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KEY POINTS

- Mongolia has enough water to support its population and economic activities. But its water is not available at the right place, at the right time, and in the right quality.
- Mongolia's water challenges should be addressed through a more holistic and integrated approach to water resources management.
- The rapid growths in urbanization and the mining industry have drawn attention to two local hot spots of water insecurity in Mongolia: (i) Ulaanbaatar, where half of the country's population resides; and (ii) the South Gobi region, where the country's mining industries are clustered.
- Based on the findings of the country water security assessment, a water sector investment program has been developed for Mongolia targeting the five key water security dimensions.
- The program includes requirements for investments in water-related infrastructure (such as improved water supply and sanitation facilities, and irrigation systems) and measures for institutional strengthening (particularly, developing river basin organizations into becoming drivers of sustainable integrated water resources management).

Making Water in Mongolia Available at the Right Time, at the Right Place, and in the Right Quality

Mingyuan Fan
Principal Water Resources Specialist
East Asia Department
Asian Development Bank
mfan@adb.org

INTRODUCTION

The water resources situation in Mongolia is unique (as presented in the map on page 3). With glaciers in the northwest, the Gobi Desert in the south, and endless steppes in the central and eastern regions, the country covers a wide spectrum of water features. Most of the territory (about 70%) has a highly continental semi-arid to arid climate, characterized by low precipitation and, therefore, low water availability. Perennial rivers exist in the northern part of the country, but are lacking in the dry southern part, particularly in the *gobi* (a desert area) region. River runoff is variable and depends on the amount of rainfall during the summer months and melting water from the ice and snow in the mountains during the winter season.

Availability of surface water averages 2,091 million cubic meters per annum. However, on a dry year, estimate for surface water availability is more conservative at 1,294 million cubic meters per annum. Approximately 75% of surface water is stored in the lakes and, among these lakes, Lake Khuvsgul stores three-fourths of the total lake water volume. Infiltrating rainfall and surface water are the main sources of groundwater recharge. In the dry southern region, groundwater can only be found in fossil (nonrecharged) groundwater reservoirs, where recharge is almost negligible. Groundwater is available throughout the year, mostly from shallow wells and occasionally from deep wells. The quality of groundwater varies depending on the location of the source. In over 100 of the 330 *soums* (districts), groundwater fails to meet the quality standards for drinking water and, thereby, requires treatment.

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Climate change will lead to higher temperatures in Mongolia. The average temperature has risen by 2.8°C since 1960 and is projected to further increase by 4.0°C–4.5°C toward the year 2100. The higher average temperature has already substantially reduced the size of the mountain ice caps, thus affecting glacier-fed rivers. It will also increase evaporation, intensifying soil dryness.

Currently, the agriculture sector is the largest water user in Mongolia, with irrigation accounting for 30% and livestock for 24% of the total water demand. Mining accounts for 13% of the total water demand but is likely to become a major water user in the future. Drinking and household uses vary between 18% and 22%. The highest level of water consumption, as a percentage of Mongolia's total water use, is reported in the Tuul (28%) and Orkhon (14%) river basins.

With a population of only 3.2 million (2018) living in an area of 1.56 million square kilometers, Mongolia is the most sparsely populated country in the world (at two persons per square kilometer). At the same time, nearly half of the population resides in the capital, Ulaanbaatar, while the rest are largely herders, moving with their families and cattle over the country. Providing safe and affordable water for Ulaanbaatar and the rural population is still a challenge. Equally challenging is providing support to the booming mining industry in the southern *gobi* and eastern steppe.

As a result of these issues, the challenges of making water available at the right place, at the right time, and in the right quality in Mongolia are complex and cannot be examined in isolation nor addressed using the traditional fragmented approach. This brief describes the challenges and proposes a holistic approach through the process of integrated water resources management (IWRM), drawing from the findings and recommendations of two assessment reports prepared on Mongolia's water sector.[1]

THE CHALLENGES

At a national scale, Mongolia has enough water, by volume and quality, to support its growing population (1.7% per year) and economic development. This will also remain the case in the future. The primary issue is that water is not available at the right place, at the right moment, and in the required quality. The main challenges include

- access to safe drinking water and provision of effective wastewater treatment—the present water infrastructure system is far from adequate;
- conservation of water resources to satisfy the demand of a growing population and burgeoning industries, combined with an increase in mining activities and irrigated agriculture;
- pollution of water resources, which at present is mainly a local problem caused by mining activities and inadequate wastewater treatment;
- sufficient and clean water for the environment to safeguard the aquatic and riparian ecosystems;
- restoration of water resources that were damaged by overuse or neglect;
- hazards arising from floods, droughts, *dzuds* (severe winter), and other disasters that threaten both population and livestock;
- capacity building for water management at national and local government institutions;
- research and monitoring for water resources management;
- information and data management—currently, data on water resources management are not centrally available for key decision makers and stakeholders;
- awareness and participation of the general public in water management;
- lack of funding to cover infrastructure costs (capital, operation and maintenance, etc.) and recurrent expenses of water management institutions; and
- transition of institutions to enable them to deal with modern water management, including the involvement of the private sector.

ULAANBAATAR—THE GROWING CAPITAL

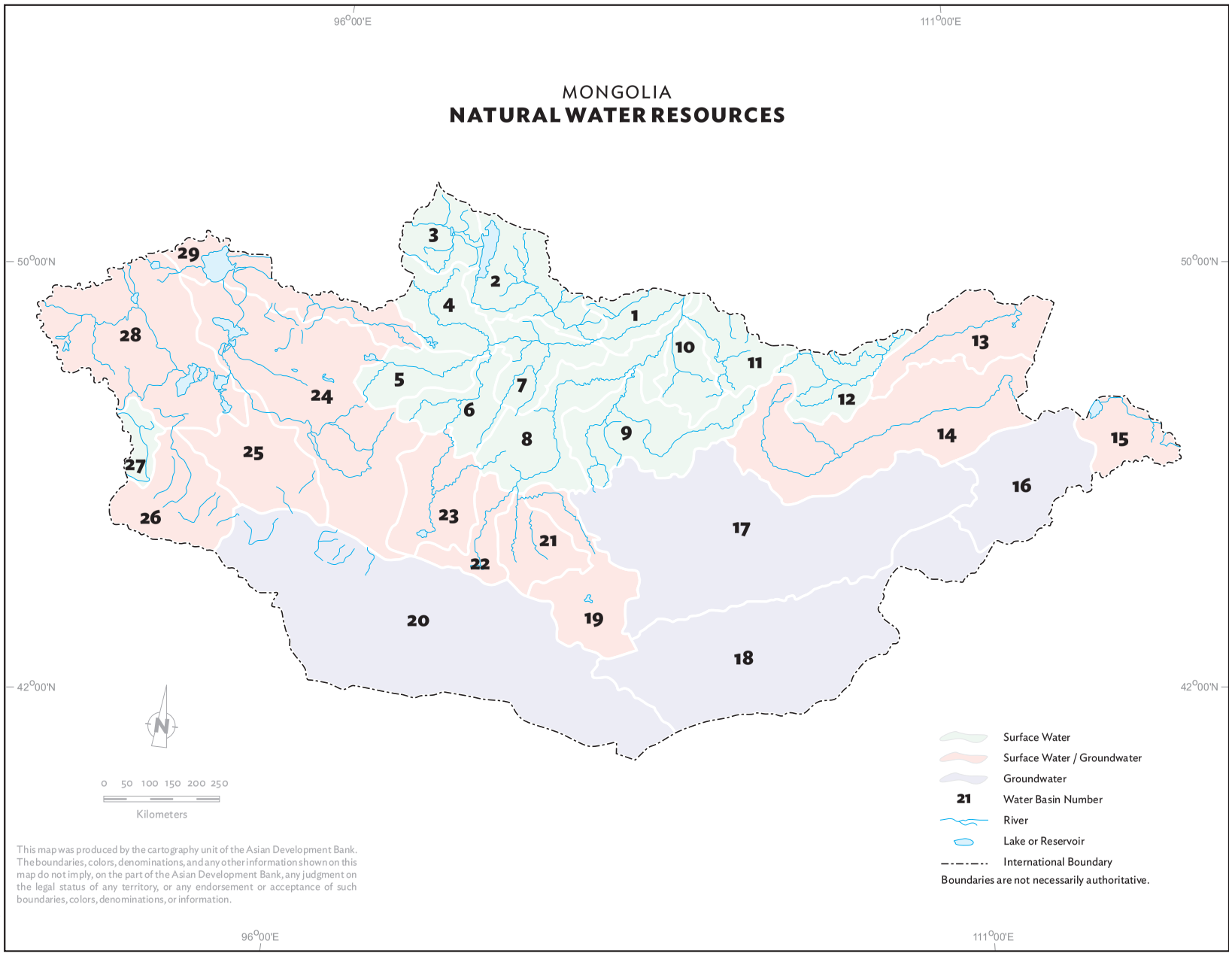
Mongolia's capital city is growing rapidly, from less than 0.8 million people in the year 2000 to an estimated 1.4 million in 2017. This growth is expected to continue given the job opportunities the city provides. The city faces many typical issues hounding large cities, such as major air pollution in winter and year-round traffic congestion. Water and sanitation facilities are limited and, hence, need to be upgraded and expanded. Only 59% of the population have piped water supply connections (direct house connections and kiosks), and only 20% are connected to piped sanitation.

A rapidly growing urban population puts further pressure on an already weak urban infrastructure and public service delivery system, including housing and energy needs. Significantly large

Ulaanbaatar and the Tuul River. The Tuul River starts at the confluence of the Namiya and Nergui streams and flows southwest passing through the capital, Ulaanbaatar, before joining the Orkhon River (photo by the Asian Development Bank TA 8855-MON project team).

[1] Asian Development Bank (ADB). 2017. *Country Water Security Assessment of Mongolia*. Consultant's report. Manila (TA 8855-MON); and M. Fan and E. van Beek. 2020. *Overview of Mongolia's Water Resources System and Management: A Country Water Security Assessment for Mongolia*. Manila: ADB.

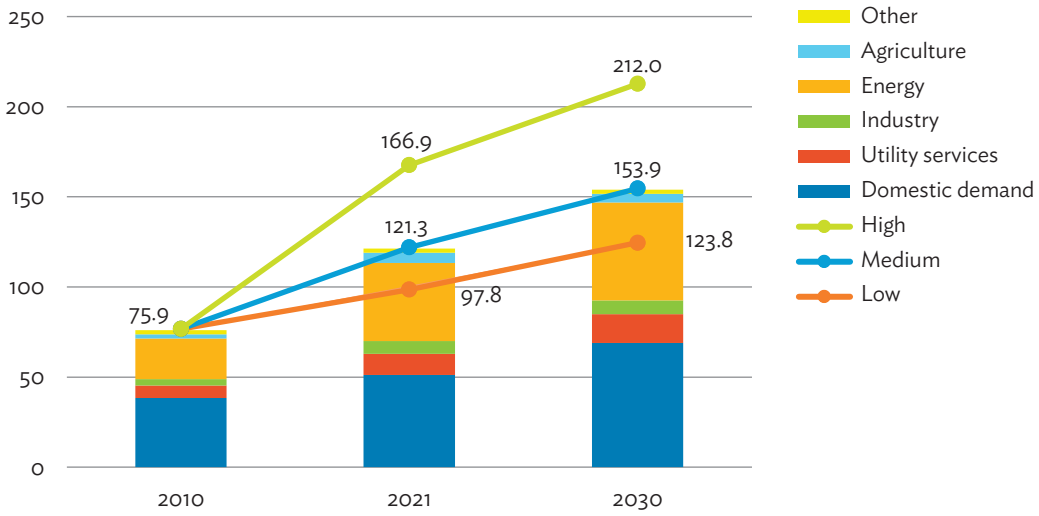
Natural Water Resources in Mongolia



1-Selenge, 2-Khuvsgul Lake-Eg, 3-Shishged, 4-Delgermurun, 5-Ider, 6-Chuluut, 7-Khanui, 8-Orkhon, 9-Tuul, 10-Kharaa, 11-Eroo, 12-Onon, 13-Ulz, 14-Kherlen, 15-Buir Lake–Khalk Gol, 16-Menen Steppe, 17-Umard Goviin Guveet–Khalhiin Dundad Tal, 18-Galba–Uush–Doloodiin Govi, 19-Ongi, 20-Altain Uvur Govi, 21-Taatsiin Tsagaan, 22-Orog Lake–Tui, 23-Buuntsagaan Lake–Baidrag, 24-Khyargas Lake–Zavkhan, 25-Khuisiin Govi–Tsetseg Lake, 26-Uench–Bodonch, 27-Bulgan, 28-Khar Lake–Khovd, and 29-Uvs Lake–Tes.

Source: Asian Development Bank.

Figure 1: Water Demand in Ulaanbaatar, 2010, 2021, and 2030
(million cubic meter per year)



Note: Three water demand scenarios were calculated based on projections of population, water connections, and water consumption:
(1) Low scenario: 2015–2021 population growth (1.0%), 2021 urban population (69.4%), 2021 water connections (53.6%), municipal water services growth (4.5%), municipal water use growth (0.7%), industrial water use growth (4.0%), water demand growth and water use (20% lower than medium scenario);
(2) Medium scenario: 2015–2021 population growth (1.2%), 2021 urban population (70.7%), 2021 water connections (56.4%), municipal water services growth (7.6%), municipal water use growth (1.4%), industrial water use growth (6.9%), 2015–2021 water demand growth (16.5%), and 2015–2021 water use (12.0%); and
(3) High scenario: 2015–2021 population growth (1.3%), 2021 urban population (71.9%), 2021 water connections (62.2%), municipal water services growth (14.5%), municipal water use growth (4.0%), industrial water use growth (12.6%), water demand growth and water use (20% higher than medium scenario).

Source: Asian Development Bank. 2017. *Country Water Security Assessment of Mongolia*. Consultant's report. Manila (TA 8855-MON); and 2030 Water Resources Group. 2016. *Hydro-Economic Analysis on Cost-Effective Solutions to Close Ulaanbaatar's Future Water Gap*. Washington, DC.

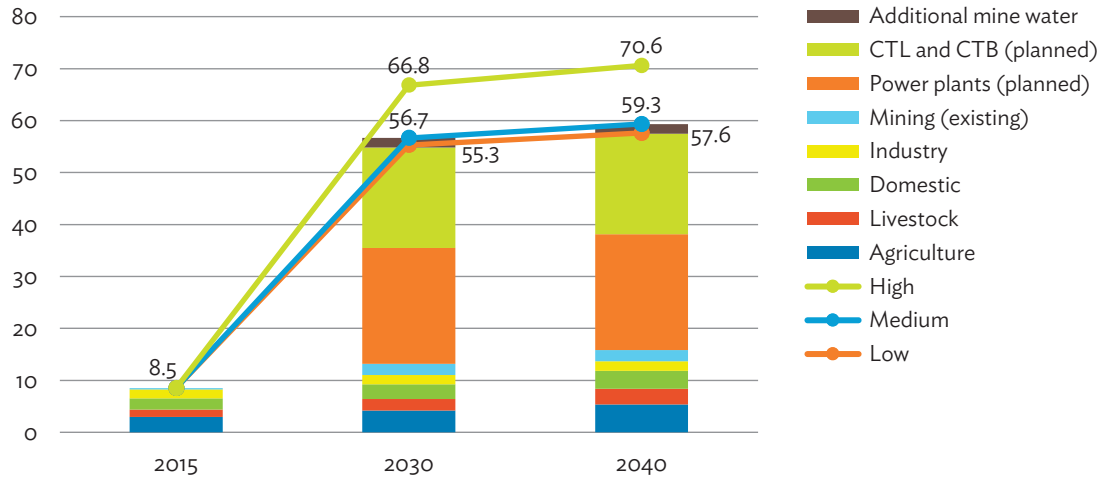
investments are needed to achieve the Sustainable Development Goal targets on water supply and sanitation. But the availability of water is an issue by itself. Depending on the water supply ability scenario chosen (low, medium, or high), water demand in Ulaanbaatar can no longer be met by 2021 or 2030 under the low and medium water supply scenarios (Figure 1). There is an urgent need for solutions that require the cooperation of key water users (domestic, energy, and industrial sectors) and include integrated measures for water demand reduction and water supply augmentation.

MINING IN SOUTHERN GOBI

The mining industry has developed itself as the backbone of the Mongolian economy. Mining activities need water; yet, the irony of it is that the concentration of Mongolia's mining industry is in the very dry Gobi Desert. Water availability threatens to become a limiting factor for its growth and development. Coal mining activities are concentrated in two key areas: Nyalga Shivee Ovoo (in Bagnauur) and Tavan Tolgoi. Mongolia's largest copper mine, Oyu Tolgoi, is also located in the Gobi Desert.

Mining in the South Gobi region. Coal mining is among the predominant mining activities undertaken in the southern region of the Gobi Desert (photo by the Asian Development Bank TA 8855-MON project team).

Figure 2: Water Demand in Nyalga Shivee Ovoo, 2015, 2030, and 2040
(million cubic meter per year)



CTB = coal-to-briquette, CTL = coal-to-liquid.

Note: The underlying assumptions and applied growth rates of the three demand projections (low, medium, and high) are the same as presented in Figure 1 on page 4.

Source: Asian Development Bank. 2017. *Country Water Security Assessment of Mongolia*. Consultant's report. Manila (TA 8855-MON); and 2030 Water Resources Group. 2016. *Prioritized Solutions to Close the Water Gap: Hydro-Economic Analysis on the Coal Mining Regions in Mongolia's Gobi Desert*. Washington, DC.

A 2016 study by the 2030 Water Resources Group has assessed that, by 2030, water demand–supply gap will reach 35% (or equivalent to 34.25 million cubic meters per year) in the Nyalga Shivee Ovoo region and 60% in Tavan Tolgoi.[2] The scheduled and proposed investments in value-adding mining infrastructure are the principal drivers for the water gaps. These investments include power plants, coal-to-briquette plants, coal-to-liquid plants, and coal washing. The transfer of surface water from the northern region (e.g., the Orkhon–Gobi water diversion project) is very costly and faces many environmental and political issues. Thus, focus should be set on water demand reduction measures, along with further investigations on the sustainable use of groundwater in this area.

Figure 2 presents the water demand in Nyalga Shivee Ovoo area under low, medium, and high water demand scenarios by 2030 and 2040, with 2015 as the base year.

THE FOOD–ENERGY–WATER AND ENVIRONMENT NEXUS

The national policy of Mongolia is to become self-sufficient in food and energy. At present, Mongolia still relies on large imports of food and energy from the People's Republic of China and the Russian Federation. Government programs in agriculture include a considerable extension of the area under irrigation from the current 54,000 hectares to 120,000 hectares in 2030. Most of the irrigation schemes are found in the Selenge and Orkhon river basins, basins draining toward the north to the Russian Federation. One of the options to achieve self-sufficiency in energy is to generate hydroelectricity. Irrigation and hydropower require the construction of dams and will lead to increased water losses. These losses result from increased evapotranspiration in irrigation and increased surface water evaporation from the reservoirs.

With the Russian Federation, a transboundary water agreement was signed that limits the potential for the development of surface water resources in Mongolia such as hydropower dams and water transfers. In line with that agreement, there is international pressure on Mongolia to protect the unique ecosystem of Baikal Lake in the Russian Federation, putting constraints on changes in quality and quantity of the water that flows out of Mongolia to Baikal Lake. Both conditions limit the development of the

[2] 2030 Water Resources Group. 2016. *Prioritized Solutions to Close the Water Gap: Hydro-Economic Analysis on the Coal Mining Regions in Mongolia's Gobi Desert*. Washington, DC.

water systems in Mongolia that aim to achieve food and energy security for the country. In addition, Mongolia has one of the most stringent environmental flow requirements in the world, which is set at 90%–95% of long-term (i.e., over 20 years) average flow.[3]

CLIMATE CHANGE—THREAT OR BLESSING?

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 its social and economic development.[4] Expected temperature increase in Mongolia is way above the world average. This temperature increase, in general, will have a positive impact on agriculture production, which will support the food security objective of the government. But the overall negative impacts of climate change might be dominant, e.g., water availability is expected to decrease, climate will become more extreme, soil fertility will go down, and desertification will increase. Land degradation and the expected increase in droughts and *dzuds* will heavily impact animal husbandry, threatening the livelihood of herders.

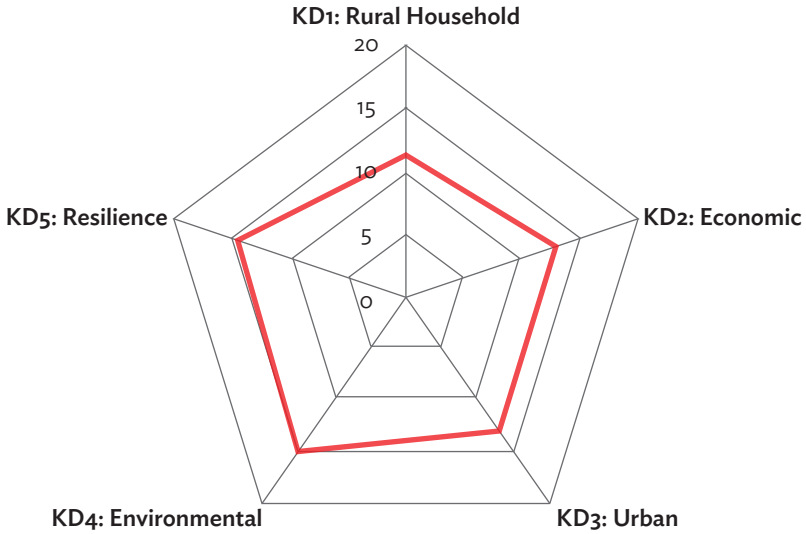
Monitoring data over the last 50 years show a decrease of water availability. Most climate models (such as the general circulation models), however, predict a gradual increase in precipitation—20 millimeters by 2050 and 44 millimeters by 2090—accompanied by a greater seasonal variability. Glacier volumes will decrease, which will amplify this variability. Drought, flood, and *dzud* incidences are expected to go up. Mongolia has seen severe *dzuds* in the recent period. A point of concern is the expected impact of climate change on the livestock and pasture conditions. On the other hand, overgrazing might have more impact than climate change.

The increased temperature will lead to an increase in evaporation. Some research predicts that every 1°C increase in temperature will result in 2% annual river flow decrease. But, in case precipitation will indeed increase by 44 millimeters by 2090, there will be an expected increase in the annual river flow and possible onset of flooding disasters. Intensive monitoring is needed to follow climate change trends and impacts (which currently remain uncertain) and take action when the impacts become clear enough to warrant major investments in adaptation measures.

COUNTRY WATER SECURITY ASSESSMENT

The Asian Development Bank and the Government of Mongolia's Ministry of Environment and Tourism carried out a country water security assessment to ascertain the state of water security

Figure 3: Mongolia's Water Security by Key Dimension



KD = key dimension.

Source: Asian Development Bank. 2017. *Country Water Security Assessment of Mongolia*. Consultant's report. Manila (TA 8855-MON).

[3] Environmental flow requirement refers to the amount of water (e.g., within river basins, lakes, or wetlands) allotted to sustain ecosystem functioning and human livelihoods.

[4] Government of Mongolia, Ministry of Environment and Green Development. 2014. *Mongolia Second Assessment Report on Climate Change 2014*. Ulaanbaatar; and M. I. Westphal, G. A. Hughes, and J. Brommelhorster, eds. 2013. *Economics of Climate Change in East Asia*. Manila: ADB.

across Mongolia.[5] The assessment, based on the methodology of the Asian Water Development Outlook series,[6] identifies five key dimensions (KDs) of water security: rural household water security (KD1), economic water security (KD2), urban water security (KD3), environmental water security (KD4), and resilience to water-related disasters (KD5). Each KD is rated on a scale from 1 (*high risk* or *low water security*) to 20 (*low risk* or *high water security*). The results are presented in the pentagram (Figure 3).

Figure 3 shows that all KDs are more or less at the same level. The relatively low score of rural household water security (KD1) is influenced by the poor access of the herder communities to improved water and sanitation services. The economic water security (KD2) score is likewise low, reflecting some water constraints, particularly during the drought season and in the southern region where there is a full dependency on groundwater. The score of urban water security (KD3) is constrained by the small number of urban population with access to piped water supply and sanitation services. The low scores of the water supply and sanitation indicators for the urban areas (KD3) and the rural households (KD1) are hot spots that require staunch management and targeted investments to provide adequate and improved water supply and sanitation services. The score of the environmental water security (KD4) is comparatively high, primarily because of the country's small population size, good water quality, and reasonable proportion of land designated as state and local protection areas. KD4 also benefited from the agriculture sector's low fertilizer usage. Also scoring a relatively high mark is resilience to water-related disasters (KD5).

INSTITUTIONAL DEVELOPMENT OF INTEGRATED WATER RESOURCES MANAGEMENT IN MONGOLIA

Mongolia has a strong commitment to IWRM, as defined in the 2012 Water Law, and good progress has been made. This includes the establishment of river basin organizations (RBOs) to manage the 29 river basins in the country. Currently, there are 21 operational RBOs. A benchmarking analysis of these 21 RBOs identified two core weaknesses: (i) insufficient financing and (ii) weak linkages with the *aimag* (province) and *soum* governments and the water sector agencies. Financing of the RBOs should be reviewed, and policies and regulations need to be harmonized to clarify the roles of the different organizations involved in water resources. Strengthening RBOS to enable them to progress from their current supporting and monitoring roles into becoming drivers of sustainable IWRM is the next stage in the development of a decentralized IWRM.

PROGRAM OF INVESTMENTS

Based on the results of the country water security assessment, a program of investments is proposed for Mongolia, setting out the details and direction of key investments for the water sector from 2018 to 2030. The core areas of investment that address the availability of water in Mongolia, both in terms of quantity and quality, are assessed within the KDs of water security as follows:

- Investments in rural household water security will target improved water supply and sanitation for rural communities in accordance with the Sustainable Development Vision 2030.[7] The program will provide support to herder families for self-investment in low-cost water supply and sanitation.
- Investments to support economic security will include
  - development of 70,000 hectares of modern and improved irrigation system;
  - promotion of livestock management, and establishment of livestock pasture and water points;
  - research and employment of sustainable bulk water supplies to foster economic growth in the southern Gobi Desert region;
  - generation of 1,300 megawatts of renewable energy; and
  - construction of energy-efficient, rehabilitated, and new coal-fired power stations as well as combined heat and power systems.
- Investments in urban water security will follow the Sustainable Development Vision 2030 targets and are designed to support the development of improved water services for Mongolia's rapidly expanding urban centers, including demand for domestic, industrial, municipal, and public services. Investments will include upgrading of water supply and sanitation in Ulaanbaatar, 21 *aimag* centers, and 330 *soum* centers.
- Investments in environmental water security primarily relate to the establishment of policy and institutional frameworks for sustainable water resources management. Most investments would be through the various water sector programs; some environment-specific investments would be made to support environmental protection zones as well as initiatives for the rehabilitation and improvement of water resources.
- Investments for reducing water-related disasters focus on promoting awareness and improving understanding of disaster risks to enhance the effectiveness of drought, *dzud*, and flood protection and management initiatives, and to reduce water-related disaster risk.

The proposed investment program is worth $6.50 billion, to be financed as follows: $3.67 billion (56%) from the private sector, $1.76 billion (27%) from the government, and $1.07 billion (16%) from the beneficiaries.

[5] ADB. 2014. *Technical Assistance to Mongolia for Country Water Security Assessment*. Manila (TA 8855-MON).
[6] ADB and Asia-Pacific Water Forum. 2013. *Asian Water Development Outlook 2013: Measuring Water Security in Asia and the Pacific*. Manila; and ADB and Asia-Pacific Water Forum. 2016. *Asian Water Development Outlook 2016: Strengthening Water Security in Asia and the Pacific*. Manila.
[7] Parliament of Mongolia. 2016. *Mongolia Sustainable Development Vision 2030*. Ulaanbaatar.

RECOMMENDATIONS

Mongolia faces challenges in terms of the spatial and temporal distribution of its water resources. Water availability varies from one region to another. Water supply is also affected by seasonal and climate variations. Challenges in water availability (both in terms of quantity and quality) is likewise exacerbated by the continued increase in water stress as a result of economic development, demographic changes, and climate change impacts. These water issues should not be assessed and addressed in isolation. Rather, a more holistic approach to water management should be taken to ensure the efficient and sustainable development and management of water resources—this is the underlying principle of the IWRM process.

Investments in water sector infrastructure will help cope with the water quantity challenges, especially in Mongolia's hot spots of water insecurity, e.g., bulk water provision for Ulaanbaatar and the mining sector by means of storage and interbasin transfers, and provision of water supply and sanitation facilities for the herder communities. Upgrading Mongolia's outdated wastewater treatment plants and on-site sanitation in *ger* areas (traditional tent communities) can help reduce soil and water pollution and over-abstraction. But these supply-side solutions are not enough; they have to be complemented by demand management measures to increase water use efficiency and water availability, e.g., water recycling, rainwater harvesting, improved irrigation system, and other water conservation efforts.

Moreover, to enhance the sustainable management of water resources, including the decentralized approach to IWRM, the capacity and institutional setting of key water sector agencies, such as the RBOs, should be strengthened and their financial capabilities improved. Promoting effective coordination between these agencies and other stakeholders, as well as strengthening water-related policies and regulations, should also be undertaken.

The proposed water sector investment program, if successfully implemented, will help overcome the water resources challenges in Mongolia. Translating the proposed actions into bankable projects requires the identification of the mode for implementation, the role of the private sector, the strategies for securing funding and financing alternatives, and the assessment of technical and institutional capacity, among others. The government and the private sector should work more closely together, given that a substantial part of the investment program will be carried out through partnerships with the private sector.

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Asian Development Bank
6 ADB Avenue, Mandaluyong City
1550 Metro Manila, Philippines
Tel +63 2 8632 4444
Fax +63 2 8636 2444

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