for hydropower vary depending on physical parameters of the scheme, but typically required investment per hydropower in Asia is around $2.4 million/MW, indicating a total investment cost of $1.6 billion for 650 MW of hydropower development by 2030. The investment program for water for energy is shown in Table 23.

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(i) preparation of an integrated financing plan for renewable and non-renewable power including review of tariffs and feed-in tariff support for renewable energy; (ii) comparative feasibility studies for wind, hydropower, solar and geothermal investments, environmental impact assessments; and (iii) preparation of financing plan for integrated energy investments of renewable and non-renewable energy.  
(Q4 2018). |
| B4.2 | (TA) Transboundary Environmental Impact Assessment of Hydropower Development  
Environmental assessment of hydropower impacts in the Selenge River and Lake Baikal in Russia. |
| B4.3 | (TA) Planning and Detailed Design of the Selected Hydropower Schemes  
(i) site selection, hydrological and geological studies; and (ii) detailed planning and design of schemes.  
(Detailed design for 100 MW Q4 2019). |
| B4.4 | Investment in 650 MW Hydropower  
As part of an integrated program of renewable energy.  
(130 MW by 2024, 520 MW by 2030). |

**Responsibility:** ME, including options for public-private partnerships (design build and operate). Environmental responsibilities through MET.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

**Institutional and policy initiatives:** The investment program for energy will address key issues of sourcing low-cost financing for renewable energy systems, including mechanisms to increase the ‘feed-in tariff’ for renewable energy.

**Environmental and social impacts:** The environmental impacts of coal-based power generation are well documented and the investment would be directed at providing 15% renewable energy through hydropower by 2030. Economic planning and evaluation for different energy sources (coal and hydropower) needs to incorporate full economic price of coal and incorporate the price of carbon emissions.

Potential hydropower projects are mainly in the Selenge River (five plants have been identified with a total of about 900 MW). There is much sensitivity around development of hydropower in the Selenge River, due to the possible impacts on the transboundary Baikal Lake, a UNESCO site in Russia. Thus, development will need to be supported by a major TA to prepare transboundary environmental impact assessments.

Renewable energy can reduce water demand for energy generation. Solar and wind power do not require water; hydropower has a low water requirement while changes in the flow regime require consideration. Geothermal power, however, requires around 13 m$^3$/MWh for cooling which is more than what is currently required for coal-based energy generation.

**Financial analysis**: If externalities such as CO$_2$ penalties are not considered, the least cost option for energy generation in near future remain to be coal-fired power plants. If carbon emissions are incorporated into the analysis, considering a carbon price of $26/ton, then renewable energy, in particular hydropower and wind energy, becomes significantly more attractive.

Future development of renewable energy depends on the level of government subsidized feed-in tariffs. Currently these are insufficient and below the costs of production, with exception for large-scale wind energy. Costs are sensitive to the cost of capital, and there is scope to access low-cost capital for renewable energy systems. New energy-efficient coal power systems have energy costs of around $40/MWh$^{55}$, with older power stations of around $60/MWh. In comparison, renewable energy costs amount to $80/MWh for large hydropower, $67/MWh for wind, and $205/MWh for solar power.

The main problems of renewables are low operating (load) factors, when compared with the coal load factor of 40%: load factors are typically 30% for hydropower (but effectively non-operational during winter), 30% for wind (lower performance in winter), and 17% for solar energy. Development of new and non-renewable power need to be optimized.

### 5. Investment Program for Urban Water Security

**Challenge**

Urban water security scores the lowest of all KDs. Rapid urbanization over the last decade has put major pressure on existing urban WSS systems. Much of the existing water infrastructure and water treatment systems are old and not operating efficiently. Of special concern are the rapidly expanding ger areas, which lack many facilities normally provided to urban populations and often pay higher tariffs for lower levels of service. Costs of improved WSS for ger areas are high and there is no clear strategy of up-scaling access to improved WSS. Increased demand for water includes requirements for domestic supply, industry, and public and municipal services.

There are major issues of sewerage systems not meeting operational targets. Decentralized on-site sanitation offers many advantages for smaller lower-density centers, such as simpler operation and maintenance, and reduced water requirements. United Nations Development Program (UNDP) identifies the change from a simple pit to improved dry latrine as having the highest cost-benefit ratio of all assessed sanitation investments. There is a need to define standards for improved on-site sanitation.

There is a need for policies and strategies to balance the needs of public health, investment, and sustainable cost recovery for operations. The challenge is to identify investments in the WSS sector, which maximize improvements in public health, while supporting socioeconomic development and

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$^{55}$ Costs are the Levelized Least Cost of Energy (LCOF) which is the net present value of the unit-cost of electricity (at 8% discount) over the lifetime of a generating asset. It is often taken as a proxy for the average price that the generating asset must receive in a market to break even over its lifetime
employment opportunities. Management of urban WSS needs to move towards an integrated approach, which considers both centralized and decentralized WSS, and options for house connections against standpipes. Various government corporations acting as PUSOs and working through service contracts are responsible for management of urban services including water supply, wastewater management, district heating, and solid waste management services. Urban WSS is seriously constrained by low economic and financial returns from the investment, poor performance of operations, lack of finance, and low levels of cost recovery. The lack of finance is affecting the quality of service and sustainability of the investment itself. The achievement of adequate finance to meet operational costs is a key target.

The investment requirements for urban water supply are significant, and there will be a need to access finance from various sources, including government and beneficiaries, private sector, and bilateral and multilateral donor agencies. Accessing external finance requires adequate economic and financial returns, which may not be feasible from WSS alone. A potential solution could be to package the investments with integrated urban development initiatives, such as power, heating, roads industry, and peri-urban agriculture.

MCUD holds overall responsibility for urban development including urban WSS. In the case of Ulaanbaatar, urban WSS falls under the mandate of Ulaanbaatar City Government and is executed through the government-owned Water and Sewerage Authority of Ulaanbaatar (USUG). Local governments have direct responsibility for planning, programming, and carrying out urban development activities, but have limited financial and institutional resources to fulfill these responsibilities effectively.

### Technologies for Waste Water Treatment

There have been significant advances in the technologies of waste water treatment and there is a need to investigate alternatives and identify low-cost and simple systems.

Two options that could be of potential application in Mongolia are:

(i) Researchers in Finland have shown that when wastewater freezes, the surface ice is cleaner and the lower ice layers are more concentrated. The clean layer of ice can be removed mechanically from the rest of the wastewater, and the remaining wastewater is more concentrated and can be set aside for treatment. This new energy-efficient method of purification is based on the natural freezing process of water. Energy is required only for breaking the surface ice and transporting it from wastewater pools. Freezing of wastewater could be used to complement aerobic water treatment plants in winter when low temperatures significantly reduce performance.

(ii) Natural lagoons and reed beds can be used to provide a simple, low-cost natural secondary/tertiary treatment of wastewater treatment systems combining lagoon and wetland technology. Reed beds in North America can operate at short-term temperatures of around -40°C. Reed beds require adequate space and can support groundwater recharge.

### Objectives of Investment

Investment objectives for urban water security include: (i) improving financial and economic viability of urban WSS with operation costs fully covered by revenues; (ii) undertaking cost-effective investments to support health, social wellbeing, socioeconomic development and to reduce inequalities related to service coverage in ger areas; (iii) supporting investment for water supply and wastewater treatment for industry in or near urban areas to support economic development; (iv) providing maximum coverage to widen benefits and revenue base of service providers; and (v) strengthening framework for investment and management through public-private partnership and other appropriate investment and management models.
**Investment Program**

Urban water security investment program builds on the government’s SDV2030 strategies to provide access to safe water supplies for up to 90% of the population and improved sanitation for 60% of the population by 2030. Further, the approach builds on the National Water Program (2010-2021) and the National Urban Development program currently under preparation by the MCUD. Investments for Ulaanbaatar’s WSS follow the city’s ‘Urban Development Master Plan 2020 and Development Directions 2030’ which was formally approved in February 2013.

Investments in urban water security include development of water supply, i.e. water sources, water treatment, storage, distribution, as well as house, yard, and standpipes. Investments in sanitation incorporate centralized and decentralized sanitation, sewerage systems, as well as domestic and industrial wastewater treatment. Investments incorporate new approaches to ensure that the investments are: (i) financially and economically viable; and (ii) sustainable, as they will be supported by sufficient revenues from consumers.

Inequities in service delivery between the *ger* and central urban areas will be reduced; adequate levels of investment to support improved WSS to meet the long-term needs of the *ger* areas form a key part of the plan. New initiatives for low-cost piped water and decentralized sanitation for *ger* areas need to be assessed. This includes review of different levels of service to be provided for different types of urban area: (i) standpipes or house connections; and (ii) centralized or decentralized sanitation.

Investment in urban WSS needs to follow the integrated approach set out in the Ulaanbaatar Master Plan, incorporating municipal reforms and capacity building, with the strategic objectives of: (i) improving roads, drainage, and flood protection; (ii) improving land use and urban services (water supply, sewerage, decentralized sanitation, waste management); (iii) making investments in socioeconomic development, including small enterprises and job creation; (iv) increasing operational and financial efficiencies of service providers for water, sewerage, sanitation, heating, waste management; and (v) strengthening institutions and capacity for urban planning and sub-center development, community awareness, participation and empowerment, service provider operations and management, and program implementation capacities. The investment program is shown in Table 24.

**Table 24: Investment for Urban Water Security**

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| C1  | (TA) Urban WSS Policies and Strategies Studies  
Review policies and develop strategies to improve financial and economic viability of urban WSS across Mongolia. The study will focus on the following: (i) strategies for financing WSS, linking this to support socioeconomic development, (ii) assessment of the role of public-private partnerships to support investment and operations; (iii) strategies to find WSS solutions for rapidly expanding *ger* areas; (iv) study tours to understand different management models and technologies for urban WSS.  
(by Q4/2018) |
| C2  | (TA) Detailed Planning and Design for Ulaanbaatar’s WSS  
The planning and design will be done to meet the requirements in 2030 and will incorporate increased sourcing of adequate water, including the Tuul Water Complex. Planning incorporates parallel initiatives in the master plan municipal reforms, capacity building, and socioeconomic development as well as initiatives to reduce inequalities of the level of service to *ger* areas.  
(In stages to 2030) |
| C3  | (TA) Detailed Planning and Design of WSS for 21 Aimag Urban Centers  
The planning and design will be done to meet the requirements in 2030. Design incorporates sourcing adequate water and ensuring good quality. Planning incorporate municipal reforms, |
capacity building, and socioeconomic development as well as initiatives to reduce inequalities of the level of service in ger areas.
(In stages to 2030).
(5 urban centers by Q4/2018).

**C4** (TA) **Detailed Planning and Design of WSS for 300 Soum Urban Centers**
Low-cost WSS systems will be developed to meet the needs of these small urban centers, including special needs of the expanding ger areas. The plans need to incorporate the role of the soum centers as hubs for socioeconomic development of the rural areas.
(40 advance soum centers by 2020, additional 80 centers by 2025, remaining 180 centers by 2030).

**C5** **Ulaanbaatar Urban WSS investment Program**
Investment in urban water and sanitation for the greater Ulaanbaatar urban area following the 2030 Master Plan including: (i) investment in water source development, (ii) upgrading and expanding water supply and wastewater treatment as well as provision of enhanced WSS for ger areas. Includes supply to industry, urban and public services.
(In stages to 2030).

**C6** **Investment Program for WSS in 21 Aimag Centers**
Investments in urban WSS including industry, municipal and public services for 21 aimag centers.
(In stages to 2030).

**C7** **Investment Program for WSS in 300 Soum Centers**
Investment in urban WSS for 300 soum centers including industry, municipal and public services. Governments target is to develop 100 priority soum center WSS systems.

**Responsibility:** MCUD Ulaanbaatar City Government, aimag and Soum governments.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

**Institutional and policy Initiatives:** The investment program supports: (i) strategies and policies to reduce the inequalities in the level of service for urban WSS between central and ger areas, including a higher proportion of house connections and minimum standards of pit latrines; (ii) increasing the uptake of improved pit latrines for lower-density communities in ger areas by developing workable financing systems, such as low-cost credit systems; (iii) strengthening of cost recovery for urban water utilities to ensure investments are sustainable and operation and maintenance costs are covered by revenue streams; and (iv) strengthening policy and strategies and improving investment and management based on appropriate public-private partnership models.

**Environmental and social impacts:** Investments in urban WSS up to 2030 are expected to result in an approximate 30% increase of water abstractions. Adequate water for most of the Soum and Aimag centers can be sourced from shallow groundwater, however, the hardness poses an issue in some locations. In Ulaanbaatar and possibly for some of the other urban centers, there may be a requirement to develop surface water storage to supplement groundwater abstractions. From total abstracted water, only 30% is consumed in urban areas, with the balance being returned – treated or untreated – to water bodies. This needs to be factored into water planning.

**Financial assessment:** Access to external finance will be required for the investment in urban WSS. Key requirements to access capital through loans or public-private partnerships are that investments are: (i) financially and economically viable; and (ii) sustainable and supported by sufficient revenues from consumers (cost recovery). The current models of highly subsidized systems are not considered to be sustainable (within current constraints of government finance) or attractive to external investors.
For most urban centers, the most cost-effective\textsuperscript{56} water source is shallow groundwater at a cost of $0.05/m\textsuperscript{3}. In areas where shallow groundwater is not appropriate, river storage can be considered at a cost from around $0.14/m\textsuperscript{3} for large storage to $0.2/m\textsuperscript{3} for small storage.\textsuperscript{57} There are options to reduce water demand through water efficiency and reuse of treated wastewater. In Ulaanbaatar, for example, water demand can be reduced by increasing energy and water efficiency of combined heat and power plants, and/or by reusing treated municipal wastewater (from WWWTP) as cooling water at the combined heat and power plants.\textsuperscript{58}

The cost for sanitation systems depends on scale and choice of investment. Due to economies of scale, small, centralized systems with a capacity of 100 m\textsuperscript{3}/day (500 persons) cost approximately $2.8/m\textsuperscript{3} or $200/person compared to large centralized systems (>25,000 persons) which cost approximately $1.3/m\textsuperscript{3} or $95/person. For smaller and low-density communities, as well as for low-income households in \textit{ger} areas, there are cost savings when choosing on-site systems: (i) septic tanks cost around $1.0/m\textsuperscript{3} or $60/person; or (ii) improved pit latrines cost around $11/person. The cost per cubic meter and cost per person for different types of sanitation and water treatment systems are shown in Figure 37.

\textbf{Figure 37. Costs Curves of Different Types of Waste Water Treatment and Sanitation}

![Costs Curves of Different Types of Waste Water Treatment and Sanitation](source)

Urban WSS programs can support economic development and provide benefits to health and social wellbeing. As such, planning should incorporate appropriate initiatives to support local economies, particularly \textit{ger} areas. Economic and financial returns can potentially be improved if the urban WSS investments are packaged with other urban programs to support urban and regional development,

\textsuperscript{56} The cost effectiveness ratio is financial cost to supply 1 m\textsuperscript{3} of water, considering the capital costs as well as the annual operation and maintenance costs.

\textsuperscript{57} Based on costs for the Tuul Dam prepared by the Water Resources Group 2030.

\textsuperscript{58} Costs from the Water Resources Group 2030.
including roads, waste management, district heating, small-scale enterprises, sustainable communities, employment generation and performance-oriented governance.

D. Investment Program for Environmental Water Security

Environmental water security requires effective management to ensure that the quantity and quality of surface water and groundwater resources are maintained to sustain a balanced ecosystem and protected aquatic environment, while allowing sustainable use of water resources for social and economic development. Investment program for environmental security is cross-cutting across all water security dimensions.

Challenge

Environmental management and overall regulation did not keep pace with the rapid change Mongolia’s economy experienced over the past decades.

Wastewater: Main wastewater producers include coal and gold mines; extractive industries; food, wool, leather and cashmere processing factories; households; and agriculture. As of 2012, there are around 155 wastewater plants treating 146 Mm$^3$/year, including industrial and municipal wastewater treatment $^{59}$. Infrastructures for sewer facilities were developed with assistance from the former Soviet Union and equipment is now out of date, with poor operation and maintenance being a major challenge. There are no accurate estimates on total volumes of generated industrial wastewater; it is estimated that gold and extractive mines reuse approximately 70% of generated wastewater in their industrial process. The balance of 30%, however, is released untreated into the soil or river causing serious surface water and groundwater pollution and environmental degradation. Wastewater generated from coal mining, which is mostly from dewatering the mines, contains less pollutants and, following a risk assessment, it can potentially be used for irrigation and livestock watering. Most industrial primary wastewater treatment plants discharge treated effluent to the environment, while some are connected to secondary wastewater treatment systems. Decentralized sanitation can offer a cost-effective alternative to expensive and — currently — poorly performing centralized wastewater treatment plants. Various new designs are being promoted and piloted to reduce health risks and avoid soil and groundwater pollution. Options include the ventilated pit latrine ($400 /family unit) and the eco-toilet, which also allows for composting ($800/family unit). More expensive decentralized units include the MOMO aerobic unit ($5,000/ family unit) and anaerobic septic tanks ($5,000-$10,000/unit including soakaway for 5-50-person equivalent). Progress on installing decentralized sanitation is slow due to lack of awareness, reluctance, and limited financial capacities by families to invest. It is important to monitor water quality near industrial and mining plants and urban areas, while streamlining and enforcing a process to penalize any violation in wastewater discharges.

Given the projected economic and population growth, wastewater volumes are expected to be significantly higher by 2030. Major investments in upgrading and replacing the old existing systems as well as expanding services to meet future needs of the new systems will be required. Direct investment in environmental enhancement and mitigation is required to meet the needs of ensuring environmental integrity of the water resources systems.

Mine operations: Most of the mine water processes are ‘invisible’, with operations taking place behind the security fences and many processes impacting groundwater quality being under the ground, including: (i) shafts and tunnels intersect and interconnect groundwater systems; (ii) oxidation of certain minerals can cause development of acidic groundwater and induce other contaminants to dissolve storage; (iii) unsealed infrastructure, such as tailings dams, can lead to contaminants leaching

$^{59}$ The largest wastewater treatment plant is in Ulaanbaatar (CWWTP) with a current capacity of 58 Mm$^3$/year. Currently, the construction of a new CWWTP with a capacity to 91 Mm$^3$/year of municipal and industrial wastewater up to tertiary level is planned, for which the feasibility study is being completed.
into groundwater; and (iv) disposal of saline and contaminated wastewater into the ground can intercept and contaminate shallow groundwater. Impacts on groundwater quantity include the lowering of groundwater tables by pumping.

There are reports that wells in South Gobi that are poorly grouted with impermeable material, resulting in water leakage from the shallow aquifer to the deep aquifer. Mines require some level of hydrological and water quality characterization and monitoring throughout the project life, not just at the planning stage. Environmental impact assessments need to be strengthened to include a full cumulative hydrologic impact assessment if there are multiple mine investments in a river basin or aquifer unit. For this, mines and RBOs need to work more closely together, to allow RBOs to better understand and inspect the complex water systems used for mining operations and processing of ore with respect to water usage and effluent disposal. Further, upgrading the management of tailings is important: new technologies are available to allow the thickening of tailings by using mechanical systems to reduce the water content of tailings. Paste tailings are an option that allows for an increased level of dewatering, which effectively removes bleed water that can leach into groundwater or surface water and cause pollution. There are gaps and inconsistencies in regulatory processes for mines under the MM, and the wider water resources/environment framework under MET, which need to be addressed.

**Water and overgrazing of pasture land:** One of the main environmental issues that Mongolia faces is overgrazing of pastureland. The carrying capacity of livestock has been exceeded and damage is particularly focused around livestock watering points. The problem is complex, as it requires the reduction of livestock, while herder incomes should not be negatively impacted. As is described under the economic water security, programs on water for livestock need to be integrated with pasture and livestock management initiatives.

**Surface water storage:** Construction of dams and reservoirs can mitigate water shortages and allow for increased water use, while their environmental impact needs to be assessed and mitigated. Surface water storage, however, is not financially viable for irrigation, but could be considered for urban water supply in areas of poor or insufficient groundwater.

**Integrated surface water and groundwater management:** Although in most areas groundwater is within sustainable levels, there are localized areas of concern, such as Ulaanbaatar and other urban centers with poor groundwater recharge and issues of water quality, as well as the mining areas in the Southern Gobi Region. The bulk of the groundwater is abstracted from shallow aquifers in river valleys. Internal hydraulic connections between the surface water and groundwater result in the fact that abstractions in one part of the river basin affect the availability of water in another part. Environmental water security requires significantly improved understanding of groundwater, including conjunctive surface water and groundwater management and managing pollution of the groundwater. Investment in conjunctive surface water and groundwater management should be considered, especially where groundwater abstractions are close to the limit of recharge or where abstractions are being made from the non-renewable aquifers. As such, an underground dam is proposed by Japan International Cooperation Agency (JICA) for Ulaanbaatar’s urban supply, and it is proposed that a further study into the potential for groundwater recharge and underground dams is undertaken, including some investment in pilot projects\(^6\).

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\(^6\) Surface water, storm water, sewage, and other wastewater effluents are common sources of water for aquifer recharge. Underground dams are complementary to the managed aquifer recharge in that they help retain and store the groundwater in the areas of demand.
Groundwater Recharge and Underground Dams

Research by scientists in Australia has demonstrated that ‘dams’ for storing water underground can be more effective than surface water dams which avoid flooding of productive land, environmentally sensitive issues, losses from evaporation and leakage. It is cheaper to store water underground than constructing a dam on the surface. In addition, the minimum economic storage volume is several orders of magnitude smaller than surface dams and it is possible to store enough to match demand, storage can be increased as demand increases. Aquifers are far more common than good dam sites and they allow the water supply to be located closer to the community or industry that uses it.

Environmental impact of underground storage is also far less than surface dams, and leakage can be minimized by good design and there are no losses to evaporation. Storing water underground cleanses the water of bacteria and sediment, while shielding it from pollution and toxic algae. Scientists in Australia have shown that it is possible to store fresh water in a saline aquifer, creating a large ‘bubble’ of fresh water which can be tapped at will; low rates of flow restrict the mixing of the injected fresh water with the salty groundwater.

Scientists believe that underground storage can be used in a wide variety of ways, including to supplement drinking water supplies for communities whose natural supply becomes salty or undrinkable by mixing groundwater with surface water. Also, surplus water from floods can be used to recharge Australia’s natural artesian and fossil aquifers, which can be used by water users including the gold extraction industry.

Australian Commonwealth Scientific and Industrial Research Organisation (CSIRO) is researching innovative managed aquifer recharge technology which supports development of alternative water supplies for livable, sustainable and resilient cities.61

Good governance is essential to allow for environmental water security. The role of RBOs together with government departments needs to be strengthened and made more efficient to ensure the critical water issues are adequately addressed.

There are core issues of poor performance of industry and mine water treatment systems, which in many cases results in untreated water entering the groundwater systems. Better information and investments to support management of groundwater is a key requirement.

Physical investments to ensure environmental water security are primarily the responsibility of water sector agencies and private sector water users themselves. The MET and RBOs need to ensure that water use by government agencies and private sector is compliant with environmental standards and with the strategies for integrated water resources management.

Objectives of Investment

The broad objective of the investment program is to ensure the environmental water security through maintaining the quantity and quality of surface water and groundwater resources to sustain balanced ecosystems and protect the environment. The objectives include:

- Strengthening of the institutional framework to support sustainable water resources management by improving the linkages between RBOs and aimag and soum administrations, and allowing for more effective stakeholder and community representation through the RBCs. Further, the mandate of the RBOs needs to be strengthened to ensure water abstraction and water pollution are adequately managed.

- Increasing the effectiveness and sustainability of surface water and groundwater resources management within river basins, including climate change and transboundary considerations.
- Implementation of targeted investments to protect, correct, and mitigate damage to water resources and environment.

**Investment Program**

Within the investment program, physical investments for environmental security are primarily financed under the four water security areas (household, economic, urban, and disaster). Direct physical investments in water security are proposed to support the very important cross-cutting environmental protection and mitigation measures. It is proposed that 2% of the overall investment program should be assigned to environmental water security with financing based on 70% government, 10% beneficiary, and 20% private sector. The investment program for water security would include three components:

- **Strengthening of institutional and regulatory framework**: The role, mandate, and resources of MET and RBOs should be strengthened to increase their capacity to support decision making in management of water operations. Water abstraction rules and regulations will be clarified and streamlined. Water license tariffs and royalties need to be set at appropriate levels to promote efficient water use, and procedures to address non-compliance need to be simplified and adequately financed.

- **Strengthened understanding and awareness of water and environmental systems**: River basin planning and information systems will be improved; environmental monitoring will be streamlined and made more efficient through technologies; data sharing will be improved and specialist analysis of toxic pollutants will be made available. Environmental performance of different water sector agencies will be strengthened through increased awareness on water issues, raising the environment profile of water resource and promoting new approaches to increase water use efficiencies, as well as of new technologies. Water resources analyses need to be carried out within the 29 river basins, while they also need to be synthesized and consolidated for the three major river basins as well as for the whole country.

- **Direct investment in water resources protection and enhancement**: Focus on cross-cutting investment in mitigation of environmental impacts including initiatives to enhance surface water and groundwater to support sustainability of water resources and the environment.

The investment program is shown in Table 25.

**Table 25: Investment for Environmental Water Security**

<table>
<thead>
<tr>
<th>REF</th>
<th>DESCRIPTION</th>
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</thead>
<tbody>
<tr>
<td>D1</td>
<td><strong>(TA) Strengthening of River Basin Governance</strong></td>
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<tr>
<td></td>
<td>Including: (i) review and adjustments to the institutional framework of the RBOs based on lessons learnt since 2012; (ii) provision of training and institutional support to strengthen and empower RBAs and RBCs, aimag and soum environmental units; (iii) increase of the profile and mandate of the RBOs and influence in driving sustainable water resources; (iv) support for establishment and operationalization of RBCs (v) improvement of RBA financing and consideration of different RBA models; (vi) preparation of outstanding river basin plans and establishment of integrated water resources data bases; (vii) support for implementation of river basin management plans (h) overseas study tours to gain exposure to best practice RBOs and integrated water resources management, including transboundary river management.</td>
</tr>
<tr>
<td>D2</td>
<td><strong>(TA) Strengthening of Overall Water Resources Management Capacity</strong></td>
</tr>
<tr>
<td></td>
<td>Including: aimag and soum governments, NWC, water ministries and agencies. Support to strengthen capacities at central level on areas including surface water and groundwater</td>
</tr>
</tbody>
</table>
assessments, climate change, legal, managerial and contractual skills. Increased support for RBOs, provincial government, and ministries to drive integrated water resources management negotiations.

**D3 (TA) Planning and Design for Water Resources Protection and Enhancement**

Including: (i) establish inventory and GIS data base of key water and environmental data; (ii) increase awareness of water resources issues and strengthening stakeholder participation; (iii) planning and preparation of program to strengthen the knowledge base, monitoring, institutions and environmental frameworks for water resources management; (iv) focused studies to maintain and enhance water resources through groundwater recharge, protection of catchment in areas of risk of over abstraction and contamination; (v) identify potential economic activities and employment generation to be derived from water protection and enhancement; and (vi) assess options for financing including role of private sector-based on principles of ‘polluter pays’.

**D4 Investment in Water Resources Protection and Enhancement**

Environmental initiatives to: (i) protect water sources, water bodies, groundwater and wild life; (ii) restoration of critical catchment areas; (iii) groundwater recharge including underground storage dams in critical groundwater areas; (iv) special investment in wastewater treatment to in environmentally sensitive areas; (v) protection of ecosystems including wetlands from economic activities and climate change; (vi) establishing and safeguarding recreational areas. Investments to include strengthening of monitoring and addressing institutional and policy requirements.

**Responsibility:** MET, aimag and soum governments, and sector agencies.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

**Institutional and policy initiatives:** Investment in environmental water security incorporates a focus on improving policies and the regulatory framework for integrated water resources management including: (i) clarification of inconsistencies in the water sector and on regulatory procedures related to water resources and environment; (ii) clear demarcation of responsibilities across the government to reduce overlaps; (iii) strengthening of the policy and legal framework for issuing licenses; (iv) strengthening of compliance with license commitment; and (v) strengthening the remit and capacities of the RBOs to drive proactive water resources management; (vi) establishment of effective RBC to ensure stakeholder participation; (vii) strengthening of the environmental units in the aimag and soum offices; and (viii) strengthening of water resources capacities of central government.

**Environmental and social impacts:** Investments are designed to support environmental sustainability, especially in localities of high levels of water abstraction and risk of pollution.

**Financial assessment:** Financial benefits will be achieved through long-term sustainable water resources to support socioeconomic development.

E. **Investment Program for Resilience to Water-Related Disasters**

**Challenge**

Mongolia faces a wide range of disaster risks, many of which are related to water resources, such as directly related risks of flood and drought, as well as indirectly related risks where water is one part of a more complex problem, for example weather-related risks to livestock and crops. The key challenge of water-related disasters is how to invest scarce financial resources most effectively to avoid potential and uncertain risks. Improved knowledge, more sophisticated assessment of risks, increased awareness, and a strong cross-sectoral institutional framework are key prerequisites. A number of
strategies and actions\textsuperscript{62} are identified in different sectors vulnerable to climate change, including animal husbandry, arable farming, water resources, human health, and forestry.

Mongolia faces the risk of many water-related disasters. Some key parameters are described below:

**Urban floods:** In Mongolia, between 70% and 80% of flooding is caused by rainfall from June to September, while 20% to 60% of flooding is caused by snowmelt in April. Although floods occur in the rural areas, the impacts are relatively small; urban areas are mainly impacted. Specifically, for the capital, the Ulaanbaatar City Master Plan includes three options: (i) relocating people from the flood plain, including resettlement ($200 million); (ii) physical investments in storm drains to rehabilitate dykes ($60 million); and (iii) support for awareness and community-based management ($3 million).

**Drought:** Precipitation and discharge records since 1995 show an increase in more pronounced dry periods as well as the dry zone shifting north. Droughts occur on a regular cycle, with the impact felt mainly in the winter, as less forage is available, and can have a dramatic impact when combined with extremely low temperatures. Yields of rainfed crops are affected by drought; irrigation can help mitigate these impacts.

**Dzud:** A dzud is a complex meteorological natural disaster in which a dry summer is followed by a winter with abnormally low temperatures and high winds. The dry summer means that livestock have not grazed sufficiently, so they are underweight and less resilient to the harsh winter weather. Dzuds can lead to economic crisis and food security issues because of the overwhelming loss of livestock. Improved and timely information of dzud risk prior to the onset of winter would allow herders to take early action, such as to reduce herd size and purchase fodder. Fodder production remains significantly below the estimated requirements and the lack of fodder is a significant factor in the vulnerability of livestock. Various studies have identified the need for fodder production to increase resilience of livestock. Pilot programs were set up by UNDP and the World Bank: they have however received a mixed response. Pilot studies identified the potential role of irrigation and improved seeds for improving fodder production. Index-based livestock insurance was introduced after the dzud in early 2000 to support the improved resilience of herders to cope with drought and dzud, but coverage is still limited.

**Toxic spills:** That toxic spills pose a real risk was already proven in Khongor soum (Darkhan-Uul aimag) in 2007, when groundwater was contaminated near the wastewater treatment plant. Toxic spills from factories or mines along rivers also pose a significant risk, as the contaminated surface water and groundwater can also threaten ecosystems and water users downstream. Spills can involve a range of chemical substances (heavy metals, pesticides, oil); safe disposal of toxic materials must be made a critical part of licensing and monitoring arrangements. Wastewater testing for toxic waste requires specialized laboratories.

**Tailings dams:** Tailings dams contain mining wastewater. Experience shows that a catastrophic release of tailings can lead to long-term environmental damage with huge cleanup costs. Infiltration of toxic waste of mine tailings can also affect the groundwater. The failure rate of tailings dams is globally significantly higher than that of water supply reservoir dams, partly due to poor design and lack of quality control. The design standards for most tailings dams need to be overseen by governmental

\textsuperscript{62} The National Action Plan for Climate Change was approved in 2010 and sets out strategies and actions which enable vulnerable sectors to adapt to potential climate change and to mitigate greenhouse gas emissions. Implementation strategies encompassed institutional, legislative, financial, human, education and public awareness, and research aspects. Implementation obstacles and possible solutions were also identified. The National Development Strategy of 2008 defines the country’s policy up to the year 2021 and calls for the promotion of Mongolia’s “capacity to adapt to climate change and desertification, to reduce their negative impacts”. It also identifies adaptation activities and measures. A study for the national climate risk management strategy was prepared in 2009. The plan seeks to build climate resilience at the community level through reducing risk and facilitating adaptation.
dam safety agencies. In-country specialist expertise in tailings dams needs to be established and regular monitoring of tailings dams need to be carried out.

**Objectives of Investment**

Objective of the investment program is to review key water-related disaster risks and to identify the most viable areas of targeted investment to reduce the risks and increase security from water-related disasters.

**Investment Program**

Physical investments in disaster protection and management are expensive and tend to protect only a low percentage of the population. Investments are best targeted if they are integrated with socioeconomic development to ensure parallel economic returns. There are two types of adaptation measures:

- Soft measures, including awareness raising, training and management initiatives, provide a limited level of benefit, but reach out to a wider population.
- Hard measures require larger investments and need to be accompanies by changes in practices through soft measures. The scale and numbers of those affected by large-scale disaster such as drought and dzud require low-cost initiatives that can be realistically implemented on a large-scale.

Developing strengthened mechanisms for knowledge and assessment of disaster risks is critical and is key part of the investment strategy. Wherever possible, disaster risk reduction strategies need to be incorporated into sector programs. It is proposed that RBO and MET take a lead role in improving knowledge on risks of water-related disasters.

Investments in flood protection and management need to be low-cost and sustainable. Investment however needs to be better supported by technical studies and economic assessment. Further, operation and maintenance of investments needs to be improved. It is proposed that a detailed review of water-related disasters is undertaken, including financial and economic assessment of soft and hard adaptation measures, to reduce disaster risk along with climate change impacts. Investment program is outlined in Table 26.

**Table 26: Investment for Water-Related Disasters**

<table>
<thead>
<tr>
<th>REF</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>(TA) Integrated Planning and Design to Reduce Water-Related Disasters</td>
</tr>
<tr>
<td></td>
<td>(i) identifying priorities and cost-effective solutions to reduce water-related disasters incorporating improved assessment of climate change impacts and adaptation measures; (ii) assessment of financial and economic benefits of different strategies; (iii) feasibility studies and design for priority projects; (iv) support for strengthening the institutional framework including engagement, training and awareness raising. (by Q4/2019).</td>
</tr>
<tr>
<td>E2</td>
<td>Integrated Investments in Urban Flood Protection and Management</td>
</tr>
<tr>
<td></td>
<td>(i) land use planning to reduce development in the flood plains and adequate set back of housing from natural drainage channels to reduce risks from long period and flash floods; (ii) establishing natural flood retention areas upstream of urban centers which can also support groundwater recharge, recreation or parks; (iii) development of natural earth drains rather than concrete drains; (iv) investment in early flood warning systems; (v) improving maintenance and clearing of drains, a low-cost solutions. Costs of physical investments would be financed through the urban water security component. (Stage 1 by 2023)</td>
</tr>
</tbody>
</table>
E3 Investments in Integrated Disaster Management

Including soft and hard investments to protect and reduce risks of water-related disasters including dzud, drought, toxic spills, and tailings dams. Program to include extensive stakeholder engagement and awareness raising in risks as well training in key areas. Physical investments would be through sector agencies.

Responsibility: The program would be managed through NEMA. Overall direction would be provided through SEC, chaired by the Deputy Prime Minister and comprises of 10 ministries. MET would play a key role in improving knowledge and supporting inter-sector cross-cutting initiatives.

Source: TA 8855-MON: Mongolia Country Water Security Assessment

F. Hydro-economic Analysis

1. Costs of Water Supply Augmentation and Water Demand Reduction Measures

An overview of the assessed costs related to selected water supply augmentation and water demand reduction measures which can contribute to meet the 2030 water demand are shown in Figure 38. The assessment is based on the cost effectiveness ratio which measures the financial cost to make 1 m$^3$ of additional water available ($$/m^3$), considering the capital costs as well as the annual operation and maintenance costs.

Figure 38. Cost effectiveness of Water Supply and Demand Measures

The costs to make on additional m$^3$ of water available vary widely, depending on the water usage as well as on whether surface or groundwater is required. The costs only apply to making the water available and thus exclude the cost of treatment and distribution.

Source: TA 8855-MON: Mongolia Country Water Security Assessment
2. Cost Curves

Using information on the above-mentioned cost effectiveness ratios and on the potential water quantity that can be made available by each assessed measure, so-called ‘cost curves’ can be derived. These cost curves offer insight on how the projected water shortage by 2030 can be alleviated in the most cost-effective manner. Preliminary cost curves were estimated for: (i) Ulaanbaatar urban water supply (including industry, municipal and urban services), (ii) urban water supply for 21 aimag and 330 soum centers (including industry and urban services), (iii) irrigation, and (iv) mining. It should be noted that these cost curves are based on estimates and require a more detailed analysis before implementation. The results are shown Figure 39; key points include:

Ulaanbaatar water supply: Based on the Ulaanbaatar City Master Plan and the JICA 2013 study, the water demand gap (domestic and non-domestic) in Ulaanbaatar is estimated at 110 Mm$^3$/year by 2030. To close the gap, the most cost-effective measures are water demand reduction measures at combined heat and power systems (CHPs) which can make 18.4 Mm$^3$/year of water available, as well as increasing supply by approximately 91 Mm$^3$/year with the Tuul Storage Dam and Reservoir Complex ($0.14$/m$^3$). It is estimated that the Tuul Storage Dam and Reservoir Complex would become operational by 2023. The time frame of introducing water efficiencies in the CHPs, however, is uncertain as it requires agreements to retrofit existing CHP with water saving technologies, or to invest in new CHP plants. There may be a need to assess the potential of complementing water supply with additional groundwater abstraction to bridge any potential water shortage for a period until suggested measures are implemented.

Aimag and soum water supply: For the 23 aimag and 331 soum centers, the water demand-supply gap is estimated to be 50 Mm$^3$/year. The demands are dispersed and the water source and costs are very site-specific. Indicatively, it is estimated that water supply could be increased by three categories of measures: (i) around 60% (30 Mm$^3$/year) could be sourced from low-cost groundwater at $0.05$/m$^3$ located reasonably close to urban centers; (ii) for about 20% of demand (10 Mm$^3$/year), the water requires some treatment or needs to be sourced from greater distances as some locations face groundwater issues (poor quality and quantity), increasing the cost to $0.1$/m$^3$, and (iii) for about 20% of demand (10 Mm$^3$/year), significant water supply issues are expected, which would require introduction of surface water storage, sourcing from distant aquifers, or the increase of groundwater recharge and storage through the use of underground dams, increasing the costs to indicatively $0.2$/m$^3$.

Irrigation: For irrigation, the incremental water requirement for 70,000 ha is estimated to be 100 Mm$^3$/year. The economic analysis shows that financial returns from irrigation are very sensitive to the investment costs, with water supply costs above $0.1$/m$^3$ being less likely to be financially viable (costs of water for irrigation are higher as the investment is only in operation for about 130 days per year). Sourcing 100 Mm$^3$/year of low-cost water will require studies to select the technically and financially most suitable locations; costs are very site-specific and it is not possible to prepare a definitive assessment of costs for different sites in this analysis. Indicatively it is estimated that: (i) 10 Mm$^3$/year could be saved by introducing improved irrigation management at a cost of $0.05$/m$^3$ for existing and new irrigation; (ii) 30 Mm$^3$/year additional water would be required for rehabilitation of schemes and expansion of irrigation areas; (iii) 30 Mm$^3$/year for new irrigation schemes could be sourced by low-cost pumping directly from rivers.; (iv) 10 Mm$^3$/year is expected to require heavier investment and significant upgrading of existing schemes; and (v) about 20 Mm$^3$/year could be sourced from groundwater.

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63 Costs are taken from 2030WRG and based on ‘previous alternative’
Mining: For mining, the incremental water demand gap is estimated to be 70 Mm$^3$/year by 2030$^{64}$. It is estimated that:

- Around 30% of the demand (20 Mm$^3$/year) could be met from shallow groundwater or rivers mainly in the northern part of the country at a cost of $0.1/m$^3$, there are also options for water demand reduction measures (the 2030 Water Resources Group identify potential savings of 30 Mm$^3$/year in the Nyalga Shivee Ovoo coal region, south-east of Ulaanbaatar).

- Meeting water demand in the South Gobi Region is more complex and the costs are significantly increased (the 2030 Water Resources Group study indicates that water demand reduction measures, for example for coal washing and dust suppression, could save approximately and 10.5 Mm$^3$/year in the Tavan Tolgoi region at an average cost against the current (2014) situation of $1.2/m^3$). For small mines, it is estimated that groundwater can be sourced from small aquifers at around $1.2/m^3$. This leaves an estimated shortfall of supply by 2030 of around 30Mm$^3$, which would require sourcing significantly more water from deep non-renewable aquifers often at significant distance. There is a lack of information on the feasibility and costs of using deep aquifer groundwater; an analysis of various studies indicates that for large-scale mines the costs could be $1.8-3.0/m^3$, depending on location and assessment methodology,$^{65}$ further site-specific studies are required to assess exact figures. Significant uncertainty about the groundwater may require consideration of the option of the Orkhon-Gobi water transfer; the high costs ($2.7/m^3$) and major concerns about the technical feasibility and environmental impacts need however to be carefully evaluated.

$^{64}$ MET. 2013. Integrated Water Management Plan: Water in the desert and other sources
$^{65}$ Estimates for groundwater in the South Gobi Region include: (i) 2030 Water Resources Group (2016) the average cost for additional groundwater (financial cost) for Tavan Tolgoi coal area is $3.56/m$^3$; (ii) World Bank (2010) $3.1/m^3$; and (iii) estimated costs from for the Oyu Tolgoi Mine $1.8/m^3$
G. Investment Costs and Financing

Summary cost of the proposed investment program by the key areas of investment is shown in Table 27, with details provided in Table 28. Estimated overall cost of the proposed water sector investment program is $6.5 billion, of which $1.8 billion (27%) would come from government, $1.1 billion (16%) from beneficiaries, and $3.7 billion (56%) from private sector sources.

Total requirement for TA to support planning and design, institutional development, and pilot investments would be $228 million (about 4% of the total investment costs); the TA cost would be composed of $100 million from government sources and $129 million from private sector. The TA budget required from government sources in stage 1 (2018 to 2025) would be $50 million.
3. Financing and Prioritization

Finance for water sector investments: Finance for the water sectors is strongly linked with the state of the national economy: Mongolia available finance is highly exposed to international commodity price volatility and dependency on regional export markets. These are now affecting the water sector through reduced investment and resources allocated to operations and management; RBOs for example have identified lack of finance as a key issue, according to feedback from stakeholders. There is a need to strengthen and stabilize finance for the water sector by focusing on economically and financially viable projects that are not dependent of subsidies for operation and maintenance.

Over the period 2002-2010, total water-related expenditures made up 2.1% of total government expenditures. Water sector finance over the period 2003-2011 was sourced through $15 million from government expenditure and $12 million from official development assistance.

To meet the national targets will require significant capital and operational expenditure. Financing of the water sector investment program comes at a difficult time for the Mongolian economy with GDP growth in 2016 of 1% compared with 17% in 2011. The investment program will cost around $500 million per year over the 13 years which is approximately 4% of the 2016 GDP and is significantly above current levels of investment in the water sector. New initiatives for financing including public-private partnerships need to be better investigated and strengthened.

Financing share: The government needs to develop a flexible and dynamic approach to investment in the water sector incorporating a wide range of financing modalities, including:

- **Government contribution** will be critical to support the investment program; it is important that scarce government resources are focused to provide a catalyst for co-financing from beneficiaries or private sector. Government can potentially access soft financing from international financing institutions that can be used as soft loans to provide access to finance for beneficiaries, as well as ‘viability gap financing’ to support public-private partnerships investments.

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**Table 27: Summary of Proposed Investment Program**

<table>
<thead>
<tr>
<th>#</th>
<th>Investment Component</th>
<th>Total cost (MNT million)</th>
<th>Total cost ($ million)</th>
<th>% of total cost</th>
<th>% of total</th>
<th>Stage 1 (2018-2024)</th>
<th>Stage 2 (2025-2030)</th>
<th>% Govt</th>
<th>% Beneficiary</th>
<th>% Private Sector</th>
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<td>Beneficiary</td>
<td>Private Sector</td>
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</tr>
<tr>
<td>1</td>
<td>Household Water Security</td>
<td>37,800</td>
<td>17</td>
<td>0.3%</td>
<td>40%</td>
<td>7</td>
<td>10</td>
<td>24%</td>
<td>76%</td>
<td>0%</td>
</tr>
<tr>
<td>2</td>
<td>Irrigation</td>
<td>305,760</td>
<td>138</td>
<td>2%</td>
<td>30%</td>
<td>41</td>
<td>96</td>
<td>31%</td>
<td>10%</td>
<td>59%</td>
</tr>
<tr>
<td>3</td>
<td>Water for Livestock</td>
<td>747,252</td>
<td>337</td>
<td>5%</td>
<td>30%</td>
<td>100</td>
<td>236</td>
<td>59%</td>
<td>31%</td>
<td>10%</td>
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<td>4</td>
<td>Water for Mining</td>
<td>232,650</td>
<td>105</td>
<td>2%</td>
<td>42%</td>
<td>44</td>
<td>61</td>
<td>16%</td>
<td>0%</td>
<td>84%</td>
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<td>Water for Energy</td>
<td>3,566,830</td>
<td>1,607</td>
<td>25%</td>
<td>20%</td>
<td>328</td>
<td>1,279</td>
<td>10%</td>
<td>0%</td>
<td>90%</td>
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<td>6</td>
<td>Urban WSS for Ulaanbater</td>
<td>5,207,400</td>
<td>2,343</td>
<td>36%</td>
<td>50%</td>
<td>1,180</td>
<td>1,162</td>
<td>20%</td>
<td>19%</td>
<td>60%</td>
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<tr>
<td>7</td>
<td>Urban WSS for Aimag Centers</td>
<td>2,403,140</td>
<td>1,082</td>
<td>17%</td>
<td>31%</td>
<td>333</td>
<td>749</td>
<td>32%</td>
<td>29%</td>
<td>40%</td>
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<tr>
<td>8</td>
<td>Urban WSS for Soum Centers</td>
<td>927,740</td>
<td>418</td>
<td>6%</td>
<td>30%</td>
<td>126</td>
<td>292</td>
<td>40%</td>
<td>29%</td>
<td>31%</td>
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<td>9</td>
<td>Environmental Water Security</td>
<td>241,980</td>
<td>109</td>
<td>2%</td>
<td>50%</td>
<td>55</td>
<td>55</td>
<td>62%</td>
<td>18%</td>
<td>19%</td>
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<tr>
<td>10</td>
<td>Resilience to Water Disaster</td>
<td>766,011</td>
<td>345</td>
<td>5%</td>
<td>31%</td>
<td>106</td>
<td>240</td>
<td>81%</td>
<td>10%</td>
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<tr>
<td></td>
<td>Total</td>
<td>14,429,903</td>
<td>6,500</td>
<td>100%</td>
<td>36%</td>
<td>2,320</td>
<td>4,180</td>
<td>27%</td>
<td>16%</td>
<td>56%</td>
</tr>
</tbody>
</table>

By Component:

### A. Household Water Security

<table>
<thead>
<tr>
<th>Total cost (MNT million)</th>
<th>Total cost ($ million)</th>
<th>% of total cost</th>
<th>% of total</th>
<th>Stage 1 (2018-2024)</th>
<th>Stage 2 (2025-2030)</th>
<th>% Govt</th>
<th>% Beneficiary</th>
<th>% Private Sector</th>
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<tr>
<td>37,800</td>
<td>17</td>
<td>0.3%</td>
<td>40%</td>
<td>7</td>
<td>10</td>
<td>24%</td>
<td>76%</td>
<td>0%</td>
</tr>
</tbody>
</table>

### B. Economic Water Security

<table>
<thead>
<tr>
<th>Total cost (MNT million)</th>
<th>Total cost ($ million)</th>
<th>% of total cost</th>
<th>% of total</th>
<th>Stage 1 (2018-2024)</th>
<th>Stage 2 (2025-2030)</th>
<th>% Govt</th>
<th>% Beneficiary</th>
<th>% Private Sector</th>
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<tbody>
<tr>
<td>4,852,492</td>
<td>2,186</td>
<td>34%</td>
<td>23%</td>
<td>513</td>
<td>1,672</td>
<td>19%</td>
<td>5%</td>
<td>75%</td>
</tr>
</tbody>
</table>

### C. Urban Water Security

<table>
<thead>
<tr>
<th>Total cost (MNT million)</th>
<th>Total cost ($ million)</th>
<th>% of total cost</th>
<th>% of total</th>
<th>Stage 1 (2018-2024)</th>
<th>Stage 2 (2025-2030)</th>
<th>% Govt</th>
<th>% Beneficiary</th>
<th>% Private Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>8,531,620</td>
<td>3,843</td>
<td>59%</td>
<td>43%</td>
<td>1,639</td>
<td>2,204</td>
<td>26%</td>
<td>23%</td>
<td>51%</td>
</tr>
</tbody>
</table>

### D. Environmental Water Security

<table>
<thead>
<tr>
<th>Total cost (MNT million)</th>
<th>Total cost ($ million)</th>
<th>% of total cost</th>
<th>% of total</th>
<th>Stage 1 (2018-2024)</th>
<th>Stage 2 (2025-2030)</th>
<th>% Govt</th>
<th>% Beneficiary</th>
<th>% Private Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>241,980</td>
<td>109</td>
<td>2%</td>
<td>50%</td>
<td>55</td>
<td>55</td>
<td>62%</td>
<td>18%</td>
<td>19%</td>
</tr>
</tbody>
</table>

### E. Resilience to Water Related Disaster

<table>
<thead>
<tr>
<th>Total cost (MNT million)</th>
<th>Total cost ($ million)</th>
<th>% of total cost</th>
<th>% of total</th>
<th>Stage 1 (2018-2024)</th>
<th>Stage 2 (2025-2030)</th>
<th>% Govt</th>
<th>% Beneficiary</th>
<th>% Private Sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>766,011</td>
<td>345</td>
<td>5%</td>
<td>31%</td>
<td>106</td>
<td>240</td>
<td>81%</td>
<td>10%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Total: 14,429,903

Source: TA 8855 MON: Mongolia Country Water Security Assessment
• **Beneficiary contribution** will be requested for investments where there is a direct benefit to the individual households; these include on-site sanitation, household water treatment, and livestock management. In most cases, households have very restricted access to finance and it will be necessary for government or private sector to provide access to low-cost credit, for example through microfinancing initiatives.

• **Private sector contribution** will be essential to bridge the gap in government finances and capacities. The private sector will only support investments with adequate financial returns and relatively low risk. Except for mining, most of the private sector projects are financially less viable without some form of government technical or financial support. Financing of public-private partnerships projects can involve the use of government funds to reduce the risk to private investors and to provide viability gap financing where financial viability is uncertain. For example, the Government of India provides 20% viability gap financing for infrastructure projects to make them financially viable an attractive for public-private partnerships type investments. There are a range of public-private partnerships models and it is critical that options are fully investigated to allow for the development of appropriately balanced packages.

Financing of programs:

• For household water security, rural WSS will be targeted: The government contribution of 24% is required to create awareness, training, as well as to support access to low-cost cost credit for beneficiaries and to support beneficiary initiatives for low-cost sanitation and household water treatment. The program targets to provide improved WSS to 60% of rural households by 2030. However, this may need to be scaled back if the response by herder families to invest is less than envisaged.

• Irrigation development is only financially viable for capital investments below approximately $2,000/ha; schemes selected for investment must meet the criteria of low-cost systems and have adequate levels of return to ensure cost recovery of operation and maintenance costs by water users. The investment proposal foresees that 30% is financed by government, 10% by beneficiaries, and 60% by private sector sources. Government contribution should focus on ‘viability gap financing’ to provide support for private sector or community-based management to take on management responsibilities. The approach and methodology needs to be investigated and piloted. If cost-sharing between private sector and beneficiaries is not feasible, the target of additional 70,000 ha by 2030 would need to be scaled back. Economic analysis of irrigation projects is required to assess the costs to the country of investing in irrigation for food crops compared to the option of importing from neighboring countries where growing conditions may be more favorable.

• Water for livestock is an integrated investment plan, including water points, pasture and livestock production initiatives. Tackling the issue of livestock numbers exceeding the carrying capacity is a critical requirement with potentially serious and irreversible damage if not addressed. Government contribution is based on 40%, with 50% from beneficiaries and 10% from private sector. Beneficiaries will require access to credit; there is scope for SMEs to invest in processing and marketing. It is suggested that this program is to be given priority due to the key role of livestock in supporting rural livelihoods. The program is considered as a high priority involving significant efforts to drive new initiatives to achieve viable and sustainable livestock production systems by 2030.

• Investments for mining are planned to be funded by 84% from private sector. The actual investment until 2030 depends on the take up of mine concessions by domestic and foreign investors. Many issues around mining and industry relate to water; and the government contribution of $17 million is directed at ensuring adequate and sustainable sources of water. Investment initiatives are proposed to support a reduction of water use, an improvement in effluent quality through a program of special support for selected mine operations, as well as an improvement in monitoring and control mechanisms. With the value of mining resources
estimated to be between $1-3 trillion, a strong framework for government support to ensure sustainable and environmentally sound use of water resources is critical.

- Water for energy focuses on hydropower development on the Selenge River. It is proposed that 90% is financed by private sector investors with a government contribution of 10% to support studies and part of the investment. Viability of the hydropower program needs to be reviewed and verified and is subject to: (i) technical and financial viability of hydropower schemes including cost effectiveness in comparison with other potential sources of renewable energy, (ii) positive environmental assessment including addressing transboundary river issues; (iii) establishment of adequate feed-in tariffs to meet the higher costs of renewable energy compared with coal; and (iv) being able to attract private sector investment.

- Urban WSS is a critical area and has the lowest water security score of the five the KDs. Investment in urban water security has the highest cost and comprises 56% of the total investment program. About 50% of the water demand in 2030 is from industry, municipality and public services; financing packages need to incorporate appropriate cost recovery mechanisms for these non-domestic demands. Investments include requirements for domestic and industrial water supply as well as public and municipal utilities. A key issue is how to finance the investments and how to ensure that operational expenditures are recovered. Financing is proposed as a mix of government, beneficiaries, and private sector; government contribution is critical to support loans for beneficiaries as well as gap financing for private sector investment. Financial returns to investment are estimated be highest for Ulaanbaatar water supply where cross-subsidies from industry and apartments can be used to support low-income areas; a higher percentage of private sector finance is proposed for Ulaanbaatar, and lowest for soums. Beneficiary contribution is critical to support costs of low-cost decentralized sanitation. Investments need to address the inequities of supply to the central and ger areas, which will require government financing initiatives including improved access to credit to support beneficiary contributions.

- Investments in environmental water security and resilience to water-related disasters is primarily financed from government sources; some environmental protection and enhancement measures should be assigned to private sector water users through licensing and royalty agreements.

**Schedule**

The proposed schedule of the investment program is shown in Figure 40.
Table 1: Investmen Schedule

<table>
<thead>
<tr>
<th>Investment Component</th>
<th>Units</th>
<th>Total</th>
<th>2018 1</th>
<th>2019 1</th>
<th>2020 2</th>
<th>2021 1</th>
<th>2022 1</th>
<th>2023 1</th>
<th>2024 1</th>
<th>2025 1</th>
<th>2026 1</th>
<th>2027 1</th>
<th>2028 1</th>
<th>2029 1</th>
<th>2030 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Household</td>
<td>Nr</td>
<td>120,000</td>
<td>PD 20,000</td>
<td>28,000</td>
<td>72,000</td>
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<tr>
<td>B1. Irrigation</td>
<td>Ha</td>
<td>70,000</td>
<td>PD 5,000</td>
<td>16000</td>
<td>49,000</td>
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<tr>
<td>B2. Livestock</td>
<td>Million Ha</td>
<td>75</td>
<td>PD 6</td>
<td>16.5</td>
<td>52.5</td>
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</tr>
<tr>
<td>B3. Mining</td>
<td>Mm3</td>
<td>60</td>
<td>PD 24</td>
<td>36</td>
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<td></td>
<td>Mm3</td>
<td>10</td>
<td>PD 2</td>
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<tr>
<td>B4. Energy</td>
<td>MW</td>
<td>650</td>
<td>PD</td>
<td>130</td>
<td>520</td>
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</tr>
<tr>
<td>C. Urban Water and Sanitation</td>
<td>Unit</td>
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<td>PD</td>
<td>TBD 60% of Investment</td>
<td>TBD 40% of Investment</td>
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<tr>
<td></td>
<td>Unit</td>
<td>21</td>
<td>PD</td>
<td>TBD 40% of Investment</td>
<td>TBD 60% of Investment</td>
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<tr>
<td></td>
<td>Unit</td>
<td>300</td>
<td>PD 40</td>
<td>80</td>
<td>180</td>
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<td></td>
</tr>
<tr>
<td>D. Environment</td>
<td>LS</td>
<td></td>
<td>PD</td>
<td>TBD 50% of Investment</td>
<td>TBD 50% of Investment</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>LS</td>
<td></td>
<td>PD</td>
<td>TBD 50% of Investment</td>
<td>TBD 50% of Investment</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>E. Disaster Resilience</td>
<td>LS</td>
<td></td>
<td>PD</td>
<td>TBD 30% of Investment</td>
<td>TBD 70% of Investment</td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>LS</td>
<td></td>
<td>PD</td>
<td>TBD 30% of Investment</td>
<td>TBD 70% of Investment</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Notes</td>
<td>Planning and Design-initial activities (follow-on intermittent planning and design not shown)</td>
<td></td>
<td>PD</td>
<td>Advance/pilot programs</td>
<td>Stage 1 Programs</td>
<td>Stage 2 Programs</td>
<td>TBD Program to be Determined</td>
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</tr>
</tbody>
</table>

Source: TA 8855 MON: Mongolia Country Water Security Assessment
4. Project Concept Notes

Project concept notes have been prepared for eight proposed projects, which have been identified and agreed with MET, namely:

- Strengthened river basin governance to support water resources development and management
- Integrated water supply and sanitation, water points, pasture, and livestock production systems
- Strategic investment for soum water supplies and sanitation
- Strategic investment for WSS in Ulaanbaatar’s ger areas
- Support for the water-energy-mining and tourism nexus
- Integrated investment for irrigation
- Integrated investment for flood protection in urban areas
- Initiatives to support glacier water conservation and climate change adaptation.

The project concept notes are designed as a preliminary stage to plan investments; the projects have been developed with reference to the overall investment program. Each project has been packaged incorporating different components of the investment program to meet the requirements of a viable and integrated investment proposal. Financial requirements are estimated based on the project being a first step of the overall investment program that could be rapidly taken up by government and/or donors.
Table 28: Investment Costs

<table>
<thead>
<tr>
<th>#</th>
<th>Investment Component</th>
<th>Unit</th>
<th>NR</th>
<th>Unit cost (MNT million)</th>
<th>Total cost (MNT million)</th>
<th>Total cost ($ million)</th>
<th>Stage 1 (% of total)</th>
<th>Stage 1 2018-2024</th>
<th>Stage 2 2025-2030</th>
<th>% Govt</th>
<th>% Benef</th>
<th>% Private Sector</th>
<th>Inv. Cost Govt</th>
<th>Inv. Cost Benef</th>
<th>Inv. Cost Private sector</th>
<th>TA Cost Govt</th>
<th>TA Cost Total</th>
<th>TA Cost Govt Stage 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Household Water Security (Herder Water and Sanitation)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>A1</td>
<td>(TA) Planning and Design for Herder WSS</td>
<td>LS</td>
<td>1</td>
<td>1,800</td>
<td>0.8</td>
<td>50%</td>
<td>0.4</td>
<td>0.4</td>
<td>100%</td>
<td>0%</td>
<td>0.8</td>
<td>-</td>
<td>0.8</td>
<td>0.8</td>
<td>0.4</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>A2</td>
<td>Investment in Low Cost Sanitation and Household Water Treatment.</td>
<td>Nr</td>
<td>0.3</td>
<td>36,000</td>
<td>16.2</td>
<td>40%</td>
<td>6.5</td>
<td>9.7</td>
<td>20%</td>
<td>80%</td>
<td>3.2</td>
<td>13.0</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sub Total</td>
<td></td>
<td></td>
<td>37,800</td>
<td>17.0</td>
<td>40%</td>
<td>6.9</td>
<td>10.1</td>
<td>24%</td>
<td>76%</td>
<td>4.1</td>
<td>13.0</td>
<td>0.8</td>
<td>0.8</td>
<td>0.4</td>
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</tr>
<tr>
<td>B</td>
<td>Economic Water Security</td>
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</tr>
<tr>
<td>B1</td>
<td>Irrigation</td>
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<td></td>
</tr>
<tr>
<td>B1.1</td>
<td>(TA) Planning and Design for irrigation</td>
<td>LS</td>
<td>1</td>
<td>21,250.0</td>
<td>11,760</td>
<td>5.3</td>
<td>0.6</td>
<td>1.6</td>
<td>50%</td>
<td>50%</td>
<td>2.6</td>
<td>53.2</td>
<td>53.2</td>
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</tr>
<tr>
<td>B1.2</td>
<td>Investment in rehabilitation and expansion of irrigation.</td>
<td>Ha</td>
<td>4.0</td>
<td>280,000</td>
<td>128.1</td>
<td>30%</td>
<td>37.8</td>
<td>88.3</td>
<td>30%</td>
<td>10%</td>
<td>37.8</td>
<td>126.6</td>
<td>75.7</td>
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</tr>
<tr>
<td>B1.3</td>
<td>Investment in new technologies and agriculture production support.</td>
<td>Ha</td>
<td>0.2</td>
<td>14,000</td>
<td>6.3</td>
<td>30%</td>
<td>1.9</td>
<td>4.4</td>
<td>40%</td>
<td>10%</td>
<td>2.5</td>
<td>6.6</td>
<td>3.2</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Sub Total B1</td>
<td></td>
<td></td>
<td>305,760</td>
<td>137.7</td>
<td>30%</td>
<td>41.3</td>
<td>96.4</td>
<td>31%</td>
<td>10%</td>
<td>43.0</td>
<td>13.2</td>
<td>81.5</td>
<td>5.3</td>
<td>2.6</td>
<td>0.8</td>
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</tr>
<tr>
<td>B2</td>
<td>Water For Livestock</td>
<td></td>
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</tr>
<tr>
<td>B2.1</td>
<td>(TA) Planning and design for livestock water points, pasture management, production and marketing systems.</td>
<td>LS</td>
<td>1</td>
<td>14,652</td>
<td>6.6</td>
<td>20%</td>
<td>1.3</td>
<td>5.3</td>
<td>90%</td>
<td>10%</td>
<td>5.9</td>
<td>0.7</td>
<td>6.6</td>
<td>5.9</td>
<td>1.2</td>
<td></td>
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</tr>
<tr>
<td>B2.2</td>
<td>Investment in new water points,pasture and livestock management systems in unused grazing areas</td>
<td>Ha</td>
<td>0.022</td>
<td>111,000</td>
<td>50.0</td>
<td>30%</td>
<td>15.0</td>
<td>35.0</td>
<td>50%</td>
<td>40%</td>
<td>25.0</td>
<td>20.0</td>
<td>5.0</td>
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</tr>
<tr>
<td>B2.3</td>
<td>Investment in upgrading of water points, pasture and livestock production systems in existing grazing areas</td>
<td>Ha</td>
<td>0.009</td>
<td>621,600</td>
<td>280.0</td>
<td>30%</td>
<td>84.0</td>
<td>196.0</td>
<td>60%</td>
<td>30%</td>
<td>168.0</td>
<td>84.0</td>
<td>28.0</td>
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<td>Sub Total B2</td>
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<td>747,252</td>
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<td>5.9</td>
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<tr>
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<td>Water for Mining</td>
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<tr>
<td>B3.1</td>
<td>(TA) Water resources assessments and planning for SGR and other critical areas</td>
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<td>9,900</td>
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<td>B3.2</td>
<td>(TA) Studies to assess scope for reduced water use and improved waste water quality</td>
<td>LS</td>
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<td>1,650</td>
<td>0.7</td>
<td>70%</td>
<td>0.5</td>
<td>0.2</td>
<td>80%</td>
<td>0%</td>
<td>0.6</td>
<td>0.7</td>
<td>0.6</td>
<td>0.4</td>
<td>0.4</td>
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<tr>
<td>B3.3</td>
<td>Investments in mine water sources and waste water treatment</td>
<td>Mm3</td>
<td>60</td>
<td>3,300</td>
<td>198,000</td>
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<td>35.7</td>
<td>53.5</td>
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<td>90.9</td>
<td>-</td>
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<td>B3.4</td>
<td>Financing Support for New Mine Technologies</td>
<td>Mm3</td>
<td>10</td>
<td>3,300</td>
<td>33,000</td>
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<td>87.9</td>
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<td>B4</td>
<td>Water for Energy</td>
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<td>(TA) Integrated energy studies and planning for renewable energy.</td>
<td>LS</td>
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<td>2,220</td>
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<td>1.0</td>
<td>-</td>
<td>80%</td>
<td>0%</td>
<td>20.0</td>
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<td>0.2</td>
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<td>(TA) Transboundary environmental impact assessment of hydropower development in Selenge river</td>
<td>LS</td>
<td>1</td>
<td>4,440</td>
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<td>100%</td>
<td>2.0</td>
<td>-</td>
<td>100%</td>
<td>0%</td>
<td>2.0</td>
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<tr>
<td>B4.3</td>
<td>(TA) Planning and design for selected hydropower schemes (TA)</td>
<td></td>
<td></td>
<td>96,970</td>
<td>43.7</td>
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<td>30.6</td>
<td>10%</td>
<td>0%</td>
<td>4.4</td>
<td>39.3</td>
<td>43.7</td>
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<td>1.3</td>
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<td>B4.4</td>
<td>Investment in 650 MW of hydropower</td>
<td>MW</td>
<td>650</td>
<td>5,328.0</td>
<td>3,463,200</td>
<td>1,560.0</td>
<td>20%</td>
<td>312.0</td>
<td>1,248.0</td>
<td>10%</td>
<td>156.0</td>
<td>-</td>
<td>1,404.0</td>
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<td>Sub Total B4</td>
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<td>3,566,829.6</td>
<td>1,606.7</td>
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<td>1,728.6</td>
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<td>0%</td>
<td>163.2</td>
<td>-</td>
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<td>513.4</td>
<td>1,672.4</td>
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<td>5%</td>
<td>75%</td>
<td>-</td>
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<td>Investment Component</td>
<td>Unit</td>
<td>NR</td>
<td>Unit cost (MNT million)</td>
<td>Total cost (MNT million)</td>
<td>Total cost ($ million)</td>
<td>Stage 1 (% of total)</td>
<td>Stage 1 2018-2024</td>
<td>% Govt</td>
<td>% Benefic.</td>
<td>% Private Sector</td>
<td>Govt</td>
<td>Beneficiary</td>
<td>Private sector</td>
<td>TA Cost Govt</td>
<td>Stage 2 2025-2030</td>
<td>TA Cost Govt</td>
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<td>C. Urban Water Security (includes water for industry, public and municipal services)</td>
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<tr>
<td>C1</td>
<td>(TA) Urban WSS policies and strategies studies</td>
<td>LS</td>
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<td>(TA) Detailed Planning and Design for Ulaanbaatar Urban Area</td>
<td>LS</td>
<td>200,000</td>
<td>90.1</td>
<td>60%</td>
<td>54.1</td>
<td>36.0</td>
<td>30%</td>
<td>70%</td>
<td>27.0</td>
<td>-</td>
<td>-</td>
<td>63.1</td>
<td>27.0</td>
<td>16.2</td>
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<td>(TA) Detailed Planning and Design for 23 Major Urban Centers</td>
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<td>92,400</td>
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<td>70%</td>
<td>30%</td>
<td>29.1</td>
<td>-</td>
<td>-</td>
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<tr>
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<td>(TA) Detailed Planning and Design for 331 soum centers</td>
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<td>3.6</td>
<td>8.5</td>
<td>50%</td>
<td>50%</td>
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<td>Ulaanbaatar urban WSS: investments program</td>
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<td>C6</td>
<td>Investment Program for WSS in 21 aimag centers</td>
<td>Nr</td>
<td>21</td>
<td>110,000.0</td>
<td>2,310,000</td>
<td>1,040.5</td>
<td>30%</td>
<td>312.2</td>
<td>728.4</td>
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<td>30%</td>
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<td>C7</td>
<td>Investment program for WSS for soum centers</td>
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<td>300</td>
<td>3,000.0</td>
<td>900,000</td>
<td>405.4</td>
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<td>30%</td>
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<td>D1</td>
<td>(TA) Strengthening River Basin Governance</td>
<td>LS</td>
<td>8,880</td>
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<td>(TA) Strengthening of Overall Water Resources Management Capacity</td>
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<td>-</td>
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<td>D3</td>
<td>(TA) Planning and Design for Water Resources Protection and Enhancement</td>
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<td>3.0</td>
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<tr>
<td>D4</td>
<td>Investment in Water Resources Protection and Enhancement</td>
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<td>241,980.0</td>
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<td>E. Resilience to Water Related Disasters</td>
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<td>(TA) Integrated Planning and Design for Water Related Disasters</td>
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<td>Integrated Investments for Urban Flood Protection and Management</td>
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<td>Investment in Integrated Disaster Risk Management</td>
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<td>10%</td>
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<td>14,429,903</td>
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Source: TA 8855 MON: Mongolia Country Water Security Assessment